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Development and psychometric properties of the DCDDaily: a new test for clinical assessment of capacity in activities of daily living in children with developmental coordination disorder

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Abstract

Objective: To develop the DCDDaily, an instrument for objective and standardized clinical assessment of capacity in activities of daily living (ADL) in children with developmental coordination disorder (DCD), and to investigate its usability, reliability, and validity.

Subjects: Five to eight-year-old children with and without DCD.

Main measures: The DCDDaily was developed based on thorough review of the literature and extensive expert involvement. To investigate the usability (assessment time and feasibility), reliability (internal consistency and repeatability), and validity (concurrent and discriminant validity) of the DCDDaily, children were assessed with the DCDDaily and the Movement Assessment Battery for Children-2 Test, and their parents filled in the Movement Assessment Battery for Children-2 Checklist and Developmental Coordination Disorder Questionnaire.

Results: 459 children were assessed (DCD group, $n = 55$; normative reference group, $n = 404$). Assessment was possible within 30 minutes and in any clinical setting. For internal consistency, Cronbach's $\alpha = 0.83$. Intraclass correlation = 0.87 for test–retest reliability and 0.89 for inter-rater reliability. Concurrent

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correlations with Movement Assessment Battery for Children-2 Test and questionnaires were $\rho = -0.494$, 0.239, and –0.284, $p < 0.001$. Discriminant validity measures showed significantly worse performance in the DCD group than in the control group (mean (SD) score 33 (5.6) versus 26 (4.3), $p < 0.001$). The area under curve characteristic = 0.872, sensitivity and specificity were 80%.

Conclusions: The DCDDaily is a valid and reliable instrument for clinical assessment of capacity in ADL, that is feasible for use in clinical practice.

Keywords

Developmental coordination disorder (DCD), activities of daily living (ADL), test design, assessment, usability, reliability, validity

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Introduction

Children with developmental coordination disorder (DCD) experience motor difficulties in a broad range of activities of daily living (ADL), such as mobility, personal hygiene, feeding, and dressing; handwriting and crafting; ball skills, and riding a bike.[1–3] Moreover, owing to their limited capacity in ADL, children's participation may be restricted and psycho-social consequences may arise, such as low self-esteem and social exclusion.[3–6] The great impact of DCD on children's daily lives necessitates proper diagnosis and intervention, in order to limit the consequences of the disorder.[7–9]

ADL difficulties are an inclusive diagnostic criterion for DCD (Criterion II), according to both the Diagnostic and Statistical Manual of Mental Disorders and the recently developed International Clinical Practice Guideline for DCD.[1,2] Assessment of capacity in ADL is thus required to obtain a comprehensive diagnosis of DCD.[1,2,9,10] Capacity is defined as what a child is capable of in a standardized environment.[11,27] This necessitates a standardized and objective clinical instrument to assess ADL. Assessment of capacity in ADL would also be a starting point for therapy, as insight into the functional problems of a child may help clinicians to specify treatment goals.[2,8,12]

Despite the importance of ADL, and the need for assessment thereof, current instruments do not provide comprehensive assessment of capacity in ADL in children with DCD.[2,9,13] Standardized and objective instruments that are most commonly used to assess children with DCD are the Movement Assessment Battery for Children-2 Test and the Bruyninks-Oseretsky Test of Motor Proficiency-2.[2,6,14–16] With these instruments, however, emphasis lies on the measurement of movement skills (Criterion I according to the diagnostic criteria for DCD according to the Diagnostic and Statistical Manual of Mental Disorders), rather than assessment of ADL (Criterion II).[1,2,8,17] Other instruments, which may be used for assessment of capacity in ADL in children, are for example the Do-Eat, and the school version of the Assessment of Motor and Process Skills (schoolAMPS).[18–20] These instruments however, do not provide comprehensive assessment of ADL, despite the importance to cover a broad range of ADL in a heterogeneous disorder such as DCD.[4,9,21,22]

For assessment of Criterion II, questionnaires are currently used, such as the Movement Assessment Battery for Children-2 Checklist and the Developmental Coordination Disorder Questionnaire.[1,2,15,23] However, according to the International Clinical Practice Guideline for DCD, a reliable method is urgently needed for clinical assessment of Criterion II.[2] Questionnaires are designed to assess performance, which reflects what a child does in daily life.[11,24] What a child does, i.e. ADL performance, may differ from what a child is capable of, i.e. capacity in ADL.[11,24]

Moreover, as questionnaires are mainly subjective, they can only assist in screening for DCD and do not suffice for identification or scaling of the disorder.[2,24,25] Questionnaires are of use to obtain insight into participation and into ADL that cannot be addressed with objective instruments owing to ethical or environmental constraints, e.g. bathing and riding a bike. For comprehensive assessment of ADL in children with DCD, a combination is thus needed of standardized and objective assessment of the child's capacity in ADL, and subjective assessment of the child's performance.[2,24,26] Despite the need for an instrument for standardized and objective assessment of capacity in ADL, this is currently lacking for children with DCD.

To fill this gap, a new test was designed to provide standardized and objective clinical assessment of capacity in ADL in five to eight-year-old children with DCD: the DCDDaily. The aim of the current study is the development of the DCDDaily and investigation of its usability, reliability, and validity.

The DCDDaily

The design of the research version of the DCDDaily comprised five phases. Subsequently, usability, reliability, and validity analyses were performed. Adaptations were made based on the results of these analyses, entailing the final version of the DCDDaily.

First, a theoretical model was described for the DCDDaily. Relating to the model of the International Classification of Functioning, Disability and Health (ICF), which is the universal framework for health-related conditions, ADL are defined as functional motor activities that are performed during daily life, on a daily basis.[27] In order to cover ADL in a comprehensive way, the three domains of ADL were used as a basis for inclusion of items in the DCDDaily: 'self-care and self-maintenance', 'productivity and schoolwork', and 'leisure and play'.[9,28]

Second, five specifications were set for the DCDDaily, based on the literature: (I) assessment of ADL should be standardized and objective, to ensure reliable and valid test results;[2,8,13] (II) assessment of ADL should encompass all three domains of ADL, as DCD is a heterogeneous disorder that is represented by a wide range of variation in everyday performance;[4,5,9,21,22] (III) ADL should be assessed that are part of daily functioning in five to eight-year-old children. This age range was considered appropriate as DCD is often recognized around school-age;[22] (IV) assessment of ADL should be ecologically valid, in order to optimally reflect the child's functioning.[18,29–31] An ecologically valid test comprises of items that represent those ADL that are performed during actual daily life. Further, these ADL should be assessed in a natural setting to render generalizable test results; (V) the instrument should be easy to use, assessable in any clinical setting, and assessment time should be limited to 30 minutes.

Third, the relevant literature was explored and experts were interviewed, in order to select items for inclusion in the DCDDaily. An overview was obtained of all ADL that are daily routine for five to eight-year-old children, and that children with DCD experience problems with. The literature review was conducted, with the databases of MEDLINE (1989–2007), EMBASE (1989–2007), EBSCO (1989–2007), and Web of Science ISI (1989–2007) searched by two reviewers, for articles describing ADL in children with DCD, using the following keywords: 'developmental coordination disorder' and 'activities of daily living'. In order to complete this overview, semi-structured expert interviews were held with physical therapists (n = 2), occupational therapists (n = 2), and scientists (one rehabilitation researcher and one psychologist), who regularly work with children with DCD.

The fourth phase comprised an expert meeting to discuss the list of relevant ADL, and to reach consensus on the items to be included in the DCDDaily. The experts were occupational therapists (n = 2), physical therapists (n = 2), a paediatrician (n = 1), a clinical neuropsychologist (n = 1), and researchers in psychology, paediatric rehabilitation, human movement sciences (n = 3), all working in the field of DCD for more than ten years. Two of the researchers involved are also authors of the current study. Consensus was reached on the items to be included in the DCDDaily, feasibility issues were

Table 1. Items included in the research version of the DCDDaily, sequenced to reflect 'a regular day'.

1. Home	2. School	3. Break	4. Shopping (dressing)	5. Free time
Buttering gingerbread[a]	Writing[b]	Constructional play[c]	Tying shoelaces[a]	Playing marbles[c*]
Cutting gingerbread[a*]	Gluing paper[b]	Pouring a drink[a]	Putting on trousers[a]	Hopping in squares[c]
Opening and closing lunchbox[a]	Folding a Jacobs ladder[b]	Walking with a drink[a]	Putting on polo[a]	
Opening and closing backpack[a*]	Colouring[b]	Spoon up a drink[a]	Putting on body-warmer[a]	
Walking with a chair[a]	Cutting[b]	Unwrapping package[a]		

[a]Activities from the domain of 'self-care and self-maintenance'.
[b]Activities from the domain of 'productivity and school'.
[c]Activities from the domain of 'leisure and play'.
*Items excluded from the final version of the DCDDaily.

discussed, an ecologically relevant sequence of the items was agreed on, instructions to be given during assessment were formulated, and a simple and transparent scoring system was designed (see Appendix 1, available online). The expert meeting resulted in the *pilot version of the DCDDaily*, which comprised 17 items, embedded in a story of simulating 'a regular day'.

In the fifth phase, a pilot study was performed with nine children with DCD and 26 children that were typically developing. For practical reasons, children aged seven and eight years were included only. Although the results regarding feasibility and psychometric properties of the DCDDaily were promising, adaptations were made for all items in order to optimize assessment. Experts were again involved in this process, who were also involved in the expert meeting, e.g. an occupational therapist, a physical therapist, and two researchers in psychology and human movement sciences. Furthermore, four advanced students in human movement sciences were involved, who had assessed children with the pilot version of the DCDDaily. This resulted in the *research version of the DCDDaily*.

Following these five phases, reliability and validity analyses were performed as described in this study. The results showed three out of 21 items of the research version not to be differentiating between children with and without DCD. These items were therefore deleted, resulting in the *final version of the DCDDaily*, holding 18 items.

The research version of the DCDDaily comprises a sequence of 21 items that simulate 'a regular day': starting with breakfast, going to school, having a break, getting dressed, and ending with free time. Table 1 shows the sequence of assessment of the items and the related domains of ADL.

For all items, both *success* and *time* were scored. *Success* scores were defined per item, i.e. what is a (1) successful, (2) medium, or (3) poor performance; *time* is scored in seconds and subsequently standardized into (1) good, (2) medium, or (3) poor, based on norm scores (for an extensive description of the *success* and *time* scores, calculation of the norm scores, and an example of item description, see Appendix 1). *DCDDaily item scores* are calculated as the average of *success* and *time* scores per item (resulting in 21 *item scores* of 1 – 1.5 – 2 – 2.5 – 3). The *DCDDaily total score* is calculated as the sum of 21 *DCDDaily item scores*, ranging from 21 (good) to 63 (poor).

Scoring the quality of the movement, i.e. how the item is carried out, was considered less relevant, since (i) a successful performance can be reached in several ways;[26] and (ii) inefficiency will be reflected in the time needed to perform the item. For the clinician involved, however, insight into the quality of certain ADL, may provide additional information to guide the planning of intervention.[32]

Methods

Five to eight-year-old children, both with and without DCD, were assessed with the research version

of the DCDDaily to analyse usability, reliability, and validity of the instrument.

Two groups of children were selected, a DCD group and a normative reference group. All children in the DCD group were diagnosed by a Medical Doctor in a rehabilitation centre or physical therapy centre in the Netherlands, according to the criteria for DCD operationalized in the International Clinical Practice Guideline for DCD:[2] (A) a score equal to or lower than the 16th percentile on the Movement Assessment Battery for Children-2 Test; (B) an indication for problems with ADL (currently operationalized as a score equal to or lower than the 15th percentile on the Developmental Coordination Disorder Questionnaire or Movement Assessment Battery for Children-2 Checklist); and (C) the absence of a general medical condition (e.g. cerebral palsy, hemiplegia, or muscular dystrophy or pervasive developmental disorder) according to the results of a paediatric neurological examination. Further, only children with IQ scores above 70 were included.[1]The reference group comprised a representative sample of the Dutch population of five to eight-year-old children, selected from mainstream primary schools throughout the Netherlands. Schools were selected from various geographic locations, accounting for possible differences between larger cities and smaller villages. As a control group, a third group was composed to enable comparison of children with DCD and typically developing children, needed for validity analyses. The control group comprised children randomly selected from the reference group, matched for age (within one year) and gender with the DCD group. Children who had a known clinical condition, such as uncorrected visual problems, or who were at risk for DCD (a score equal to or lower than the 16th percentile on the Movement Assessment Battery for Children-2 Test), were excluded from selection for the control group.

The study was approved by the Medical Ethics Committee of the University Medical Center Groningen in the Netherlands. After informed consent was obtained from their parents, children were assessed with the DCDDaily and the Movement Assessment Battery for Children-2 Test, in a separate room in their school or rehabilitation centre. Assessors were advanced students with a background in human movement science or physical therapy, who were trained in the assessment of the Movement Assessment Battery for Children-2 Test and the DCDDaily, but who had not been involved in the design of the instruments. The Developmental Coordination Disorder Questionnaire and Movement Assessment Battery for Children-2 Checklist were sent to the parents, who returned these to the researchers after completion.

For test–retest reliability analyses, a random group of children from the reference group performed a retest within two weeks of the original assessment, with the same assessor. Retests were not assessed for children with DCD, because this would create too much pressure on these children as their referral to clinical rehabilitation already involved an extensive diagnostic process. For inter-rater reliability, data were used from both the reference group and the DCD group. A random set of children was videotaped during assessment, after additional informed consent. Subsequently, this assessment was rated by two assessors, who separately observed the same video.

Data analyses were performed using SPSS Statistics Data Editor (IBM SPSS, version 20.0, Chicago, IL, USA). Because the distribution of data was not normal, non-parametric tests were used. Alpha was set at 0.05.

For reliability, test–retest reliability, inter-rater reliability, and internal consistency of the DCDDaily were analysed. Test–retest and inter-rater reliability were determined by calculating intraclass correlations for DCDDaily total scores, with data of children from the reference group and both the reference group and DCD group used, respectively. Two-way mixed effects models of the absolute agreement type intraclass correlations were used, and output of the 'single measure' interpreted, with intraclass correlations values >0.75 as excellent reliability; 0.40–0.75 as fair-to-good reliability; and <0.40 as poor reliability.[33] The internal consistency of the DCDDaily was investigated calculating Cronbach's α for the DCDDaily items scores of all children included, with 0.70 stipulated as an acceptable level.[34]

For validity, concurrent validity was determined calculating Spearman's ρ for mean DCDDaily total scores (a higher score means poorer performance) and mean percentile scores on the Movement Assessment Battery for Children-2 Test (a higher score means better performance), and Movement Assessment Battery for Children-2 Checklist (a higher score means poorer performance) and Developmental Coordination Disorder Questionnaire total scores (a higher score means better performance), using data of all children included. Furthermore, a receiver–operator characteristics curve was composed to analyse the agreement between the indication for DCD based on the DCDDaily score, with this indication based on the current diagnostic criteria, using data of the DCD group and the control group. The receiver–operator characteristics curve was used to determine an appropriate cut-off point for the DCDDaily score to indicate DCD, accounting for optimal sensitivity and specificity, e.g. at or above 0.80.[35] Further, the area under curve statistic was calculated to reflect the probability that a child with DCD (according to the current diagnostic criteria) has a worse score on the DCDDaily than a typically developing child, with a value above 0.80 considered high.[36] Finally, discriminant validity of the DCDDaily was determined by calculating differences between the DCD group and the control group for mean DCDDaily total scores and for mean DCDDaily item scores, using Mann-Whitney *U*-tests.[33]

Results

In total, 459 five to eight-year-old children were included, with 55 children in the DCD group and 404 children in the reference group. Further, the control group was composed of 55 children selected from the reference group. Descriptive statistics of the three groups are shown in Table 2. For analysis of the test–retest reliability, 20 children from the reference group were assessed with a retest; for inter-rater reliability analysis, assessments of seven children from the DCD group and seven children from the reference group were video-taped.

Assessment with the DCDDaily did not exceed 25 minutes for children in the reference group, or 30 minutes for children with DCD. Materials were easy to transport and set up, and assessment was possible in all clinical settings.

For internal consistency of the DCDDaily, Cronbach's $\alpha = 0.83$. The intraclass correlation for test–retest reliability of the DCDDaily was 0.87, the intraclass correlation for inter-rater reliability was 0.89.

For concurrent validity, significant correlations were found between mean DCDDaily total scores and mean Movement Assessment Battery for Children-2 Test percentile scores, Movement Assessment Battery for Children-2 Checklist total scores, and Developmental Coordination Disorder Questionnaire total scores, $\rho = -0.494$, 0.239, and –0.284 respectively, $p < 0.001$.

For discriminant validity, mean DCDDaily total scores were significantly higher for the DCD group than for the control group, indicating that children with DCD performed worse (mean (SD) DCD group = 33 (5.6); control group = 26 (4.3), $p < 0.001$). Further, significant differences were found between the groups for 17 out of 21 DCDDaily item score means (Mann-Whitney *U*-test range $p < 0.001$–0.005 for these 17 items). The items 'opening and closing lunchbox' (item 3, $p = 0.852$), 'walking with a chair' (item 5, $p = 0.721$), 'walking with a drink' (item 13, $p = 0.056$), and 'playing marbles' (item 20, $p = 0.136$), did not differentiate between groups, see Figure 1.

Item 13, 'walking with a drink', did differentiate for the group of children of six years and older ($p = 0.034$). As they did not differentiate between children with and without DCD, items 3, 5, and 20 were excluded from the *final version* of the DCDDaily (total score ranging from 18 (good) to 54 (poor)). Further analyses were performed with this final version of the DCDDaily.

An analysis of agreement was performed for the total scores of the final version of the DCDDaily, encompassing 18 items, and the current diagnostic criteria for DCD. The area under curve characteristic = 0.872. The receiver–operator characteristics curve is shown in Figure 2. With a cut-off at 24.6, both sensitivity and specificity were found 80%.

Table 2. Descriptive statistics of the reference group, DCD group, and control group, per age group.

	Male:female ratio	Mean MABC2 (SD, range)	Mean MABC2Q (SD, range)	Mean DCDQ (SD, range)
Reference group				
n = 404; age = 7.1 (1.1)	199:205	49 (29; 0.1–99)	3 (5; 0–34)	45 (22; 0–75)
Age 5 (*n* = 73)	41:32	42 (27; 0.5–98)	4 (6; 0–20)	41 (21; 11–74)
Age 6 (*n* = 119)	51:68	46 (28; 1–99)	3 (5; 0–25)	42 (21; 0–74)
Age 7 (*n* = 108)	54:54	52 (30; 0.1–99)	3 (5; 0–34)	47 (23; 0–75)
Age 8 (*n* = 104)	53:51	55 (30; 0.1–99)	3 (5; 0–20)	49 (23; 0–75)
DCD group				
n = 55; age = 7.0 (1.0)	47:8	6 (5; 0.1–16)	21 (13; 0–51)	34 (16; 6–36)
Age 5 (*n* = 5)	5:0	6 (3; 1–9)	14 (7; 7–23)	47 (25; 10–36)
Age 6 (*n* = 9)	9:0	7 (6; 0.5–16)	22 (10; 6–36)	38 (13; 22–59)
Age 7 (*n* = 21)	17:4	7 (6; 0.1–16)	24 (14; 0–44)	31 (14; 6–57)
Age 8 (*n* = 20)	16:4	5 (6; 0.1–16)	18 (14; 0–51)	31 (15; 9–51)
Control group				
n = 55; age = 7.0 (1.0)	47:8	59 (25; 25–98)	4 (6; 0–25)	46 (24; 14–75)
Age 5 (*n* = 5)	5:0	42 (25; 25–84)	6 (7; 0–13)	47 (24; 24–71)
Age 6 (*n* = 9)	9:0	51 (25; 25–84)	11 (10; 0–25)	31 (20; 15–70)
Age 7 (*n* = 21)	17:4	60 (23; 25–98)	2 (4; 0–13)	49 (23; 14–75)
Age 8 (*n* = 20)	16:4	66 (26; 25–95)	2 (5; 0–20)	47 (26; 17–75)

[a]Reference group: representative sample of the Dutch population.
[b]DCD group: children diagnosed according to the current diagnostic criteria for developmental coordination disorder.
[c]Control group: typically developing children, selected from the reference group, matched for age and gender with the DCD group.
[d]*n* = number of children, per group; age = age mean (SD).
MABC2, Movement Assessment Battery for Children-2 Test percentile score; MABC2Q, Movement Assessment Battery for Children-2 Checklist total score; DCDQ, Developmental Coordination Disorder Questionnaire total score.

Reliability and validity analyses were repeated for the final version of the DCDDaily, comprising 18 instead of 21 items: for internal consistency, Cronbach's $\alpha = 0.83$; for test–retest reliability, the intraclass correlation = 0.90, and for inter-rater reliability, the intraclass correlation = 0.93; for concurrent validity, correlations between mean DCDDaily total scores and mean Movement Assessment Battery for Children-2 Test percentile scores, Movement Assessment Battery for Children-2 Checklist total scores, and Developmental Coordination Disorder Questionnaire total scores were significant, $\rho = -0.509$, 0.239, and –0.275, $p < 0.001$; for discriminant validity, significantly higher mean (SD) DCDDaily total scores were found for the DCD group than for the control group (29 (5.2) versus 22 (4.0), $p < 0.001$) and for all individual items (ranging $p < 0.001$–0.005), with the exception of item 13, 'walking with a drink' ($p = 0.56$ for all children in the DCD group and control group ($n = 110$); $p = 0.034$ for children six years or older ($n = 100$)).

Discussion

The aim of this study was to develop a standardized and objective instrument for clinical assessment of capacity in a broad range of ADL, in children aged five to eight years suspected of having DCD: the DCDDaily, and to investigate its psychometric properties. A thorough review of the literature and extensive communication with experts ensued the design of the DCDDaily to fulfil the specifications set. In the current study, the DCDDaily demonstrated the ability to differentiate between children with and without DCD. Further, the items of the DCDDaily showed high internal consistency and good repeatability, and the DCDDaily demonstrated

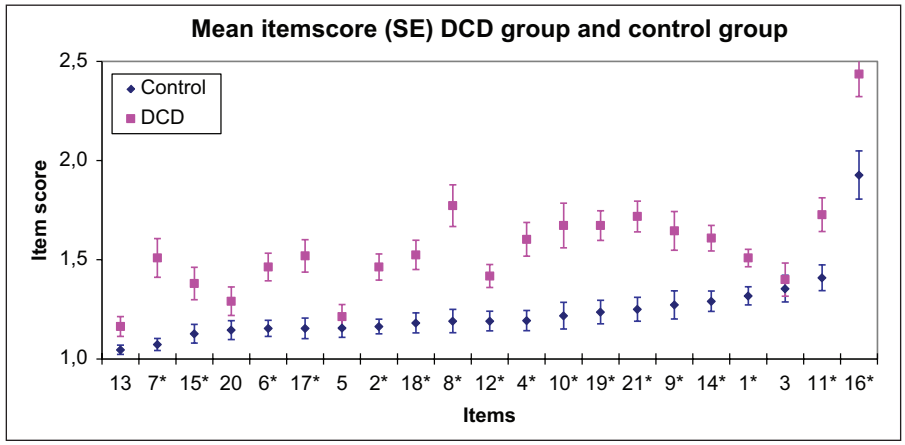

Figure 1. Mean scores on all DCDDaily items of the DCD group and the control group.
[a]Mean scores for all items are shown for the DCD group (n = 55) and the control group (n = 55), ranked from good to poor, according to the mean scores of the control group.
[b]A higher score indicates a worse performance.
[c]Items that differentiate between the DCD and the control group, showing a significant difference between mean scores of both groups, are marked with an *.
[d]Items: 1 = buttering gingerbread; 2 = cutting gingerbread; 3 = opening and closing lunchbox; 4 = opening and closing backpack; 5 = walking with a chair; 6 = writing; 7 = gluing paper; 8 = folding a Jacobs ladder; 9 = colouring; 10 = cutting; 11 = constructional play; 12 = pouring a drink; 13 = walking with a drink; 14 = spoon up a drink; 15 = unwrapping package; 16 = tying shoelaces; 17 = putting on trousers; 18 = putting on polo; 19 = putting on body-warmer; 20 = playing marbles; 21 = hopping.
[e]See Appendix 2 (available online) for the mean scores (SD; range) on all items, for the control group and the DCD group. DCD, developmental coordination disorder; SE, standard error.

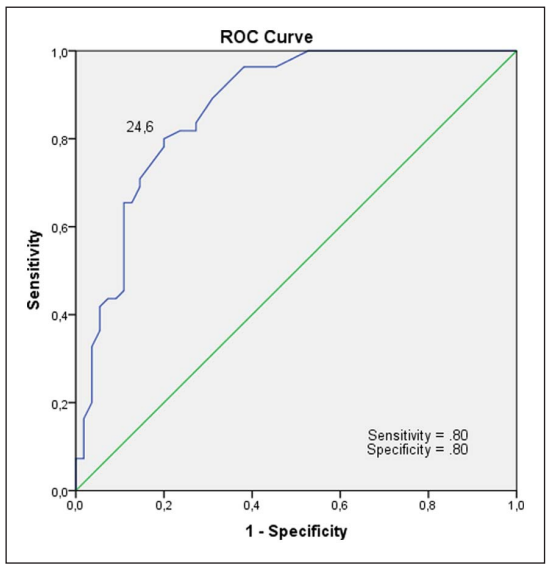

Figure 2. Receiver–operator characteristics (ROC) curve for the DCDDaily total score (18 items) in relation to the current diagnostic criteria for DCD.
ROC, receiver–operator characteristics.

to be clinically feasible. As expected, a significant but moderate correlation was found between the DCDDaily and the Movement Assessment Battery for Children-2 Test, that both address different aspects of motor capacity, e.g. capacity in ADL (Criterion II of the diagnostic criteria for DCD) and general motor skills (Criterion I).

The ability of the DCDDaily to differentiate between children with and without DCD was considered the most important element for use in clinical practice. The research version of the DCDDaily was able to discriminate between children with and without DCD in 17 of the 21 items. The item 'walking with a drink', did differentiate for the group of children of six years and older. The three other items, 'opening and closing lunchbox', 'walking with a chair', and 'playing marbles', did not discriminate for any age group and were therefore excluded, resulting in the final version of the DCDDaily comprising 18 items. Analyses of reliability and validity were performed on the final version of the DCDDaily, as discussed in the following section.

The present data clearly demonstrated the discriminative ability of the DCDDaily. Therefore, it can be used to differentiate between children with and without DCD. Moreover, the sensitivity and specificity of the DCDDaily were good, showing agreement with the current diagnostic criteria for DCD: the DCDDaily correctly identified children diagnosed with DCD and children in the control group who did not have DCD.[35] Further, the internal consistency of the DCDDaily was high and the instrument showed good repeatability: test results were comparable across different moments of testing and across different assessors.[33,34] The usability of the DCDDaily was also found to be good. The assessment time was limited to 30 minutes and materials were easy-to-use, making the DCDDaily feasible in clinical practice. Moreover, children reported that they understood the principle of simulating 'a regular day', and the children and assessors enjoyed the assessments. This is important in supporting the ecological validity of the instrument, reflecting actual daily functioning rather than a forced execution of a set of items. The significant but moderate correlation found between the DCDDaily and the Movement Assessment Battery for Children-2 Test may be explained by the additional value of the DCDDaily.[2,37] Both instruments are standardized and objective clinical tests for the assessment of motor capacity, however, different aspects of motor capacity are addressed, i.e. capacity in ADL and general motor skills. The same reasoning holds for the significant but poor correlations found between the DCDDaily and the Movement Assessment Battery for Children-2 Checklist and the DCDDaily and the Developmental Coordination Disorder Questionnaire. Comparison of these instruments demonstrate an important difference between capacity (assessed with a standardized clinical test such as the DCDDaily) and performance (as addressed with questionnaires).[37] Often, what children demonstrate in a standardized test does not reflect what they do in actual daily life according to their parents.[11]

Limitations in the study should be considered. First, limitations were found in the study population, although both are in agreement with the DCD population: (A) only a small number of five-year-old children officially diagnosed with DCD were included; and (B) only a small number of females were included in the DCD group. As the diagnostic process is initiated around school age, five-year-old children are often not yet diagnosed.[16] Further, DCD is known to be diagnosed more often in boys than in girls.[38] It is recommended however, to assess more girls and five year old children officially diagnosed with DCD, to further investigate the reliability and validity of the DCDDaily in these groups of age and gender. Second, test–retest reliability was only analysed in typically developing children. Comparable results across different moments of testing may not be as likely in children with DCD, as more variation in motor functioning might be expected in the group of children with DCD.[29] In the current study, children with DCD did not perform a retest, as their referral to clinical rehabilitation already involved extensive assessment. In future research, it is considered worthwhile to investigate the test–retest reliability of the DCDDaily in the population it was designed for. Finally, assessors were not blinded to diagnosis, as children were assessed in their own 'daily' environment, e.g. a regular primary school (reference group) or at the rehabilitation centre where they received intervention (children with DCD). This may have influenced the scores given by the assessors. Bringing children to a location where they could be assessed by blinded assessors was considered too demanding. In future research however, it may be considered to make videos of assessment that can be scored by blinded assessors afterwards, as this is an important issue.

For use in clinical practice, the DCDDaily manual contains clear instructions for undertaking the assessment. Norm scores are available for each item to provide clinicians with information about the capacity in ADL of the individual child. In future research, it may be investigated whether the DCDDaily has the ability to support clinicians in setting therapy goals in a valid and reliable way. As the DCDDaily comprises a comprehensive range of ADL, most difficulties in children's daily life might be found. Individualized instruments like Goal Attainment Scaling or the Canadian Occupational Performance Measure might be needed however, to explore all difficulties of individual children with DCD.[39,40] Finally, possible evaluative abilities of the DCDDaily may be analysed, as this would add to the evaluation of currently used intervention methods, that are focussed on

children's capacity in ADL, e.g. Cognitive Orientation to Daily Occupational Performance and Neuromotor Task Training.[12,41–44]

Overall, the DCDDaily is a reliable and valid instrument that provides a standardized and objective clinical assessment of children's capacity in ADL. Reliable and valid assessment of Criterion II of the diagnostic criteria for DCD is indeed required, as recommended in the International Clinical Practice Guideline for DCD.[1,2] Used together with the Movement Assessment Battery for Children-2 Test (Criterion I), the DCDDaily (capacity, Criterion II) and motor questionnaires (performance, Criterion II) may provide complete assessment of the inclusive diagnostic criteria for DCD.[1,2]

Clinical messages

- The DCDDaily provides objective and standardized clinical assessment of children's capacity in ADL.
- The DCDDaily addresses a comprehensive range of ADL, relevant to five to eight-year-old children with and without DCD.
- The DCDDaily is a reliable and valid instrument, feasible for use in clinical practice.

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Conflict of interest

None declared.

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