Research Paper

RELIABILITY AND VALIDITY OF THE ICF-CY BASED MOBISCREEN 4-6 FOR 7- AND 8-YEAR-OLD CHILDREN

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Abstract

Background: Children with a motor development delay need to be identified early in order to initiate appropriate therapies. In the first step of a sequential diagnostic strategy, a screening should be used to shorten this process. Therefore, the mobility screening MobiScreen 4-6 is tried to be validated for children from 7 years and older. Methods: A total of 90 children, of whom 60 boys and 30 girls at a mean age of 7.33 ± .45 years, from two German primary schools participated. All underwent the MobiScreen 4-6. Internal consistency, construct validity, and discriminant ability were evaluated. The significance level was set at $p<.05$. Results: Cronbach's α reached .83 for the split times, inter-item correlations range from $r=.42$ to $r=.73$. Factor analysis reveals a single component with an eigenvalue of 3.67 with a variance explanation of 73%. Discriminant analysis shows significant differences between healthy children and children with a medical diagnosis, excepting slalom. Conclusions: Total time is considered the primary decision criterion and the given criteria were achieved, but the tasks climbing, crawling and transporting are too simple for this age group. Nevertheless, further studies should follow to improve the criteria. For this, the screening should be modified. A study on this is underway.

Keywords: mobility, motor development, screening, primary school, validation study

Children with a motor development delay need to be identified early in order to initiate appropriate therapies. They have a hard time coping with their everyday life. Their movements are poorly timed and rhythmic as well as inefficient. Similarly, they have poorer postural control, which may affect the acquisition of gross motor skills (Schott, 2010). The smoothness of movement and sense of balance are lacking in those children, and they learn to ride a bike or swim later compared to healthy individuals of the same age (Esser & Petermann, 2010). They are worse at catching, have high variability in gait patterns and poor balance, and have poor movement awareness (Becker et al., 2011). Jaščenoka and Petermann (2018) additionally describe problems with rocking and climbing, walking on uneven ground, and running and stopping or changing direction and throwing. Children who suffer from a motor development delay are usually conspicuous by clumsiness, frequent falling or dropping of objects. Further deficits become apparent in everyday activities such as eating with knife and fork, dressing and undressing, tying shoes or doing puzzles. Even in kindergarten, affected children stand out because they are clumsy. However, the disorders only become relevant when higher gross and fine motor requirements are placed on the children, usually when they start school. Thus, an accurate diagnosis already in kindergarten is of high practical importance. Deficits can thus be detected at an early stage and appropriate support measures can be initiated so that the child can compensate for this deficit in comparison to its peers (von Suchodoletz, 2005). However, it seems that motor development disorders are often overlooked at kindergarten age. The study of Erb and Werner (2003) shows that at the school entry examination 6% of the children show significant problems in gross and fine motor tasks which were however noticed in advance at the mandatory screening examination U9[1] at the pediatrician only in 40% of these affected children. At this point, the question would arise as to whether the available test procedures that are consistently used in practice (milestone concept, U examinations) are either not sensitive enough - or not suitable at all - to detect such disorders, or whether there is perhaps too much subjective leeway in the assessment. Michaelis and Niemann (2017) see the problem for diagnostics also in the fact that affected children often hide their weaknesses with a lot of imagination and skill, avoid corresponding situations or simply stubbornly refuse to face them. Therefore, even their own parents may not notice such a disorder or notice it only late. For the affected children, however, participation in social life is also of great importance, which is specified by the International Classification of Functioning, Disability and Health for Children and Youth ICF-CY (Hollenweger & Kraus de Camargo, 2013). Thus, participation in social life, e.g. go by bike to the park to play there with peers should be included as a diagnostic criterion of a motor development disorder to describe the limitations of the patient in age-related activities and, based on the description, these circumstances can be improved (Straßburg, 2010). Mobility, in particular, is therefore of great importance for those affected (Straßburg et al., 2008). Jaščenoka and Petermann (2018) also believe that the ICF-CY provides a good basis for systematically classifying the impairment of children with a motor development disorder. Mobility in the sense of the ICF-CY describes the own movement or the movement and handling of objects, the locomotion in different ways as well as the use of means of transport. Without it, participation does not take place. This is because it is participation that plays an overriding role, as children's life situations are constantly changing during development (Hollenweger & Kraus de Camargo, 2013). Michaelis and Niemann (2017) describe that the urge to participate is innate, can be seen as the strongest developmental generator and is an unmistakable part of early child development. The ICF-CY and the International Classification of Mental Disorders (10th revision) ICD-10 complement each other: by means of the ICD-10, the etiology of a health problem is classified, and by means of the ICF-CY, functioning and disability that exist due to this health problem are described. By combining these two classifications, a broad picture of a person's health can be created. The aim of this classification is to provide, in a uniform and standardized form, a language for describing health and health-related conditions. It allows data comparisons between different countries, health care disciplines and services (Hollenweger & Kraus de Camargo, 2013).

To validate such a test procedure, certain criteria need to be checked. The so-called psychometric properties reliability, and validity are mainly used as instruments for quality assessment and scientificity (Pospeschill, 2010). Testing and compliance with these criteria is considered essential (Bös, 2017). Reliability is the degree of accuracy of a test used to measure a particular characteristic (Lienert & Raatz, 1998). Reliability should be tested as early as possible in the development of a test, and in doing so should be tested with as large a sample as possible. A sample of over 100 subjects is already considered large (Brunner & Thieß, 1970). The reliability aspect of internal consistency can be determined by Cronbach's α from the correlation of all items among each other. Here, a value of > .70 is considered

[1] The German U9 preventive examination takes place between the 60th and 64th month of life. The doctor assesses whether the child has reached school readiness. The organ functions and general health are checked, a hearing and vision test are performed, and the urine is examined. The doctor checks the speech ability. He or she examines posture, foot position and gait, as well as gross and fine motor skills. If the doctor detects a disability or developmental delay in the child, he or she discusses with the parents what kind of support is necessary (DAK Gesundheit, 2022)

acceptable (George, & Mallery, 2002). The validity indicates whether the test measures the characteristic it claims to measure (Lienert & Raatz, 1998). The construct validity checks whether the construct measured by the test is related to a similar construct (Pospeschill, 2010). It refers to the correlation between the test and a latent dimension, i.e., the correlation of an inductively derived construct with the test result is checked in order to validate the construct of the test (Bös, 2017). For this purpose, a factor analysis is usually carried out, whereby it can be determined by how many factors a test can be explained. Here, it is important to note prerequisites and limitations when conducting a factor analysis (Bös, 2017). The first step is here to establish theoretical relationships between the constructs. In the second step, empirical relationships between the operationalizations of the constructs must be established. In the final step, these relationships must be tested to determine whether they support the hypothesis of validity (Schnell et al., 2011). Kubinger (2006) describes the ability of a test procedure to differentiate different populations from each other as a "new validation concept". For example, in a developmental test designed to separate children with motor problems from healthy children, it is precisely these two populations that should be compared. For this purpose, a discriminant analysis should be performed. With this it is possible to discover certain variables that predict group membership (Leonhart, 2013). Macha et al. (2005) state that, in addition to the possibility of group comparison, this discriminant ability can also be tested by identifying "at-risk" children characterized by an external criterion (e.g., external assessment).

The mobility screening for children from four to six years MobiScreen 4-6 (Dincher, 2020) is based on the domain of mobility of the ICF-CY. MobiScreen 4-6 is a so-called screening or filter test, which reliably identifies the conspicuous children as such. These children must be further examined with a detailed motor skills test. The screening consists of the tasks "Getting up from lying position", "Slalom", "Climbing", "Crawling", "Maneuvering" and "Transporting". The tasks are arranged as a course to be run through. This test possesses good to very good psychometric properties for children between the ages of four and six: Interrater reliability r = .96, retest reliability r = .93 (two weeks), internal consistency α = .60, criterion validity r = -.64 (MOT 4-6),r = -.71 (LoMo 3-6) and r = .72 (M-ABC-2), sensitivity .80 (4-year-olds), 1.00 (5-year-olds) and .88 (6-year-olds), AUC = .82 (4-year-olds), .86 (5-year-olds) and .91 (6-year-olds) (Dincher, 2020). MobiScreen 4-6 is based on a single-factor model in kindergarten children, namely mobility, and is able to differentiate between healthy children and children with a medical diagnosis (Dincher, 2020). Age-specific cutoff scores exist for the 4- to 6-year-olds for classification into inconspicuous and conspicuous. In addition, points are assigned for movement quality in the individual tasks, which can be used as a secondary criterion for assessment (Dincher, 2020). Initial studies have already shown that the item difficulties even for 7- and 8-year-old children are so low that the tasks can be mastered by almost all of them: 94 % can perform the Slalom without errors, 100 % the Climbing, 97 % the Crawling, 89 % the Maneuvering, and 96 % the Transporting (Dincher & Wydra, 2019). This is important at this point because MobiScreen 4-6 is designed to differentiate around lower levels of performance. In addition, this study in primary school children shows that there is no age or gender difference for 7- and 8-year-olds, so a single cutoff score is appropriate for this target group (Dincher, & Wydra, 2019). Diagnostic validity, i.e. the ability to correctly classify between conspicuous/positive and inconspicuous/negative (Marx, & Lenhard, 2011), is in a good to very good range. At a cutoff value of 20 seconds, 92% of the ill children are correctly classified as positive (sensitivity). The Area Under the Curve (AUC, sensitivity index independent of

-the cutoff value) shows a value of .82 (Dincher, in press). The following figure shows the structure of the MobiScreen 4-6.

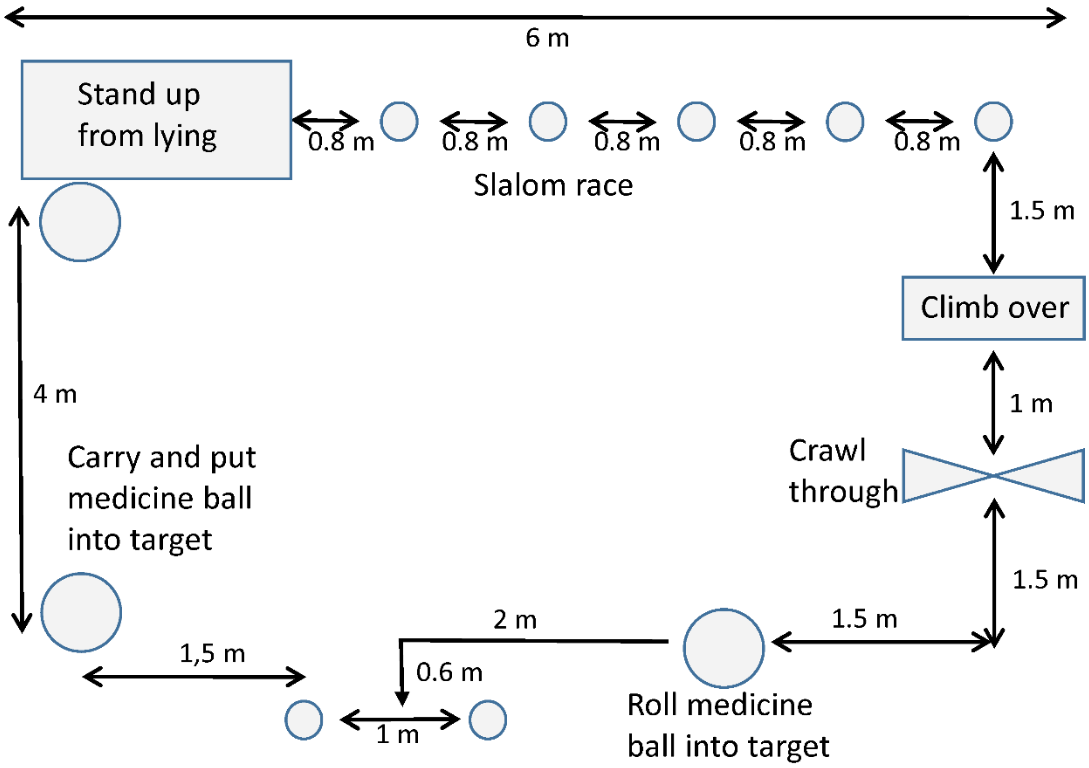

Figure 1. Structure plan of the MobiScreen 4-6 (adapted from Dincher, 2020)

A review has shown that currently only one procedure for primary school children, which is described as screening, fulfills all criteria for this with the exception of economy (Dincher & Dincher, 2023). Therefore, the MobiScreen 4-6, which was originally developed for kindergarten children, will attempt to close this gap in the diagnostic process for primary school children. In the present study it will be examined whether the MobiScreen 4-6 test version for kindergarten children can also be used with primary school children. Therefore, this version will be tested for its construct validity, internal consistency and differentiation ability for this new age group.

Methods

Participants A total of 90 children from two primary schools took part in this study. Of these, 30 were girls and 60 were boys. The age of the children was 7.33 ± .45. Table 1 provides an overview of the characteristics of the total sample as well as divided into boys and girls, showing age in years, number of children with membership in a sports club, number of children with a medical diagnosis such as ADHD, mental or physical disability, and number of children with a migration background[2].

Table 1. Overview of the characteristics of the total sample and separated by boys and girls (n = sample size, M ± SD = mean ± standard deviation).

	n	Age (years) M ± SD	Sports club members	Medical Diagnosis	Migration background
Total sample	90	7.33 ± .45	61	15	27
Boys	60	7.32 ± .45	42	6	17
Girls	30	7.34 ± .45	19	9	10

There is no significant age difference between boys and girls.

Variable sample

The MobiScreen 4-6 is used. The test has already been described above. For the present study, the split times of the items and their scores as well as total time and score are evaluated. The measuring points for the split times are determined as follows (Dincher, 2019):

- Slalom: Leaving the mat until first contact with gymnastics box
- Climbing: First contact with gymnastics box until last contact with it
- Crawling: Last contact with gymnastics box to first contact with first medicine ball
- Maneuvering: First contact with first medicine ball to first contact with second one
- Transporting: First contact with second medicine ball until its safe placement.

The quality of the task performance is measured on a six-point scale depending on the observed error (from 0 points = task was skipped to 5 points = task was completed without error) (Dincher, 2020).

All analyses will be performed for both item split times and their scores.

Procedure

After the principals of the selected schools and the parents of the children gave their consent to participate, the surveys were conducted. For this purpose, small groups of about six children were invited to the testing room (gymnasium) with a teacher. First, the test was demonstrated and explained by the examiner (author), after which each child had a practice trial to ensure that the tasks were understood. Then each child had a trial in which the data for this study was collected.

[2] Since a sports club affiliation is positively related and a migration background is negatively related to motor performance (Greier, Ruedl, & Riechelmann, 2017), these variables were also collected in the sample

Statistics

For all statistical analyses the program SPSS version 26 is used. In the present work, reliability aspects are determined via internal consistency using Cronbach's α and inter-item correlations. Construct validity is tested via exploratory factor analysis. Discriminant analysis will be used to examine the ability to differentiate between healthy children and children with a medical diagnosis. The significance level is set at $p<.05$.

Results

Descriptive statistics

Table 2 presents the descriptive results for all item split times and scores as well as total time and total score.

Table 2. Means and standard deviations (M ± SD) off item split times and scores, total time and total score for the total sample

	Slalom (M ± SD)	Climbing (M ± SD)	Crawling (M ± SD)	Maneuvering (M ± SD)	Transporting (M ± SD)	Total (M ± SD)
Times	4.89 ± .91	1.67 ± .79	3.80 ± 1.69	5.88 ± 2.96	3.61 ± 2.68	21.50 ± .79
Scores	4.07 ± 1.42	5.00 ± .00	4.88 ± .48	4.53 ± 1.07	4.90 ± .52	23.37 ± 2.04

The children complete the task climbing the fastest, the task maneuvering the slowest. They score the most points for the task climbing the fewest points for the task slalom.

Reliability

A value of Cronbach's α=.83 was obtained for the split times and α=.16 for the item scores. Table 3 below provides an overview of the inter-item correlations of the item split times and their scores.

Table 3. Inter-item correlations of the MobiScreen 4-6 (above diagonal item split times, below item scores)

	Slalom	Climbing	Crawling	Maneuvering	Transporting
Slalom		.42**	.58**	.48**	.69**
Climbing	-.07		.66**	.65**	.69**
Crawling	.28*	-.03		.64**	.73***
Maneuvering	.10	-.05	-.05		.67**
Transporting	-.12	-.02	-.04	.28*	

The correlation coefficients for the item split times are in a highly significant range between r=.42 and r=.73. For the item scores, they are all non-significant except for the correlations between maneuvering and transporting and between slalom and crawling and range between r=-.12 and r=.28.

Construct validity based on item split times

The Kaiser-Meyer-Olkin KMO measure of sample adequacy is .86, and Bartlett's test for sphericity is highly significant (p<.001) with a chi-square of 283.93 at 10 degrees of freedom. Thus, the sample of split times is suitable for main component analysis. Figure 2 shows the screeplot of the sample from the split times of the items and illustrates the eigenvalues of the individual components.

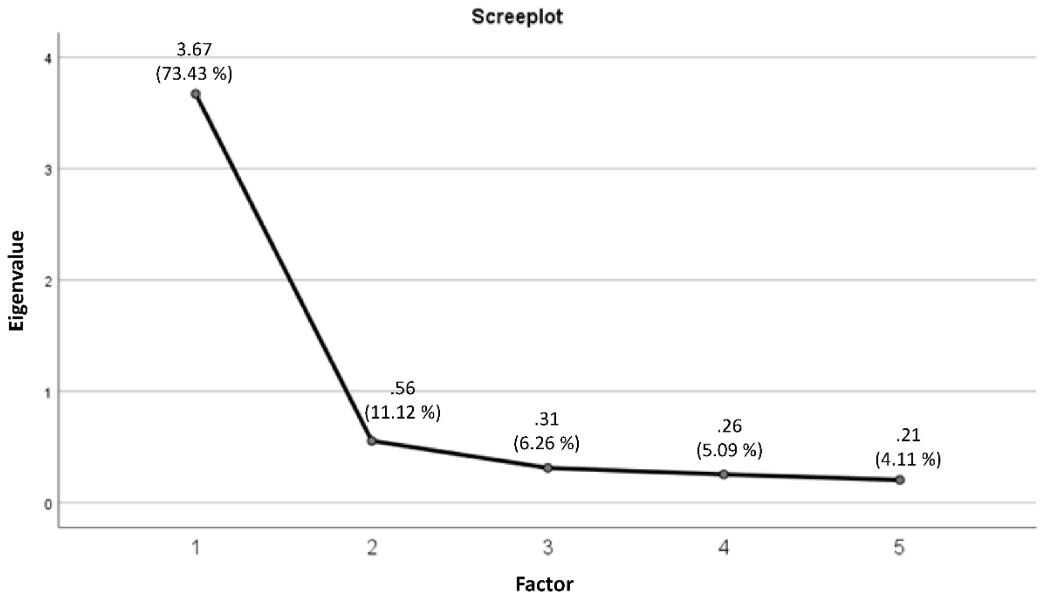

Figure 2. Screeplot of the explorative factor analysis of the split times of the MobiScreen 4-6 items

One component with an eigenvalue of 3.67 can already explain about 73 % of the variance. With a second component, this share increases to almost 85%. The eigenvalues of the remaining components are all below the limit of 1. Table 4 shows the component matrix of the factor loadings of the individual item split times in a one-factor model.

Table 4. Component matrix of the main component analysis: factor loadings of the item split times of the MobiScreen 4-6 with a one-factor model

	Component 1
Slalom	.78
Climbing	.85
Crawling	.88
Maneuvering	.86
Transporting	.91

The factor loadings of the item split times range from .78 to .91.

Construct validity based on item scores

The Kaiser-Meyer-Olkin KMO measure of sample adequacy is .46, and Bartlett's test for sphericity is not significant with a chi-square of 16.23 at 10 degrees of freedom. Thus, the sample of point values is not suitable for main component analysis.

Differentiability

Table 5 provides an overview of the discriminant analysis designed to differentiate between healthy children and children with a medical diagnosis.

Table 5. Overview of the discriminant analysis to differentiate between healthy children (Healthy) and children with a medical diagnosis (Diagnosis) based on the split times and scores of all items and total time and score (n=sample size)

	Healthy (n=50)	Diagnosis (n=13)	Wilks Lambda	Chi-Quadrat	p
Time Slalom	4.72 ± .50	5.20 ± 1.72	.95	2.93	.087
Time Climbing	1.51 ± .41	2.58 ± 1.62	.77	15.81	.000
Time Crawling	3.51 ± 1.07	5.49 ± 3.26	.82	12.10	.001
Time Maneuvering	5.04 ± 1.55	8.73 ± 5.58	.78	15.20	.000
Time Transporting	3.33 ± 1.11	5.53 ± 6.85	.93	4.68	.031
Total time	19.83 ± 3.33	29.01 ± 18.11	.84	10.75	.001
Points Slalom	4.52 ± 1.11	3.23 ± 1.74	.84	9.87	.002
Points Climbing	5.00 ± .00	5.00 ± .00	-	-	-
Points Crawling	4.90 ± .46	5.00 ± .00	.99	.59	.442
Points Maneuvering	4.76 ± .82	4.08 ± 1.44	.92	4.82	.028
Points Transporting	4.92 ± .44	4.69 ± 1.11	.98	1.31	.253
Total score	24.10 ± 1.51	22.00 ± 2.86	.82	11.84	.001

With the exception of the time for the slalom and the scores for climbing, crawling, and transporting, there are significant differences between the two groups throughout, with the healthy children taking less time to complete the tasks or the entire course and scoring more points, with the exception of the climbing and crawling tasks.

Discussion

Aim of this study was to evaluate objectivity (interrater reliability), reliability (internal consistency) and validity (construct validity, differentiation ability) aspects of the MobiScreen 4-6 version for a new age group, for primary school children.

Descriptive data show a normal distribution in nearly all variables excepting the scores for the tasks Climbing, Crawling and Transporting. Here, nearly all children reach the highest possible scores so that a ceiling effect could be assumed in these tasks. In the internal consistency analysis, a value of α=.83 was achieved for the split times, and α=.16 for the point values. A value of > .70 is considered acceptable (George, & Mallery, 2002). This was only reached for the split times. The fact that this was not reached for the point values could be due to the scaling of the points. This should be checked in further studies.

The correlation coefficients lie in a highly significant range between r=.42 and r=.73 for the item split times, indicating that there is a very high correlation between the individual test items here and that the internal consistency of the MobiScreen 4-6 for 7- and 8-year-olds is ensured. For the scores, the values range from r=-.12 to r=.28, indicating that there is little to no correlation among the items here. Again, this may be due to the scaling of the scores, so this also needs to be verified in further studies.

The explorative factor analysis of the split times shows a variance explanation of 73 % for one component with an eigenvalue of 3.67, all other components have a value of significantly less than 1. The factor loadings are between .78 and .91. Thus, the assumed one-factor model, namely that of mobility in the sense of the ICF-CY, can be confirmed via this. Nevertheless, an additional confirmatory factor analysis is to be carried out with a larger sample in order to be able to make even more precise statements.

No main component analysis could be performed for the scores, since the KMO was not significant and the sample was thus not suitable for this purpose. This may also be due to the scaling. This should also be investigated further.

The discriminant analysis clearly shows that with only a few exceptions, all items, total time and score can differentiate between healthy children and children with a medical diagnosis. The items climbing, crawling, and transporting were most likely too easy, as almost all children could master these tasks here. These tasks should be modified to increase the task difficulty. For example, the obstacle for the climbing task, a wooden three-part high gymnastics box, should be raised by one part and the 50 cm high obstacle for crawling, a gymnastic bar laying on 2 pylons or a skipping rope stretched at this height, could be lowered. Transporting could be modified so that instead of one medicine ball, two medicine balls have to be carried simultaneous. This could be tested in further studies.

Since the primary criterion of conspicuousness is the time of the complete run, the results for the item values can be neglected for the time being. Nevertheless, further validation studies must follow here.

The sample size is described as large from 100 persons (Brunner & Thieß, 1970), which was narrowly missed with 90. Therefore, further studies with a larger sample must follow.

Summary and prospects

The present work was intended to test initial validation aspects of the MobiScreen 4-6 for 7- and 8-year-old children. The internal consistency could be confirmed on the basis of the split times of the test items as well as the assumed one-factor model of mobility. Also, the procedure shows a good ability to differentiate between healthy children and children with a medical diagnosis. The results of the scores of the tasks leave much to be desired. Therefore, further validation studies need to follow with a larger sample, modified test items, and a modified scoring scale. These studies are already being conducted.

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