

## Motor Screenings for Primary School Children-A Review

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### Abstract

**Importance:** Motor deficits must be detected as early as possible to avoid negative consequences for the affected child. Within the framework of a sequential diagnostic strategy, screening should be used first in order to keep the testing effort for all children as low as possible.

**Objective:** The present study investigates the question of whether such motor screening procedures exist for primary school children and meet all necessary psychometric properties.

**Evidence review:** The literature search was conducted by January and February 2023. The electronic sources Dialnet, ERIC, PSYINDEX, PubMed, and SpoLit were systematically searched (publications in English, German, French and Spanish).

**Results:** A total of 1092 publications were found based on the selected keywords. After removing duplicates and screening the articles for eligibility, 433 publications were included in further analysis. In this process, 11 putative screenings were found. However, only one of them meets all the required psychometric properties in a high degree. Conclusions: Actually, only MobiScreen 6-8 fulfills all criteria and can be recommended for the first step in a sequential diagnostic strategy. An appropriate screening for children between eight and ten years is lacking.

**Keywords:** Motor development; Diagnostics; Screening; Primary school children; Psychometric.

### Introduction

In review, Scheuer, et al., [1] state that there are several motor tests for children of primary school age in the German- and English-speaking countries. 18 test procedures for children between four and 12 years are analyzed. These are largely based on the constructs of motor skills (29.9%), motor abilities (32.6%), or a mixture of both

constructs (38.2%). Basic motor competencies are only very weakly represented (4.9%). Other relevant constructs, such as mobility in the sense of the International Classification of Functioning, Health and Disability for Children and Adolescents ICF-CY of the World Health Organization WHO [2] as

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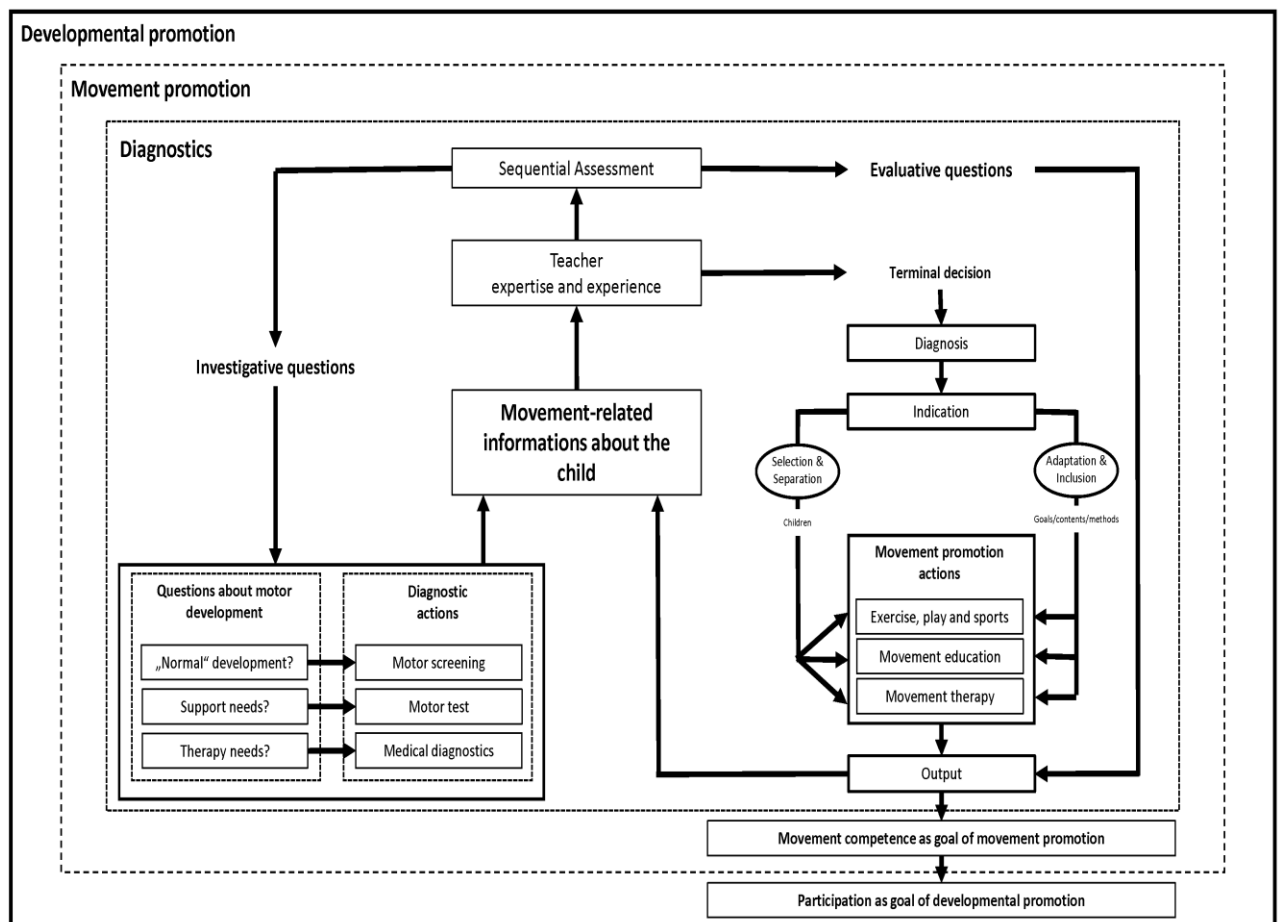
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well as screenings are not addressed here. Diagnostics in a general sense is the study of the scientific recording of personality traits and behavioral aspects as well as a snapshot of individual abilities and characteristics. This is done by various methods, such as behavioral observation, interview, experiment, or test [3]. A screening is intended to determine whether serious (motor) deficits are present or not [4]. It has a kind of filter function in the diagnostic process and serves as a quick orientation about a (developmental) abnormality [5,6]. It does not allow a specific diagnosis but

classifies into "normal" and "conspicuous"/ "impaired" [7]. Following a sequential diagnostic strategy, a screening should be used first in the context of developmental and movement promotion. This will reduce the number of children who need to undergo an extensive testing procedure [8], as this only concerns the children with a conspicuous result [9]. Based on the information gathered during testing, a diagnosis can be made, and the child can then be referred for appropriate support. The following Figure 1 illustrates this process.



**Figure 1:** Assessments in the frame of Developmental and Movement Promotion, Adapted from [10].

Screenings, like all other test procedures, are subject to various quality criteria. These include objectivity, reliability, and validity. Testing and compliance with these criteria is considered indispensable [11].

Furthermore, test economy is an important point when the procedure requires little time, material, space, and personnel [12]. This important criterion should make it easier for teachers in primary schools to be

able to conduct a screening integrated into the daily school routine without extensive training [13]. Stangler, et al., [14] also describe that for the user, the handling of a screening procedure should be easy and quick to learn. It should be quick to perform and cost little money (materials and personnel). Here, a time span of maximum 15 to 30 minutes is specified for the implementation, and the costs in relation to the benefits must be reasonable. In addition to these quality criteria, diagnostic validity is an important criterion of screenings [15]. Sensitivity, specificity, among others, best describe the ability of a test to classify someone as "abnormal" or "normal" [16,17]. In the field of developmental diagnostics, high sensitivity is required to detect even mild abnormalities during screening [7]. A test with high specificity is more likely to be used to confirm a diagnosis. If sensitivity decreases, specificity increases. To achieve an optimal balance between sensitivity and specificity, a cutoff value can be determined via a Receiver Operating Characteristic (ROC) analysis [18]. The AUC (Area Under the ROC-Curve) describes the area under the ROC curve and provides a sensitivity index independent of the cutoff value [19].

Even though the term "motor function tests" is usually used, the individual procedures are based on different constructs of motor function. Because of the importance of screenings, it should be analyzed if there are motor screenings available for children between six and ten years.

## Methods

The review followed the PRISMA checklist and was conducted in January and February 2023. Steps not relevant to this review were excluded [20]. The review was conducted in

three steps: Inclusion or exclusion of articles, review of relevance and selection of articles designated as motor screening, and search for additional sources using the literature lists of included articles and using online searches.

## Search strategy

The literature search was conducted for articles validating or investigating motor screening for children aged six to ten years and published in English, Spanish, French, or German by January and February 2023. For this purpose, the electronic data bases Dialnet, ERIC, PSYINDEX, PubMed, and SpoLit were systematically searched. The following keywords were generated and combined for this purpose:

(a) Grundschule/primary school/école élémentaire/escuela primaria or Primarerziehung/primary education/éducation élémentaire/educación primaria or Kinder/children/enfants/niños (b) screening and (c) motorische Fähigkeiten/motor abilities/capacités motrices/habilidades motrices or motorische Fertigkeiten/motor skills or motorische Kompetenz/motor competence/competence motrice/competencia motriz or motorische Qualifikation/motor qualification/qualification du moteur/calificación del motor or Mobilität/mobility/mobilité/movilidad.

## Screening and selection criteria

The article search and removal of duplicates was independently performed by both authors according to the following inclusion criteria: (a) age group six to ten years, (b) screening based on motor abilities/skills/competencies/qualifications or mobility, (c) publication in English,

French, German, or Spanish, and (d) publication date up to February 1<sup>st</sup>, 2023. Reviews and validation studies were included. The included articles were independently screened for eligibility by both authors. The literature lists of the articles were searched for further references that could provide relevant information on the test.

### Data extraction

Descriptive and psychometric properties of the procedures were extracted from the selected articles and related publications for qualitative synthesis by both authors. The presentation of the characteristics of the test procedures includes name(s) of author(s), year of publication (test version, if applicable), age of target group, number of test items and underlying construct, as well as information on common test quality criteria relevant for screenings (objectivity, reliability, validity, diagnostic validity, and economy).

### Quality of psychometric properties

In accordance with the Standards for Psychometric Characteristics of Test

Procedures by AERA, et al., [21], it is determined which test quality criteria have been tested in the various test procedures and how they are to be classified in terms of their quality. Here, objectivity, internal consistency, test-retest reliability, content validity, construct validity, criterion validity, and additionally diagnostic validity (sensitivity, specificity, AUC) are considered. Quality of psychometric properties was independently checked by both authors.

### Evaluation of the psychometric properties

Objectivity is classified into excellent (.99-.95), very good (.94-.90), medium (.89-.80), moderate (.79-.70) and low ( $\leq$  .69) [22], reliability into excellent ( $>$ .90), very good (.89-.80), medium (.79-.70), moderate (.69-.60) and low ( $\leq$  .59) [11,23], validity into excellent ( $\geq$  .60), medium (.59-.40) and low ( $\leq$  .39) [24,25], sensitivity excellent ( $>$ .80) [26], and Area Under the Curve AUC into excellent ( $>$ .90), medium (.89-.80) and low ( $\leq$  .79) [27]. The following Table 1 provides an overview of the evaluation of the economy, adapted from Bös, et al., [28].

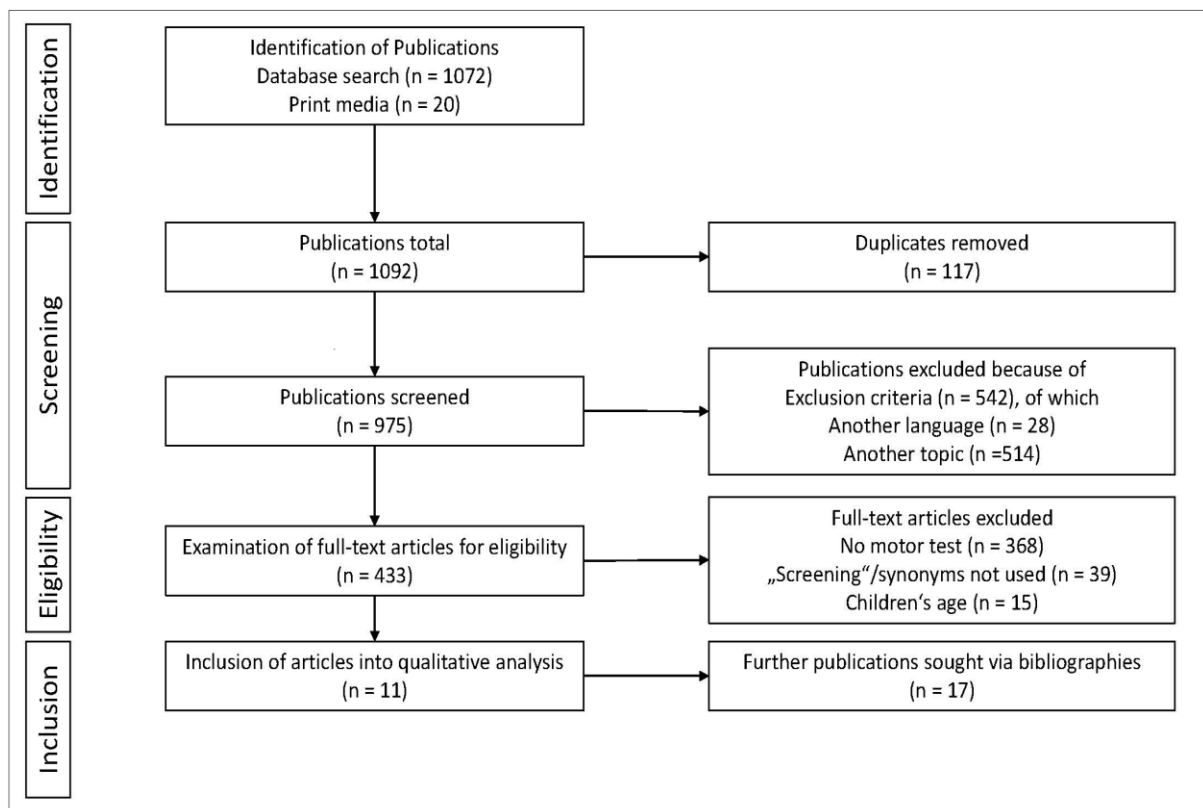
	Organization	Room	Execution time	Personal	Material
0	Strict individual test	Special test room	20 subjects >90 min (>9 min/subject)	>2 Testers	Complex equipment
1	Partial station work	Gymnasium/athletic field	20 subjects in 90 min (9 min/subject)	2 Testers	Simple additional equipment
2	Station work, partial individual test	Gymnasium	20 subjects in 90 min (4.5 min/subject)	1 Tester	Basic equipment gymnasium
3	Circuit, station work, group test	Random room	20 subjects in 45 min (2.25 min/ subjects)	1 Tester	Everyday materials

**Table 1:** Evaluation of the Test Economy, adapted from Bös, et al., [28].

Based on the table 1, a test procedure can receive a maximum of 12 points for its economy. In order to be able to form an overall judgment of the various test procedures, following the designations in Table 2, a result of 12-11 points is considered excellent, a result between 10 and 8 is considered very good, 7-5 corresponds to medium, 4-2 moderate and 1-0 low.

## Results

From 1092 publications found, 117 duplicates were removed. From these 975 screened, 542 were excluded because of exclusion criteria. 433 were examined for eligibility, where 100 of them are described as screenings. The following figure 2 gives an overview of the process of the analysis.



**Figure 2:** Prisma Flow-Diagram of the Study Process.

## Characteristics

The following Table 2 shows which test procedures were found during the research that are referred to as screening in the sources. In addition to the names in short form, the author(s), year, target group, number of items and underlying construct of the procedure are listed, as well as additional sources found that document a validation of the respective procedure and corresponding psychometric properties.

Data on objectivity/interrater reliability, internal consistency, test-retest reliability, criterion and construct validity are respectively found in three tests.

Information on diagnostic quality (sensitivity and specificity or AUC) can be found for three tests, and a cutoff value is given for one. Two tests reach more than ten points for economy. Only one tests fulfills all criteria required for screening.

Test [Source] (Age group)	Items	Construct	VS	Psychometric properties
Bruininks-Oseretzki-Test BOT-2-BF [29] (4-14)	5	Gross motor	2 [30,31]	Reliability: .90-.97 (Retest); Validity: Rasch analysis; Sensitivity: .84, Specificity: .43; AUC: .48; Economy: 5-6 (Orga: 0, Room: 3, Time/pers.: 0, Material: 2-3)
Checkliste Motorischer Verhaltensweisen CMV [32] (6-11)	78	Motor behavior	0	Reliability: .13-.92 (Retest); Validity: EFA (Construct), .30-.40 (Criterion); Economy: 5-6 (Orga: 0, Room: 2-3, Time/pers.: 0, Material: 3)
Diagnostisches Inventar taktil-kinästhetischer Alltagshandlungen DITKA [33] (5-10)	6	Tactile-kinesthetic actions of daily living	0	Economy: 11 (Orga: 3, Room: 3, Time/pers.: 2, Material: 3)
Diagnostik Motorischer Basiskompetenzen Screening DMB [34] (7-11)	6	Basic motor competencies	0	Reliability: .81 (Int. Cons.); Economy: 9 (Orga: 3, Room: 3, Time/pers.: 2, Material: 1)
Grobraster [35,36] (6-10)	12	Motor abilities	0	Economy: 5-7 (Orga: 1, Room: 3, Time/pers.: 0-1, Material: 1-2)
Kasten-Bumerang-Test [37] (>7)	1	Coordination	0	Economy: 8 (Orga: 0, Room: 3, Time/pers.: 3, Material: 2)
Movement Assessment Battery for Children M-ABC-2 [38] (3-16)	22	Motor skills	8 [39-46]	Reliability: .79 (Interrater), .62-.67 (Int. Cons.), .80 (Retest); Validity: CFA (Construct), .40-.49 (Criterion); Economy: 2-3 (Orga: 0, Room: 2-3, Time/pers.: 0, Material: 0)
Mobility Opportunities Via Education M.O.V.E. [47] (>7)	16-74	Mobility	0	Economy: 5-6 (Orga: 0, Room: 3, Time/pers.: 0, Material: 2-3)
MobiScreen 6-8 [48] (6-8)	6	Mobility	3 [48-50]	Reliability: .86-1.00 (Interrater), .89 (Int. Cons.); Validity: significant (discriminant analysis), .33-.67 (criterion); Sensitivity: 1.00, Specificity: .80, AUC: .93, Cutoff: 31 s; Economy: 12 (Orga: 3, Room: 3, Time/Pers.: 3, Material: 3)
Piratenland [51] (7-11)	24	Motor/perception	0	Objectivity: Stand. Instruct.; Economy: 6-7 (Orga: 3, Room: 2-3, Time/pers.: 0, Material: 1)
Test of Gross Motor Development Screening TGMD-3-SF [52] (3-10)	7	Motor skills	2 [52,53]	Reliability: .86-.99 (interrater), .78-.87 (retest), Validity: CFA model confirmed (construct), .89-.90 (concurrent); Economy: 9 (Orga: 3, Room: 2, Time/Pers.: 2, Material: 2)

**Table 2:** Overview of the assessments found in the search, including test name, author(s), publication year, age group, number of items, motor construct, number of validation studies and psychometric properties (age group=age in years, VS=number of validation studies).

## Discussion and conclusion

In the present study it was investigated whether or which motor screenings are available for children of primary school age. Despite searching in four different languages (English, French, German, Spanish), only 11 procedures were found that are described as screenings. In the case of screening batteries that are intended to capture the whole developmental stage of the child, only the test part that pertains to motor development was singled out for analysis.

### Use of the term "screening"

Reichenbach [54] refers to the "Abenteuer im Piratenland" procedure as a screening, but this term does not appear in the test manual. The situation is similar with the "Checklist Motorischer Verhaltensweisen CMV": Reichenbach [54] also speaks here of a screening, the author only of a rough orientation [32], which is, however, at least a characteristic of a screening [6]. The "Grobraster" [35,36] also refers to this coarse selection already in its naming, following Tröster [6]. In the DITKA, the authors speak of the six core tasks being able to provide a rough overview in the sense of a screening test [33], likewise in the DMB Screening [34] which corresponds to the criterion of classification according to Esser and Petermann [7]. The M.O.V.E. is also stated to be a placement test [47], which also corresponds to the criterion of classification [7].

### Review of the psychometric properties

Economy: Looking at the number of items, about half of the procedures have a low number, which would indicate a low time expenditure. If one looks in this context at the implementation time of the various

procedures, it is noticeable that a great deal of time is often taken up, as is the organization, often in small groups or individual situations. This contradicts the specifications of Lienert and Raatz [12] that screening should be quick and easy to perform with little effort. Many methods show very good to excellent values for space requirements and equipment selection, which is also of great importance for the users [12].

### Main psychometric properties

It is noticeable that for five procedures no information is available on the main psychometric properties, which is an indispensable prerequisite also for screenings [11]. Only M-ABC-2, MobiScreen 6-8 and TGMD-3-SF provide information about those criteria, where MobiScreen 6-8 and TGMD-3-SF show better values than M-ABC-2.

### Diagnostic validity

The diagnostic validity required by Marx and Lenhard [15], by which children are to be classified into "normal" and "conspicuous", is missing in almost all procedures. Only BOT-2-BF and MobiScreen 6-8 were tested for their diagnostic validity and provide information on sensitivity and specificity or on the AUC. Only MobiScreen 6-8 and provides information on the determination of a cutoff value. MobiScreen 6-8 provides information on the AUC and on a cutoff value based on the 16<sup>th</sup> percentile of the reference test used. Only those methods for which information on the diagnostic quality can be found in addition to the main quality criteria should continue to be referred to as screening. It is possible that the validation of the TGMD-3-SF has not yet been completed, so that further information on

this may follow in the coming months in order to assess this screening in a meaningful way. In summary, only MobiScreen 6-8 provides information on all quality criteria required for screenings, all in

a good excellent range and can be recommended for the first step of the sequential diagnostic strategy. An appropriate screening tool for children from eight to ten years is lacking.

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