

The SARAH motor-functional evaluation scale for children and adolescents with cerebral palsy

ASSESSMENT FORM	1
HOW TO FILL THE FORM	7
Patient Profile	7
Neurological State.....	7
Orthosis/Prosthesis.....	9
Special Conditions.....	9
Handedness.....	9
Evaluation Start	10
Motor Acquisitions.....	10
Locomotion.....	15
Gross Motor Skills.....	19
Upper Limb Function.....	20
Activities of Daily Living.....	21
HOW TO COMPUTE SCORES	27
Scores Description.....	27
Form with Scores	28
Expected Score by Age Group	33
Four-level Conversion	34

ASSESSMENT FORM

The SARAH motor-functional evaluation scale for children and adolescents with cerebral palsy

PATIENT PROFILE

Neurological State

Motor impairment:

- Spasticity
- Ataxia
- Hypotonia

Involuntary movement: Chorea Athetosis Choreoathetosis

Dystonia

Distribution:

- Quadriplegia Right hemiplegia Left hemiplegia Diplegia Triplegia Monoplegia

Associated disorders:

- Seizures Hearing impairment
- Dysphagia Cognitive impairment
- Gastroesophageal reflux Behavioral disorders
- Visual impairment Neuropsychological disorders

Reflexes:

- Asymmetric tonic neck reflex
- Symmetric tonic neck reflex
- Moro reflex
- Extensor thrust
- Neck-righting reflex

Reactions:

- Placing
- Parachute reaction

Orthosis/Prosthesis

- Bilateral Unilateral No

Special Conditions

- Post-surgery
- Treatment with botulin toxin or alcohol
- Treatment with serial casting

Handedness

- Right Left Not defined

EVALUATION START

Uses independent gait as a means of locomotion outside the home, without the need of mobility aids.

- No Yes (if yes, skip to question 57)

Uses independent gait as a means of locomotion at home or outside, with limitations.

- No Yes (if yes, skip to question 25)

Gait with support of cane.

- No Yes (if yes, skip to question 24)

MOTOR ACQUISITIONS

Head balance:

1. Prone position Absent Precarious Regular Good
2. Supine position Absent Precarious Regular Good
3. Sitting position Absent Precarious Regular Good

Rolling:

4. Supine/prone Complete Partial No
5. Prone/supine Complete Partial No

Creeping:

6. Pivots (prone or supine) Yes No
7. Creeps Prone position Sitting position Supine position No
8. Overcomes obstacles Yes No

Trunk balance:

9. Sitting position Absent Precarious Regular Good
10. Moves from supine to sitting position Yes No
11. Moves from prone to sitting position Yes No

Four point position balance:

12. Absent Precarious Regular Good

Crawling:

13. Homologous Reciprocal No
14. Climbs down from sofa/bed to floor Yes No
15. Climbs up from floor to sofa/bed Yes No

Kneeling balance:

16. Absent Precarious Regular Good
17. Moves to kneeling position: Without support With support No

Standing position balance:

18. Absent Precarious Regular Good
19. Moves to standing position: Without support With support No

Displacement standing up:

20. Cruising Yes No
21. Pushes a mobile support Yes No
22. Performs gait as exercise Yes No
23. Early stepping Yes No

LOCOMOTION

Usual form of locomotion

24. Most usual form of locomotion, without assistance from others:

- Absent (carried, transported in baby stroller or wheelchair)
 Crawling or creeping in sitting position
 Wheelchair
 Gait with walker
 Gait with crutches

25. Functional capacity in most frequent form of locomotion (without assistance from others):

- Absent Home Outside home No limitations outside home

Mobility aids

26. Wheelchair: Does not use Not age-appropriate or lacking physical/cognitive capacity

27. Able to follow a straight path Yes With assistance from others No
28. Performs maneuvers Yes With assistance from others No
29. Goes up/down ramp Yes With assistance from others No
30. Goes up/down sidewalk Yes With assistance from others No

Moves (from/to):

31. Wheelchair – bed Yes With assistance from others No
32. Bed – wheelchair Yes With assistance from others No
33. Wheelchair – floor Yes With assistance from others No
34. Floor – wheelchair Yes With assistance from others No
35. Wheelchair – car Yes With assistance from others No
36. Car – wheelchair Yes With assistance from others No
37. Wheelchair – toilet seat Yes With assistance from others No
38. Toilet seat – wheelchair Yes With assistance from others No

39. Walker: Does not use Not age-appropriate or lacking physical/cognitive capacity

40. Able to follow a straight path Yes With assistance from others No
41. Performs maneuvers Yes With assistance from others No
42. Goes up/down ramp Yes With assistance from others No
43. Goes up/down sidewalk Yes With assistance from others No

Moves (from/to):

44. Walker – bed Yes With assistance from others No
45. Bed – walker Yes With assistance from others No
46. Walker – floor Yes With assistance from others No
47. Floor – walker Yes With assistance from others No
48. Walker – car Yes With assistance from others No
49. Car – walker Yes With assistance from others No
50. Walker – toilet seat Yes With assistance from others No
51. Toilet seat – walker Yes With assistance from others No

52. Canes/Crutches: Does not use Not age-appropriate or lacking physical/cognitive capacity

53. Unilateral Bilateral

54. Able to follow a straight path Yes With assistance from others No
55. Goes up/down ramp Yes With assistance from others No
56. Goes up/down sidewalk Yes With assistance from others No

Locomotion capacity

57. Locomotion distance, without assistance from others

- Under 20 meters
 20 – 50 meters
 50 – 100 meters
 100 – 200 meters
 200 – 300 meters
 300 – 500 meters
 500 – 1000 meters
 Over 1000 meters

Not age-appropriate or lacking physical/cognitive capacity

57.1. Conditions of evaluation:

- Habitual
 Gait training
 Crutches training
 Walker training
 Wheelchair training

GROSS MOTOR SKILLS

58. Climbs up/down stairs Yes No
59. Kicks a ball Yes No
60. Spins around body axis Yes No
61. Starts running (accelerated gait) Yes No
62. Runs Yes No
63. Jumps, both feet simultaneously Yes No

UPPER LIMB FUNCTION

Right upper Limb:

64. Reaches objects Yes No
65. Uses limb as support Yes No
66. Voluntary prehension Yes No
67. Palmar prehension Yes No
68. Digital Yes No
69. Pincer grasp Yes No
70. Supination until midline Yes No
71. Complete supination Yes No

Left upper Limb:

72. Reaches objects Yes No
73. Uses limb as support Yes No
74. Voluntary prehension Yes No
75. Palmar prehension Yes No
76. Digital Yes No
77. Pincer grasp Yes No
78. Supination until midline Yes No
79. Complete supination Yes No

Manual function:

80. Transfers objects from one hand to the other Yes No
81. Performs wide insertions Yes No
82. Performs fine insertion Yes No
83. Piles objects on top of each other Yes No
84. Tears paper Yes No
85. Turns pages of a book Yes No
86. Puts a paper inside an envelope Yes No
87. Scribbles on paper and erases it afterwards Yes No
88. Cuts paper in half with scissors Yes No
89. Sharpens pencils Yes No
90. Can draw more than one recognizable form Yes No
91. Writes recognizable letters and numbers Yes No
92. Uses computer with interface Yes No
93. Uses computer with regular keyboard Yes No

ACTIVITIES OF DAILY LIVING

6 to 12 months

Feeding:

94. Holds bottle Yes No
95. Eats food with hands Yes No

Dressing:

96. Takes off socks Yes No
97. Takes off shoes Yes No

1 to 2 years

Feeding:

98. Brings utensils to mouth (spoon/fork) Yes No

Dressing:

99. Unties shoelaces Yes No
100. Handles Velcro on shoes/clothing Yes No

2 to 3 years

Feeding:

101. Uses eating utensils without help Yes No
102. Drinks from glass without help Yes No
103. Opens/closes containers Yes No
104. Unscrews lids Yes No

Dressing:

105. Takes off T-shirt Yes No
106. Takes off underwear Yes No
107. Takes off shorts Yes No
108. Takes off pants Yes No
109. Opens zipper Yes No
110. Closes zipper Yes No

Sphincter control:

111. Controls bowel Yes No
112. Controls bladder Yes No

3 to 4 years

Feeding:

113. Transfers liquid from one container to another Yes No
114. Spreads butter/jam on bread/toast Yes No
115. Cuts food Yes No
116. Gets food from the refrigerator Yes No

Dressing:

117. Takes off open shirts Yes No
118. Puts on open shirts (short/long sleeves) Yes No
119. Puts on T-shirts (short/long sleeves) Yes No
120. Puts on underwear Yes No
121. Puts on shorts Yes No
122. Puts on pants Yes No
123. Puts on socks Yes No
124. Fastens and unfastens buckle Yes No
125. Buttons /unbuttons Yes No

Hygiene:

126. Washes and dries hands Yes No

127. Puts toothpaste on toothbrush Yes No
128. Combs hair Yes No
129. Uses the toilet without help Yes No
130. Blows nose Yes No
131. Upper body hygiene Yes No
132. Upper-limb hygiene Yes No
133. Lower-limb hygiene Yes No
134. Rinses hair Yes No

Other abilities:

135. Opens/closes taps Yes No
136. Opens/closes doors Yes No
137. Turns lights on/off Yes No
138. Turns TV/radio on/off Yes No

4 to 5 years

Dressing:

139. Puts on shoes Yes No

Hygiene:

140. Brushes teeth Yes No
141. Washes face Yes No

5 to 6 years

Feeding:

142. Chooses and serves own food Yes No

Hygiene:

143. Washes private parts Yes No

Dressing:

144. Laces up own shoes Yes No

6 to 7 years

Dressing:

145. Ties and laces shoes Yes No

7 to 8 years

Dressing:

146. Chooses own clothes Yes No
147. Takes out clothes from drawers/closet Yes No

> 8 years

Hygiene:

148. Cuts own fingernails Yes No

HOW TO FILL THE FORM

PATIENT PROFILE

This section collects information about the child being evaluated, including: neurological state, orthosis and prosthesis, special conditions and handedness. The items evaluated in this profile are not scored.

NEUROLOGICAL STATE

Motor impairment

Mark the types(s) of motor impairment the child presents (if inexistent, leave blank).

- Spasticity: characterized by the muscle's increased sensitivity to stretching, causing contraction from the recruitment of muscle fibers. This can be defined as speed-dependent resistance to movement, associated with exaggerated deep-tendon reflexes.
- Ataxia: characterized by uncoordinated gait, wide support base and balance disorders. Other clinical signs are: dysdiadochokinesia, dysmetria, decomposition of movements, nystagmus, and dysarthria.
- Hypotonia: decreased muscle tone, often resulting in loose, floppy limbs.

Involuntary movement (if inexistent, leave blank)

- Chorea: movements that are gross, fast, arrhythmic and of sudden onset.
- Athetosis: continuous, uniform, slow movements.
- Choreoathetosis: combination of chorea and athetosis.
- Dystonia: intermittent twisting movements secondary to the simultaneous contraction of agonist and antagonist muscles involving extremities, neck and trunk.

Distribution

- Quadriplegia: involvement of all four limbs, with abnormal posturing/movements of the trunk, head and neck.
- Right hemiplegia: involvement of the upper and lower limbs on the right side of the body.
- Left hemiplegia: involvement of the upper and lower limbs on the left side of the body.
- Diplegia: the lower limbs are more affected than the upper limbs.

- Triplegia: predominant involvement of 3 limbs, normally the lower limbs and one of the upper limbs.
- Monoplegia: involvement of only one limb.

Associated disorders (if inexistent, leave blank)

- Seizures
- Dysphagia
- Gastroesophageal reflux
- Visual impairment
- Hearing deficits
- Cognitive impairment
- Behavioral disorders
- Neuropsychological disorders.

Reflexes

Should be tested in children up to 2 years of age; or in cases of tetraplegia and/or involuntary movements up to 7 years of age (if inexistent, leave blank)

- Asymmetric tonic neck reflex: flexion of the upper and lower limbs on the skull side and extension on the facing side in supine position. In some children with cerebral palsy, only one of the upper limbs may manifest an obvious reflex, together with a milder postural change in one of the lower limb.
- Symmetric tonic neck reflex: the child is placed in the crawling position. When the head is flexed ventrally, flexion of the forelimbs and extension of the lower limbs results; extension of the head and neck causes extension of the upper limbs and flexion of the lower limbs.
- Moro reflex: is a sudden abduction and extension of the upper limbs with spreading of the fingers followed by an embrace.
- Extensor thrust: the child is lifted by the axilla and suspended and then lowered so that the feet touch the floor. A positive response consists in extension of the lower limbs progressing upward into the trunk.
- Neck-righting reflex: positive if the shoulder girdle and trunk turn simultaneously when the head is turned.

Reactions (if inexistent leave blank)

- Placing: Should be tested in children between 3 months and 2 years of age. Hold the child by the chest and axilla, bring the dorsal surface of the feet upward against the edge of a table. Automatic foot placement on the tabletop surface occurs either symmetrically or asymmetrically.
- Parachute reaction: Should be tested in children between 7 months and 2 years of age. Place the child in a prone position. Lift horizontally from the table and then quickly lower to tabletop or similar surface. This movement should yield an automatic protective extension of the upper limbs and hands. If the child has severe impairment of an upper limb, the protective placement of the upper limbs may be unilateral.

ORTHOSIS/PROSTHESIS

- Yes: wears orthosis/prosthesis. Specify if it is unilateral or bilateral and the reason for its use.
- No: does not wear orthosis/prosthesis.

SPECIAL CONDITIONS

- Post-surgery: fill out this item in cases up to 1 year post-surgery.
- Treatment with botulin toxin or alcohol: fill out this item in cases up to 6 months post-procedure.
- Treatment with serial casting: fill out this item in cases up to 6 months post-procedure.

HANDEDNESS

- Mark the manual dominance (right or left). This information can be obtained from the family and should be confirmed by observing the child's performance during the evaluation. In case the manual dominance is not defined, mark "not defined".

EVALUATION START

I. Uses independent gait as a means of locomotion outside the home.

- ⤴ Yes: walks without assistance (no reliance on hand-held mobility devices or a caregiver). The minimal distance that the child should be able to walk is 300 meters. If marking this item “yes”, skip to item 57. Full credit will be given for items 1-56).
- ⤴ No: incapable of unassisted gait outside. Proceed to the next item (II).

II. Uses independent gait as a means of locomotion at home or outside, with limitations.

- ⤴ Yes: walks without assistance (no reliance on hand-held mobility devices or a caregiver) at home or outside. The maximum distance that the child is able to walk is 100 meters. If marking “yes”, skip to item 25. Full credit will be given for items 1-24).
- ⤴ No: incapable of unassisted gait at home or outside. Proceed to the next item (III).

III. Gait with support of cane

- ⤴ Yes: walks with cane but without caregiver’s assistance (at home or outside). If marking “yes”, skip to item 24. Full credit will be given for items 1-23).
- ⤴ No: unable to walk with canes or without caregiver’s assistance. Proceed to item 1.

MOTOR ACQUISITIONS

Head balance:

1. Prone position

- ⤴ Absent: the child does not lift head.
- ⤴ Precarious: cervical extension up to 45° with head oscillations, then head drops back down.
- ⤴ Regular: cervical extension > or equal 45° and maintains this position for at least 10 seconds. Has difficulties rotating head or there are head oscillations during movement.
- ⤴ Good: extends head 90°, maintains this position and is capable of cervical rotation without oscillations.

2. Supine position

- ⤴ Absent: hyperextension of head when pulled by the arms to sitting position.
- ⤴ Precarious: when first being pulled into the sitting position, there are attempts at maintaining head and trunk alignment, but then head oscillates and drops back down during the second half of movement arc.
- ⤴ Regular: head drops back down only during the final part of the maneuver, or partial flexion of the head sustained during entire movement arc.
- ⤴ Good: flexes head at beginning of maneuver (chin-tuck) and maintains it aligned with the trunk or in maximal flexion entire movement arc

3. Sitting position

- ⤴ Absent: does not extend the head.
- ⤴ Precarious: does not maintain head and trunk alignment, but tries to extend head. Head oscillations are observed.
- ⤴ Regular: head and trunk alignment maintained for at least 10 seconds, but unable to rotate head or does so with head oscillations.
- ⤴ Good: head and trunk alignment maintained, head rotation without oscillations.

Rolling:

4. Supine/prone

- ⤴ Complete: rolls from supine to prone.
- ⤴ Partial: rolls from supine to lateral decubitus. Mark this item if the child rolling from supine to prone is "accidental" (this is caused by an imbalance and not by a controlled action).
- ⤴ No: does not roll from supine to lateral decubitus or to prone, despite intention to do so.

5. Prone/supine

- ⤴ Complete: voluntarily rolls from prone to supine.
- ⤴ Partial: rolls from prone to lateral decubitus. Full score if the rolling from prone is "accidental".
- ⤴ No: does not roll from prone to lateral decubitus or to supine, despite intention to do so.

Creeping:

6. Pivots

- ⤴ Yes: makes circular movements (precedes creeping), at least 90° to the right or left. Full score for pivoting in prone or/and in supine position.
- ⤴ No: does not pivot or does so less than 90°.

7. Creeps

- ⤴ Mark how the child creeps (prone, seated or supine).
- ⤴ No: does not creep.

8. Overcomes obstacles

- ⤴ Yes: overcomes obstacles during creeping (prone, seated or supine). Some examples of obstacles are pillows and toys. This item can be tested using a pillow or a 10 cm-high cushion.
- ⤴ No: does not overcome obstacles during creeping.

Trunk balance:

9. Sitting position

- ⤴ Absent: does not maintain this position without support of caregiver or devices.
- ⤴ Precarious: can sit with upper limb support for at least 10 seconds. May try to use an arm to reach objects, but trunk flexion intensifies with this motion.
- ⤴ Regular: sits with unilateral upper limb support for at least 10 seconds. Maintaining the trunk completely erect is not necessary, but note if too much anterior trunk flexion is required to remain seated with the support of only one arm. The child may be able to sit without upper limb support during a few seconds, but is unable to rotate the trunk.
- ⤴ Good: sits without upper limb support, rotates trunk and has functional use of the hands.

10. Moves from supine to sitting position

- ⤴ Yes: moves from supine to sitting position without assistance or use of devices. Uses upper limbs for support.
- ⤴ No: does not move from supine to sitting position.

11. Moves from prone to sitting position

- ⤴ Yes: moves from prone to sitting position without assistance or use of devices.
- ⤴ No: does not move from prone to sitting position.

12. Four point position balance

- ⤴ Absent: cannot attain this position.
- ⤴ Precarious: attains this position for at least 10 seconds, but shoulder and pelvic girdle are not aligned.
- ⤴ Regular: attains this position for at least 10 seconds with shoulder and pelvic girdle aligned. Is able to free one arm.
- ⤴ Good: attains position for at least 10 seconds with shoulder and pelvic girdle aligned. Is able to free one of the upper limbs and flex the arm up to the shoulder line.

13. Crawling:

- ⤴ Homologous: crawls without dissociation of the lower limbs.
- ⤴ Reciprocal: crawls with dissociation of the lower limbs.
- ⤴ No: incapable of crawling.

14. Climbs down from sofa/bed to floor:

- ⤴ Yes: climbs down from the sofa/bed without assistance. Height of sofa/bed must allow the child to support arms/forearms on its surface with feet on the floor.
- ⤴ No: does not climb from the sofa/bed.

15. Climbs up from floor to sofa/bed:

- ⤴ Yes: climbs up to sofa/bed without assistance. Height of sofa/bed must allow the child to support arms/forearms on its surface with feet on the floor.
- ⤴ No: does not climb to sofa/bed.

16. Kneeling balance:

- ⤴ Absent: is unable to attain in this position.
- ⤴ Precarious: remains in the kneeling position using upper limb support. Unable to free one arm and use it functionally.
- ⤴ Regular: remains in the kneeling position using upper limb support. Able to free one arm from support.
- ⤴ Good: remains in kneeling position without upper limb support for at least 10 seconds. Able to reach arms out with trunk rotation and no assistance or support from devices.

17. Moves to kneeling position:

- ⤴ With support: kneels holding onto device or furniture.
- ⤴ Without support: kneels without support.
- ⤴ No: unable to kneel.

18. Standing position balance:

- ⤴ Absent: unable to remain standing even with support (devices/furniture).
- ⤴ Precarious: remains standing with upper limb support, but cannot free either arm and use it functionally. Supports lower trunk against devices/furniture to maintain balance.
- ⤴ Regular: remains standing using one arm for support and the other for functional use. Does not use devices/furniture for lower trunk support.
- ⤴ Good: remains standing without upper limb support for at least 10 seconds. Does not need devices/furniture for lower trunk support .

19. Moves to standing position:

- ⤴ With support: moves to standing position with upper limb support on devices/furniture. Able to move to standing position from a semi-kneeling position or by using the arms to push from sitting (without dissociation of the lower limbs).
- ⤴ Without support: moves to standing position without upper limb support on devices/furniture. Able to use arms to push up from the floor.
- ⤴ No: does not move to standing position.

Displacement standing up

20. Cruising

- ⤴ Yes: cruises by supporting upper limbs on furniture.
- ⤴ No: unable to cruise.

21. Pushes mobile support

- ⤴ Yes: walks pushing mobile support. (ex: chair, doll stroller).
- ⤴ No: does not walk/push mobile support.

22. Performs gait training exercises

- ⤴ Yes: begins gait training exercises with support using equipment such as parallel bars or hand-held mobility devices. Unable to perform maneuvers or control movement speed without assistance (non-functional gait).
- ⤴ No: Unable to perform gait training exercises.

23. Early stepping

- ⤴ Yes: walks a few steps without support. Must be able to walk at least 3 steps without support in order to score on this item.
- ⤴ No: unable to walk 3 steps without support.

LOCOMOTION

24. Most usual form of locomotion, without assistance from others: mark the child's most habitual form of locomotion, which on this scale is understood as the one most often used throughout the day without any assistance.

- ⤴ Absent: no form of locomotion without assistance. In this case, child is carried or transported in baby stroller or wheelchair most of the time. Children that roll or creep for short distances should score on this item, because they normally depend on assistance for moving about inside the house.
- ⤴ Crawling or creeping in seated position: the child moves about indoors by crawling or creeping in a seated position. To score on this item, the child has to be capable of moving about the home, most of the time unassisted. No score is given if movement is only for very short distances (2 meters or less).
- ⤴ Wheelchair: the wheelchair is the main form of locomotion without assistance. Children that use hand-held mobility devices for short distances and for a short period of time should score on this item.
- ⤴ Gait with walker: use of a walker without assistance is the most habitual form of locomotion.
- ⤴ Gait with crutches: use of crutches without assistance is the most habitual form of locomotion.

Note: if the child moves about with walker and/or on crutches for most of the day, even if only indoors (they need the wheelchair for outdoor locomotion), walking with walker or crutches should be considered the main form of locomotion.

25. 'Functional capacity' in the child's most frequent form of locomotion (without assistance from others) refers to endurance (item 24).

- ⤴ Absent: Does not walk or does not use wheelchair without assistance.
- ⤴ Home: walks or uses a wheelchair as the most habitual form of getting around in the home, with a maximum distance of 100 meters.
- ⤴ Outside the home: walks or uses a wheelchair as the most habitual form of getting around, with distances between 100 and 300 meters.
- ⤴ No limitations outside the home: walks or uses a wheelchair as the most habitual form of getting around, with distances greater than 300 meters

(ex., a walker is the most habitual form of getting around (item 24) outside home).

Mobility aids

26. Wheelchair

- △ Does not use: wheelchair not needed, capable of walking without restrictions/limitations. Skip to item 39.
- △ Not age-appropriate or lacking physical/cognitive capacity: no wheelchair yet; instead, is still carried or pushed in a baby stroller; or, no wheelchair is needed because the amount of distance normally walked daily is compatible with gait endurance; or uses wheelchair but is completely dependent on others to push it. Skip to item 39.

If neither of the above 2 options apply, e.g., independent wheelchair use or with minimal assistance, skip to item 27.

27-30: Mark "yes" if the child accomplishes the task independently. Mark "assistance from others" if the child accomplishes at least 50% of the task. Mark "no" if the child is incapable of performing the task or is able to do less than 50% of it independently.

27. Able to follow a straight path: moves the wheelchair forward in a straight line.

28. Performs maneuvers: deviates from obstacles, and can turn at least 90°.

29. Goes up/down ramp: goes up and down a standard-size ramp.

30. Goes up/down sidewalk: goes up and down a standard-size sidewalk.

31-38: Mark "yes" if the child independently performs transfers. Mark "assistance from others" if the child accomplishes at least 50% of the task (for example, to transfer from wheelchair to car, the child stands up with support and needs help to enter the car). Mark "no" if the child is incapable of performing the task or is able to do less than 50% of it independently (ex: to transfer from wheelchair to car, the child flexes the upper limbs but needs assistance to stand up and is completely dependent on someone for help entering the car).

31. Transfers from wheelchair to bed.

32. Transfers from bed to wheelchair.

33. Transfers from wheelchair to floor.

34. Transfers from floor to wheelchair.

35. Transfers from wheelchair to car.

36. Transfers from car to wheelchair.

37. Transfers from wheelchair to toilet seat.

38. Transfers from toilet seat to wheelchair.

39. Walker

- ⤴ Does not need: walker is not required for moving about. Skip to item 52.
- ⤴ Not age-appropriate or lacking physical/cognitive capacity: walker not used for age-related lack of motor and/or cognitive abilities. Skip to item 52.

If neither of the above 2 options apply, e.g., child uses a walker, skip to item 40.

40-43: Mark "yes" if the child performs the task independently. Mark "with assistance of others" if the child accomplishes at least 50% of the task. Mark "no" if incapable of performing task or needs assistance for more than 50% of it.

40. Able to follow a straight path: able to follow a straight line on flat surfaces using a walker.

41. Performs maneuvers: deviates from obstacles with walker, and can turn at least 90°.

42. Goes up/down ramp: goes up and down a standard-size ramp using a walker.

43. Goes up/down sidewalk: goes up and down a standard-size sidewalk with a walker.

44-51: Mark "yes" if the child performs transfers independently. Mark "assistance from others" if the child accomplishes at least 50% of the task (ex: to transfer from the floor to the walker, pulls to standing position by holding onto walker and only needs help to keep the walker stable during this transfer). Mark "no" if the child is incapable of performing the task or is able to do less than 50% of it independently (ex: to transfer from the floor to the walker, requires assistance to stand up).

44. Transfers from walker to bed.

45. Transfers from bed to walker.

46. Transfer from walker to floor.

47. Transfers from floor to walker.

48. Transfers from walker to car.

49. Transfers from car to walker.

50. Transfers from walker to toilet seat.

51. Transfers toilet seat to walker.

52. Canes/Crutches

- ⤴ Does not use: walks without hand-held mobility aids. Skip to item 57.
- ⤴ Not age-appropriate or lacking physical/cognitive capacity: does not use crutches for age-related lack of motor and/or cognitive abilities. Skip to item 57.

If neither of the above 2 options apply, e.g., the child uses crutches, skip to item 53.

53. Unilateral/bilateral: specify if the child uses unilateral or bilateral crutches.

54-56: Mark "yes" if the child performs the task independently. Mark "with assistance of others" if the child accomplishes at least 50% of the task. Mark "no" if the child is incapable of performing the task or is able to do less than 50% of it independently.

54. Able to follow a straight path: is able to follow a straight line on flat surfaces with crutches.

55. Goes up/down ramp: can go up and down a standard size ramp with crutches.

56. Goes up/down sidewalk: can go up and down a standard size sidewalk with crutches.

Locomotion capacity

57. Locomotion distance, without assistance from others.

The locomotion capacity (wheelchair or gait, with or without hand-held mobility devices) is classified in meters: up to 20, 20-50, 50-100, 100-200, 200-300, 300-500, 500-1000, more than 1000 meters.

Mark "not age-appropriate or lacking physical/cognitive capacity" in absence of any locomotion capacity.

In case the distance corresponds to a "transition" number (ex: 300 meters), choose the "inferior band" (ex: 200-300 meters) if the child has difficulties reaching the measured distance, and the "superior band" (ex: 300-500 meters) if the child appears to be able to walk further than the distance measured.

This item refers to the locomotion capacity without assistance from others. Normally the distance is measured in a clinic is up to 300 meters. For greater distances, the information should be obtained from the patient/family. In the event that distance cannot be measured in the clinic, take the family's input into account.

57.1. Conditions of evaluation: no score is given for this item. Its purpose is simply to establish the conditions under which locomotion capacity was assessed.

- ⤴ Habitual: the child is not training independent gait or gait with hand-held mobility aids; nor training the use of wheelchair.
- ⤴ Gait training: exercising independent gait.
- ⤴ Crutches training: exercising gait with crutches.
- ⤴ Walker training: exercising gait with walker.
- ⤴ Wheelchair training: exercising with wheelchair.

GROSS MOTOR SKILLS

58. Climbs up/down stairs:

- ⤴ Yes: able to climb up/down stairs, at least 5 steps, in a standing position. Full score even if done holding onto railing and without alternating feet, as long as most of the support is on lower limbs.
- ⤴ No: incapable of climbing up/down 5 steps in a standing position.

59. Kicks a ball:

- ⤴ Yes: able to kick a ball. Can hold onto walker or crutches and kick the ball with right or left foot.
- ⤴ No: unable to kick a ball.

60. Spins around body axis:

- ⤴ Yes: spins around body axis at least 180, even if with hand-held locomotion aid (except wheelchair)
- ⤴ No: unable to spin around body axis at least 180°.

61. Starts running (accelerated gait):

- ⤴ Yes: walks fast, even if with hand-held mobility devices.
- ⤴ No: unable to walk fast.

62. “Runs”:

- ⤴ Yes: walks fast enough (“run”) in such a way that at some point both feet are off the ground.
- ⤴ No: unable to “run”.

63. Jumps with both feet simultaneously:

- ⤴ Yes: jumps upward with both feet without falling and without any support. Must be able to jump 5 cm off the floor to score on this item.
- ⤴ No: unable to jump 5 cm high.

UPPER LIMB FUNCTION

64-79: Mark “yes” if the child is able to perform the tasks without assistance from others.

- ⤴ Reaches for objects (**64 and 72**): scores if able to reach for objects from any position (seated, supine, prone).
- ⤴ Uses upper limbs as support (**65 and 73**): arms are used during bimanual function to hold or to stabilize an object.
- ⤴ Voluntary prehension (**66 and 74**): grasps an object with voluntary movements of the hand. Scores if able to grasp object with any kind of prehension.
- ⤴ Palmar grasp (**67 and 75**): grasps an object with palmar prehension, which is characterized by flexion of all fingers around the object.
- ⤴ Digital (**68 and 76**): grasps small objects between the radial fingers and the thumb.
- ⤴ Pincer grasp (**69 and 77**): grasps an object between the thumb and tip of forefinger.
- ⤴ Supination up to midline (**70 and 78**): with the forearm completely pronated, supinates with a movement arc of 90° (to midline).
- ⤴ Complete supination (**71 and 79**): with the forearm completely pronated, supinates with a movement arc of 180° (complete).

Manual function

80-93: Mark “yes” if the child performs the task without assistance from others, with the exception of items 80 and 84, in which the use of both hands is obligatory. Scores on the other items even if task is performed with only one upper limb or with use of other body parts (ex: lower limbs). The aim is to evaluate functionality.

80. Transfers objects from one hand to the other: moves the object from one hand to the other.

81. Performs wide insertions: puts objects, such as cups, inside each other.

82. Performs fine insertion: inserts small objects, such as pins, into holes. The ability to cap a pen also scores on this item.

- 83.** Piles objects on top of each other: piles at least 3 objects (such as blocks) on top of each other.
- 84.** Tears paper: tears a sheet of paper using both hands. To score, it is not enough to simply be able to tear the paper by pushing the sheet; must be able to perform the opposing movements with the upper limbs)
- 85.** Turns pages of a book: turns pages of a book, one at a time. The pages should be thin.
- 86.** Puts a paper inside an envelope: folds a sheet of paper and put it inside an envelope,
- 87.** Scribbles on paper and then erases it: doodles on paper and erase it completely.
- 88.** Cuts paper in half with scissors: cuts a sheet of paper (minimum size 10 centimeters) with scissors in a straight line.
- 89.** Sharpens pencils: sharpens a pencil into a fine tip.
- 90.** Can draw more than one recognizable form: draws at least 2 recognizable forms (ex: circle, cross). The child can copy a drawing produced by the evaluator.
- 91.** Writes recognizable letters and numbers: writes at least 2 recognizable letters or numbers. The child can copy the letters/numbers written by the evaluator.
- 92.** Uses a computer with adaptations: uses the computer with adaptations (on the keyboard, mouse, etc.).
- 93.** Uses a computer without adaptations: uses a regular computer (including laptop) without any adaptations. A score on this item implies in a score on item 92 as well, since the child is also able to use computer with adaptations.

ACTIVITIES OF DAILY LIVING

The following items are organized into age groups to make it easier to identify a child's developmental level. The evaluator should give a score to all items. Those that are classified into age groups older than the child's age (ex: items in the 3-4 age group but the child being evaluated is 2 years old), the evaluator should ask the parents if their child is able to perform them; in some instances, a child may be able to accomplish tasks in a higher age group. The parents can also be asked about the items within the child's age group if it is not possible to evaluate them in clinical setting.

To receive the score (marking "yes"), the child must be able to perform the tasks without assistance from others, but may use adaptations. If the child performs the task with help, the evaluator should mark the item with a "no". Sometimes the motor capacity is there but not the necessary cognitive/neuropsychological abilities.

The aim is to evaluate capacity. Therefore, the child receives a positive score if the task is completed during the evaluation, even if it is not normally performed at home (e.g., the parents may be doing it for the child).

6 to 12 months

Feeding:

94. Holds a bottle: holds a bottle with one or both upper limbs without assistance.

95. Eats food with hands: eats solid food (ex: piece of fruit, cookies) without assistance.

Dressing:

96. Takes off socks: intentionally takes off socks without assistance. May use strategies such as sitting with support of the trunk to accomplish the task.

97. Takes off shoes: intentionally takes off shoes without assistance - any type of shoe (trainers, sandals), except flip-flops. This item does not address the ability to deal with shoelaces and buckles.

1 to 2 years

Feeding:

98. Brings utensils to mouth (spoon/fork): takes some food from the plate with a spoon or fork and bring it to mouth. Scores even if large amounts of food drop during task.

Dressing:

99. Unties shoelaces: unties shoelaces without assistance.

100. Handles Velcro on shoes/clothing: intentionally opens and closes Velcro on shoelaces and clothing without assistance.

2 to 3 years

Feeding:

101. Uses eating utensils: eats with spoon/fork without assistance. This item does not address cutting up food. To score, may not drop more than a very small amount of food.

102. Drinks from glass: holds a glass with one or both hands without assistance. Scores even if the glass is adapted (ex: glass with handle).

103. Opens/closes containers: opens and closes containers without help.

104. Unscrews lids: unscrews lid without assistance (ex: toothpaste cap).

Dressing:

105. Takes off T-shirt: takes off T-shirt without assistance.

106. Takes off underwear: takes off underwear without assistance.

107. Takes off shorts: takes off the shorts with elastic waist (this item does not address the ability to deal with buttons or zippers).

108. Takes off pants: takes off pants with elastic waist (this item does not address the ability to deal with buttons or zippers).

109. Opens zipper: opens zipper. To score on this item, does not need to be able to unclasp insertion pin from retainer box.

110. Closes zipper: closes zipper. To score on this item, does not need to be able to put the insertion pin into the retainer box (the evaluator can do this part of the task for the child).

Sphincter control:

111. Controls bowel: has bowel control. To score on this item, child must have enough control to not soil underpants.

112. Controls bladder: has bladder control. To score on this item, child must have enough control to not wet underpants (controls bladder during the day).

3 to 4 years**Feeding:**

113. Transfers liquid from one container to another: transfers liquid from one container to another. The first container must be bigger than the second one (ex: jar and glass/cup). To score on this item, none or very little liquid is spilled.

114. Spreads butter/jam on bread/toast: spreads butter/jam on the bread/toast with a knife.

115. Cuts food: cuts food using a knife. Scores on this item even if able to cut only soft food (ex: cake, bread).

116. Gets food from the refrigerator: opens refrigerator and retrieves food without assistance. May receive verbal instructions about which food to get.

Dressing:

117. Takes off open shirts: takes off open shirts without assistance. This item does not address the ability to deal with buttons/zippers.

118. Puts on open shirts (short/long sleeves): puts on open shirts without assistance. This item does not address the ability to deal with buttons/zippers.

119. Puts on T-shirts: puts on T-shirt without assistance.

120. Puts on underwear: puts on underwear without assistance.

121. Puts on shorts: puts on shorts with elastic waist unassisted. This item does not address the ability to deal with buttons/zippers.

122. Puts on pants: puts on pants with elastic waist unassisted. This item does not address the ability to deal with buttons/zippers.

123. Puts on socks: puts on socks without assistance. May use strategies such as sitting with support of the trunk to accomplish the task.

124. Fastens and unfastens buckle: fastens and unfastens buckle without assistance.

125. Buttons /unbuttons: buttons and unbuttons without assistance.

Hygiene:

126. Washes and dries hands: uses soap to wash and then adequately dries both hands. May be helped by an adult to reach the sink.

127. Puts toothpaste on toothbrush: opens the toothpaste and puts an adequate amount of paste on toothbrush. It is not obligatory to use both hands.

128. Combs hair: combs own hair.

129. Uses the toilet without help: transfers to the toilet and lowers/lifts clothing to be able to use it. This item does not address intimate hygiene.

130. Blows nose: blows nose using a handkerchief without assistance.

131. Upper body hygiene: washes trunk. Scores even if unable to wash the parts of the trunk unreachable with the hands.

132. Upper-limb hygiene: washes the upper limbs without assistance.

133. Lower-limb hygiene: washes the lower limbs without assistance. May sit in a chair to accomplish this task.

134. Rinses hair: rinses own hair with a towel without assistance. This item does not address the ability to wash the hair.

Other abilities:

135. Opens/closes faucets: opens and closes faucets without assistance.

136. Opens/closes doors: opens and closes doors without assistance. This item address the ability to deal with door handles.

137. Turns lights on/off: reaches and turns the lights on/off without assistance.

138. Turns TV/radio on/off: turns the TV/radio on/off. May use the remote control.

4 to 5 years

Dressing:

139. Puts on shoes: puts on shoes. This item does not address the ability to deal with shoelaces, Velcro or buckles. To score, must put shoe on the correct foot.

Hygiene:

140. Brushes teeth: brushes teeth completely.

141. Washes face: washes and dries face without assistance.

5 to 6 years

Feeding:

142. Chooses and serves own food: puts food on plate. May receive verbal instructions to help choose food

Hygiene:

143. Washes private parts: performs hygiene of private parts without assistance after using the toilet.

Dressing:

144. Laces up own shoes: laces up shoes without assistance.

6 to 7 years

Dressing:

145. Laces and ties shoes: laces and ties shoes without assistance.

7 to 8 years

Dressing:

146. Chooses own clothes: chooses own clothes, which should be appropriate for the occasion (setting- and weather-appropriate).

147. Takes out clothes from drawers/closet: opens drawers/closet and retrieves clothes without assistance. To score, must perform this task with the aim of actually changing clothes (taking them out just to play does not count).

8 years and older

Hygiene:

148. Cuts own fingernails: able to use a nail cutter to trim fingernails without assistance.

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Piper MC, Darrah J. Motor assessment of the developing infant. Philadelphia: WB Saunders; 1994.

Russell DJ, Rosenbaum PL, Gowland C, Lane M. Gross Motor Function Measure (GMFM-66 & GMFM-88): user's manual. London: Mac Keith Press; 2002.

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HOW TO COMPUTE SCORES

SCORES DESCRIPTION

The punctuation for the domains and dimensions of the scale, as well as the scale's overall score, each one of them separately, can range from 0 to 100 points.

The score for the motor dimension of the Sarah scale is calculated as the arithmetic mean of the points obtained for the following domains: "motor acquisition", "locomotion", "gross motor skills", and "upper limb function". The score for the functional dimension consists of the points obtained in its single domain, the domain of "activities of daily living". The overall score on the scale is the arithmetic mean of the points obtained in the two dimensions, "motor" and "functional".

Within the domains, the maximum punctuation for each item is equivalent to 100 divided by the number of items in the domain, e.g., each of the 23 items in the motor acquisition domain has a maximum score of 100 divided by 23 points ($100/23$).

The locomotion domain, because of the inherent complexity of its assessment, is an exception to the punctuation criteria described for the scale domains. For the locomotion domain: the single item referring to the "most usual form of locomotion, without assistance from others" is scored out of a maximum of $100/5$ points; the single item referring to the "functional capacity in the most frequent form of locomotion" out of a maximum of $100/5$ points; the set of items relating to the "need for and skill in the use of mobility aids" is scored out of a maximum of $(100/5)*2$ points; and the single item referring to the "locomotion distance, without assistance from others" is scored out of a maximum of $100/5$ points. The final score for the locomotion domain is the sum of the punctuation for all items in this domain and ranges, as for the other domains, from 0 to 100 points.

In the locomotion domain, the items related to the "need and skill in the use of mobility aids" were divided into three types of aids: wheelchair ($(100/5)*2*(1/3)$ points), walker ($(100/5)*2*(1/3)$), and canes/crutches ($(100/5)*2*(1/3)$). If a child or adolescent being assessed does not need that specific mobility aid, he/she receives full points for that aid; however, if he/she is too young to use that aid or is physically or cognitively unable to do so, then he/she is given a zero for that aid. If the child or adolescent uses more than one mobility aid, his/her locomotion performance is evaluated for each aid independently. Four items related to control of mobility aid concern patients who use wheelchairs or walkers, each scoring a maximum of $(100/5)*1/12$ points. There are also eight items on transfers, each scoring a maximum of $(100/5)*1/24$ points. Use of canes/crutches is classified as either unilateral, $(100/5)*1/6$ points, or bilateral, $(100/5)*1/12$ points); there are also three items related to control of mobility aids, each scoring a maximum of $(100/5)*1/6$ points.

At the beginning of the assessment, if the child or adolescent has “community ambulation without the need of mobility aids”, then the assessment skips to “locomotion capacity”, with the kid receiving the highest score for the skipped items. If the child or adolescent has “limited home or community ambulation without assistance”, then the assessment skips to “functional capacity of locomotion”, with the kid receiving the highest score for the skipped items. If the kid’s gait is aided by a cane or crutch, then the assessment skips to “most frequent form of locomotion”, and the highest score is given to the previous items.

FORM WITH SCORES

Sarah motor-functional evaluation scale: 148 evaluation items

EVALUATION START

Uses independent gait as a means of locomotion outside the home, without the need of mobility aids.

No (0) Yes (Motor Acquisitions = 100; Locomotion + 60) (if yes, skip to question 57)

Uses independent gait as a means of locomotion at home or outside, with limitations.

No (0) Yes (Motor Acquisitions = 100; Locomotion + 20) (if yes, skip to question 25)

Gait with support of cane. No (0) Yes (Motor Acquisitions = 100) (if yes, skip to question 24)

MOTOR ACQUISITIONS

Head balance:

1. Prone position Absent (0) Precarious (100/23)*1/3 Regular (100/23)*2/3 Good (100/23)

2. Supine position Absent (0) Precarious (100/23)*1/3 Regular (100/23)*2/3 Good (100/23)

3. Sitting position Absent (0) Precarious (100/23)*1/3 Regular (100/23)*2/3 Good (100/23)

Rolling:

4. Supine/prone Complete (100/23) Partial (100/23)*1/2 No (0)

5. Prone/supine Complete (100/23) Partial (100/23)*1/2 No (0)

Creeping:

6. Pivots (prone or supine) Yes (100/23) No (0)

7. Creeps Prone position (100/23) Sitting position (100/23)*2/3 Supine position (100/23)*1/3 No (0)

8. Overcomes obstacles Yes (100/23) No (0)

Trunk balance:

9. Sitting position Absent (0) Precarious (100/23)*1/3 Regular (100/23)*2/3 Good (100/23)

10. Moves from supine to sitting position Yes (100/23) No (0)

11. Moves from prone to sitting position Yes (100/23) No (0)

Four point position balance:

12. Absent (0) Precarious (100/23)*1/3 Regular (100/23)*2/3 Good (100/23)

Crawling:

13. Homologous (100/23) Reciprocal (100/23)*1/2 No (0)

14. Climbs down from sofa/bed to floor Yes (100/23) No (0)

15. Climbs up from floor to sofa/bed Yes (100/23) No (0)

Kneeling balance:

16. Absent (0) Precarious (100/23)*1/3 Regular (100/23)*2/3 Good (100/23)

17. Moves to kneeling position: Without support (100/23) With support (100/23)*1/2 No (0)

Standing position balance:

18. Absent (0) Precarious (100/23)*1/3 Regular (100/23)*2/3 Good (100/23)

19. Moves to standing position: Without support (100/23) With support (100/23)*1/2 No (0)

Displacement standing up:

20. Cruising Yes (100/23) No (0)
21. Pushes a mobile support Yes (100/23) No (0)
22. Performs gait as exercise Yes (100/23) No (0)
23. Early stepping Yes (100/23) No (0)

LOCOMOTION**Usual form of locomotion****24. Most usual form of locomotion, without assistance from others:**

- Absent (carried, transported in baby stroller or wheelchair) (0)
- Crawling or creeping in sitting position (100/5)*1/4
- Wheelchair (100/5)*2/4
- Gait with walker (100/5)*3/4
- Gait with crutches (100/5)

25. Functional capacity in most frequent form of locomotion (without assistance from others):

- Absent (0) Home (100/5)*1/3 Outside home (100/5)*2/3 No limitations outside home (100/5)

Mobility aids**26. Wheelchair:** Does not use (100/5)*2/3 Not age-appropriate or lacking physical/cognitive capacity (0)

27. Able to follow a straight path Yes (100/5)*1/12 With assistance from others (100/5)*1/24 No (0)
28. Performs maneuvers Yes (100/5)*1/12 With assistance from others (100/5)*1/24 No (0)
29. Goes up/down ramp Yes (100/5)*1/12 With assistance from others (100/5)*1/24 No (0)
30. Goes up/down sidewalk Yes (100/5)*1/12 With assistance from others (100/5)*1/24 No (0)

Moves (from/to):

31. Wheelchair – bed Yes (100/5)*1/24 With assistance from others (100/5)*1/48 No (0)
32. Bed – wheelchair Yes (100/5)*1/24 With assistance from others (100/5)*1/48 No (0)
33. Wheelchair – floor Yes (100/5)*1/24 With assistance from others (100/5)*1/48 No (0)
34. Floor – wheelchair Yes (100/5)*1/24 With assistance from others (100/5)*1/48 No (0)
35. Wheelchair – car Yes (100/5)*1/24 With assistance from others (100/5)*1/48 No (0)
36. Car – wheelchair Yes (100/5)*1/24 With assistance from others (100/5)*1/48 No (0)
37. Wheelchair – toilet seat Yes (100/5)*1/24 With assistance from others (100/5)*1/48 No (0)
38. Toilet seat – wheelchair Yes (100/5)*1/24 With assistance from others (100/5)*1/48 No (0)

39. Walker: Does not use (100/5)*2/3 Not age-appropriate or lacking physical/cognitive capacity (0)

40. Able to follow a straight path Yes (100/5)*1/12 With assistance from others (100/5)*1/24 No (0)
41. Performs maneuvers Yes (100/5)*1/12 With assistance from others (100/5)*1/24 No (0)
42. Goes up/down ramp Yes (100/5)*1/12 With assistance from others (100/5)*1/24 No (0)
43. Goes up/down sidewalk Yes (100/5)*1/12 With assistance from others (100/5)*1/24 No (0)

Moves (from/to):

44. Wheelchair – bed Yes (100/5)*1/24 With assistance from others (100/5)*1/48 No (0)
45. Bed – wheelchair Yes (100/5)*1/24 With assistance from others (100/5)*1/48 No (0)
46. Wheelchair – floor Yes (100/5)*1/24 With assistance from others (100/5)*1/48 No (0)
47. Floor – wheelchair Yes (100/5)*1/24 With assistance from others (100/5)*1/48 No (0)
48. Wheelchair – car Yes (100/5)*1/24 With assistance from others (100/5)*1/48 No (0)
49. Car – wheelchair Yes (100/5)*1/24 With assistance from others (100/5)*1/48 No (0)
50. Wheelchair – toilet seat Yes (100/5)*1/24 With assistance from others (100/5)*1/48 No (0)
51. Toilet seat – wheelchair Yes (100/5)*1/24 With assistance from others (100/5)*1/48 No (0)

52. Canes/Crutches: Does not use (100/5)*2/3 Not age-appropriate or lacking physical/cognitive capacity (0)

53. Unilateral (100/5)*1/6 Bilateral (100/5)*1/12
54. Able to follow a straight path Yes (100/5)*1/6 With assistance from others (100/5)*1/12 No (0)
55. Goes up/down ramp Yes (100/5)*1/6 With assistance from others (100/5)*1/12 No (0)
56. Goes up/down sidewalk Yes (100/5)*1/6 With assistance from others (100/5)*1/12 No (0)

Locomotion capacity

57. Locomotion distance, without assistance from others

- Under 20 meters (100/5)*1/8
- 20 – 50 meters (100/5)*2/8
- 50 – 100 meters (100/5)*3/8
- 100 – 200 meters (100/5)*4/8
- 200 – 300 meters (100/5)*5/8
- 300 – 500 meters (100/5)*6/8
- 500 – 1000 meters (100/5)*7/8
- Over 1000 meters (100/5)
- Not age-appropriate or lacking physical/cognitive capacity (0)

57.1. Conditions of evaluation:

- Habitual
- Gait training
- Crutches training
- Walker training
- Wheelchair training

GROSS MOTOR SKILLS

- 58. Climbs up/down stairs Yes (100/6) No (0)
- 59. Kicks a ball Yes (100/6) No (0)
- 60. Spins around body axis Yes (100/6) No (0)
- 61. Starts running (accelerated gait) Yes (100/6) No (0)
- 62. Runs Yes (100/6) No (0)
- 63. Jumps, both feet simultaneously Yes (100/6) No (0)

UPPER LIMB FUNCTION

Right upper Limb:

- 64. Reaches objects Yes (100/30) No (0)
- 65. Uses limb as support Yes (100/30) No (0)
- 66. Voluntary prehension Yes (100/30) No (0)
- 67. Palmar prehension Yes (100/30) No (0)
- 68. Digital Yes (100/30) No (0)
- 69. Pincer grasp Yes (100/30) No (0)
- 70. Supination until midline Yes (100/30) No (0)
- 71. Complete supination Yes (100/30) No (0)

Left upper Limb:

- 72. Reaches objects Yes (100/30) No (0)
- 73. Uses limb as support Yes (100/30) No (0)
- 74. Voluntary prehension Yes (100/30) No (0)
- 75. Palmar prehension Yes (100/30) No (0)
- 76. Digital Yes (100/30) No (0)
- 77. Pincer grasp Yes (100/30) No (0)
- 78. Supination until midline Yes (100/30) No (0)
- 79. Complete supination Yes (100/30) No (0)

Manual function:

- 80. Transfers objects from one hand to the other Yes (100/30) No (0)
- 81. Performs wide insertions Yes (100/30) No (0)
- 82. Performs fine insertion Yes (100/30) No (0)
- 83. Piles objects on top of each other Yes (100/30) No (0)
- 84. Tears paper Yes (100/30) No (0)
- 85. Turns pages of a book Yes (100/30) No (0)
- 86. Puts a paper inside an envelope Yes (100/30) No (0)
- 87. Scribbles in paper and erases it afterwards Yes (100/30) No (0)

88. Cuts paper in half with scissors Yes (100/30) No (0)
89. Sharpens pencils Yes (100/30) No (0)
90. Can draw more than one recognizable form Yes (100/30) No (0)
91. Writes recognizable letters and numbers Yes (100/30) No (0)
92. Uses computer with interface Yes (100/30) No (0)
93. Uses computer with regular keyboard Yes (100/30) No (0)

DAILY LIVING ACTIVITIES

6 to 12 months

Feeding:

94. Holds bottle Yes (100/55) No (0)
95. Eats food with hands Yes (100/55) No (0)

Dressing:

96. Takes off socks Yes (100/55) No (0)
97. Takes off shoes Yes (100/55) No (0)

1 to 2 years

Feeding:

98. Brings utensils to mouth (spoon/fork) Yes (100/55) No (0)

Dressing:

99. Unties shoelaces Yes (100/55) No (0)
100. Handles Velcro on shoes/clothing Yes (100/55) No (0)

2 to 3 years

Feeding:

101. Uses eating utensils without help Yes (100/55) No (0)
102. Drinks from glass without help Yes (100/55) No (0)
103. Opens/closes containers Yes (100/55) No (0)
104. Unscrews lids Yes (100/55) No (0)

Dressing:

105. Takes off T-shirt Yes (100/55) No (0)
106. Takes off underwear Yes (100/55) No (0)
107. Takes off shorts Yes (100/55) No (0)
108. Takes off pants Yes (100/55) No (0)
109. Opens zipper Yes (100/55) No (0)
110. Closes zipper Yes (100/55) No (0)

Sphincter control:

111. Controls bowel Yes (100/55) No (0)
112. Controls bladder Yes (100/55) No (0)

3 to 4 years

Feeding:

113. Transfers liquid from one container to another Yes (100/55) No (0)
114. Spreads butter/jam on bread/toast Yes (100/55) No (0)
115. Cuts food Yes (100/55) No (0)
116. Gets food from the refrigerator Yes (100/55) No (0)

Dressing:

117. Takes off open shirts Yes (100/55) No (0)
118. Puts on open shirts (short/long sleeves) Yes (100/55) No (0)
119. Puts on T-shirts (short/long sleeves) Yes (100/55) No (0)
120. Puts on underwear Yes (100/55) No (0)

121. Puts on shorts Yes (100/55) No (0)
122. Puts on pants Yes (100/55) No (0)
123. Puts on socks Yes (100/55) No (0)
124. Fastens and unfastens buckle Yes (100/55) No (0)
125. Buttons /unbuttons Yes (100/55) No (0)

Hygiene:

126. Washes and dries hands Yes (100/55) No (0)
127. Puts toothpaste on toothbrush Yes (100/55) No (0)
128. Combs hair Yes (100/55) No (0)
129. Uses the toilet without help Yes (100/55) No (0)
130. Blows nose Yes (100/55) No (0)
131. Upper body hygiene Yes (100/55) No (0)
132. Upper-limb hygiene Yes (100/55) No (0)
133. Lower-limb hygiene Yes (100/55) No (0)
134. Rinses hair Yes (100/55) No (0)

Other abilities:

135. Opens/closes taps Yes (100/55) No (0)
136. Opens/closes doors Yes (100/55) No (0)
137. Turns lights on/off Yes (100/55) No (0)
138. Turns TV/radio on/off Yes (100/55) No (0)

4 to 5 years

Dressing:

139. Puts on shoes Yes (100/55) No (0)

Hygiene:

140. Brushes teeth Yes (100/55) No (0)
141. Washes face Yes (100/55) No (0)

5 to 6 years

Feeding:

142. Chooses and serves own food Yes (100/55) No (0)

Hygiene:

143. Washes private parts Yes (100/55) No (0)

Dressing:

144. Laces up own shoes Yes (100/55) No (0)

6 to 7 years

Dressing:

145. Ties and laces shoes Yes (100/55) No (0)

7 to 8 years

Dressing:

146. Chooses own clothes Yes (100/55) No (0)
147. Takes out clothes from drawers/closet Yes (100/55) No (0)

≥ 8 years

Hygiene:

148. Cuts own fingernails Yes (100/55) No (0)

EXPECTED SCORE BY AGE GROUP

One cause of variation in the scores obtained on the Sarah scale is the range of ages of the children and adolescents to whom it is applied. In order to encompass the effect of age on the score, five developmental pediatricians who were members of the Sarah network’s rehabilitation team (with three to 20 years’ experience in pediatric service) independently assessed the scale items and then established a consensus as to the minimum age at which a child or adolescent without any functional or motor impairment could attain the top score for each item of the scale. Based on these evaluations, an “expected” score for each age group was established for each domain of the scale. Comparison of the actual with the expected score allows analysis of the proportional degree of deviation from the age group.

Table 1 shows the details of the expected score for each age group for each domain and dimension of the scale. For example, a child aged between 3 and 4 years with no motor or functional disability is expected to achieve scores of approximately 100 points for the domains of “motor acquisition” and “gross motor skills,” a score of approximately 84 for the “locomotion” domain, a score of approximately 77 for the “upper limb function” domain, total scores of approximately 90 points for the motor dimension and 62 points for the functional dimension (the latter of which is equivalent to the “activities of daily living” domain), and an overall motor/functional score of approximately 76 points.

Table 1 – Expected Sarah scale scores for age group^a.

Age group	Domain				Dimension		General (Motor/ Functional)
	Motor acquisition	Locomotion gains	Gross motor skills	Upper limb function	Motor	Functional	
<6 months	26.1	0.0	0.0	30.0	14.0	0.0	7.0
6 months – 1 yr	78.3	11.0	0.0	60.0	37.3	3.6	20.5
1–2 years	100.0	72.0	66.7	70.0	77.2	12.7	44.9
2–3 years	100.0	81.7	100.0	73.3	88.8	34.5	61.6
3–4 years	100.0	84.0	100.0	76.7	90.2	61.8	76.0
4–5 years	100.0	100.0	100.0	90.0	97.5	78.2	87.8
5–6 years	100.0	100.0	100.0	96.7	99.2	89.1	94.1
6–7 years	100.0	100.0	100.0	100.0	100.0	98.2	99.1
7–8 years	100.0	100.0	100.0	100.0	100.0	98.2	99.1
>8 years	100.0	100.0	100.0	100.0	100.0	100.0	100.0

(a) Expected scores for age group for children without any functional or motor impairment, established by developmental pediatricians associated with the Sarah Network of Rehabilitation Hospitals.

FOUR-LEVEL CONVERSION

The Sarah scale covers a wide range of domains, from motor skills and locomotion to gross motor skills, upper limb function, and activities of daily living. The raw scores of the Sarah scale domains range from 0 to 100 points. In order to validate the specific domains of the scale and with the aim of creating an option to reduce the score range for each domain from 100 points to a four-level classification (which can sometimes be more practical for clinical or scientific use), Sarah's professional team was consulted again. The members of the team of physical therapists, occupational therapists, and developmental pediatricians (with three to 22 years' experience in the treatment of patients with CP) were asked to assess, independently, each of the 76 children and adolescents who participated in the study for scale's validation, in each one of the scale domains using a four-level classification. In performing the four-level classification, the professionals were asked to observe, for each domain, the following criteria:

- no relevant impairment: performs 100% of tasks expected for age, exercises skills and performs tasks without help from others, within a reasonable time, with full functional performance, and without any safety concerns;
- mild impairment: performs most tasks (above 70% of those expected for age), exercises skills and performs tasks without help, but may require supervision from others, and/or requires more than a reasonable amount of time, and/or has partial functional performance, and/or elicits safety concerns;
- moderate impairment: partially performs tasks (30–70% of those expected for age), only partially possesses the skill(s) and/or partially performs the movement(s), needs help from others;
- severe impairment: does not perform the tasks (performs below 30% of those expected for age), does not possess the skill(s) and/or does not perform the expected movement(s), needs help from others.

The tasks and aspects to be considered for the classification of each domain are as follows: “motor acquisition” comprises head balance, rolling, creeping, trunk balance, four-point position balance, crawling, kneeling balance, standing point balance, and displacement standing up; “locomotion” comprises functional capacity in the most frequent form of locomotion, use of assistive devices for mobility, and dexterity in the use of any assistive device; “gross motor skills” comprise kicking a ball, climbing stairs, running, jumping, and spinning around the body axis; “upper limb function” comprises reaching for objects, using the limbs for support, voluntarily performing prehension, pincer grasping, transferring objects from one hand to the other, performing adjustment of objects, inserting sheets into an envelope, writing letters, and drawing recognizable forms; “activities of daily living” comprise feeding, dressing, toilet training, and hygiene.

The four-level classification for each individual was determined according to the consensus of the evaluation team. These results were used to establish a conversion from the Sarah scale score to a four-level classification.

Table 2 shows the limits for converting the Sarah scale (in terms of the deviation of the raw score from the expected score for age group) into a four-level classification. The limits were chosen on the basis of analysis of the 76 evaluations; adjustments were made as needed to improve the concordance between the converted Sarah scale four-level classification and the four-level classification performed by the rehabilitation professionals.

Table 2 also shows the exact proportion of agreement between the converted Sarah scale four-level classification and the examiners' classification, as well as the quadratic weighted Kappa coefficient between the two classifications, for each domain. The exact proportion of agreement between the Sarah scale and the examiners' classification ranged from 63% to 87% and the quadratic weighted Kappa coefficient from 0.84 to 0.95.

Table 2 – Conversion of the Sarah scale (in terms of the deviation of the continuous score from the expected score for age group) into a four-level classification and comparison of the converted scale with the four-level classification performed by staff members of the Sarah Network of Hospitals.

Deviation from expected score	Four-level conversion	
Value greater than -1%	0 – No relevant impairment	
Value less than or equal to -1% down to -20%	1 – Mild impairment	
Value less than or equal to -20% down to -70%	2 – Moderate impairment	
Value less than or equal to -70%	3 – Severe impairment	
(n = 76)		
Sarah scale	Proportion of agreement ^a	
	Kappa ^b (CI)	
Motor dimension	75%	0.91 (0.87; 0.95)
Motor acquisition	83%	0.95 (0.92; 0.98)
Locomotion	76%	0.92 (0.88; 0.96)
Gross motor skills	76%	0.90 (0.86; 0.95)
Upper limb function	63%	0.84 (0.78; 0.90)
Functional dimension	80%	0.88 (0.81; 0.95)
Overall motor/functional	87%	0.92 (0.88; 0.97)

CI – 95% confidence interval; n – number of participants.

(a) Exact concordance between “the Sarah scale converted to a four-level classification” and “the four-level classification performed by the Sarah network staff”.

(b) Quadratic weighted Kappa coefficient.