Research in Developmental Disabilities 35 (2014) 1528–1533

Contents lists available at ScienceDirect

Research in Developmental Disabilities

# The Democritos Movement Screening Tool for preschool children (DEMOST-PRE©): Development and factorial validity

Antonis Kambas [a,*], Fotini Venetsanou [b]

[a] School of Physical Education and Sport Science, Democritus University of Thrace, Greece
[b] Faculty of Physical Education and Sport Science, National Kapodestrian University of Athens, Greece

ARTICLE INFO

*Article history:*
Received 5 January 2014
Received in revised form 22 March 2014
Accepted 25 March 2014
Available online 22 April 2014

*Keywords:*
Preschool
Test Construction
Motor screening

ABSTRACT

The aim of this study was (a) to develop an assessment tool (the Democritos Movement Screening Tool for Preschool Children – DEMOST-PRE), designed to provide preschool educators, clinicians and researchers with information about assessment and screening of the motor proficiency of children aged 4–6 years, as well as the development and control of movement programmes and (b) to assess its factorial validity. First, tool's content and face validity were established and its final structure was determined. Then, the DEMOST-PRE was administered to 435 children (197 girls) aged 48–71 months ($M = 60.48$ months, $SD = 6.98$). The factor analysis conducted revealed two distinct components. Present evidence combined with the DEMOST-PRE administrative traits make it promising for preschool aged children's assessment.



## 1. Introduction

Some children display exceptional difficulties with tasks requiring motor co-ordination. These children are not generally delayed, they have no classical neurological signs and their difficulties cannot be linked to an identifiable neurological disease (Losse, Henderson, Eiman, Knight, & Engmans, 1991). The term used for the description of this condition is Developmental Coordination Disorder (DCD) (American Psychiatric Association – APA, 2000). The Diagnostic and Statistical Manual of Mental Disorders – IV of the APA (2000) defines that DCD is not associated with a broader medical diagnosis, is characterized by a noticeably poor performance of motor skills and negatively influences everyday activities. Children suffering from DCD constitute the 5–10% of school-aged population (Geuze, Jongmans, Schoemaker, & Smits-Engelsman, 2001) and it seems that the majority never grow out of this impairment which seems to persist into adulthood (Barnhart, Davenport, Epps, & Nordquist, 2003; Kirby, Sugden, Beveridge, & Edwards, 2008).

Researchers are increasingly interested in understanding the nature of poor coordination and in accurately identifying the condition. The significance of that research field aside, several studies have reported that motor problems are associated with several negative consequences in children's lives. First of all, due to the fact that motor competence is among the most important factors influencing children's participation in physical activity (PA) (Cliff, Okely, Smith & McKeen, 2009; Fisher, Reilly, Kelly, Montgomery, Williamson, & Paton, 2005; Graf et al., 2004; Kambas et al., 2012; Williams et al., 2008; Wrotniack, Epstein, Dorn, Jones, & Kondilis, 2006), children with DCD are inevitably drawn into a

* Corresponding author at: School of Physical Education and Sport Science, Democritus University of Thrace, University Campus, 69100 Komotini, Greece. Tel.: +30 2531039643; fax: +30 2531039623.
*E-mail addresses:* akampas@phyed.duth.gr, antoniskambas@gmail.com (A. Kambas), fvenetsanou@phed.uoa.gr (F. Venetsanou).

http://dx.doi.org/10.1016/j.ridd.2014.03.046
0891-4222/

negative cycle of avoiding PA (Cairney, Hay, Faught, & Hawes, 2005). In their recent review, Rivilis et al. (2011) state that "children's body composition, cardiorespiratory fitness, muscle strength and endurance, anaerobic capacity, power, and physical activity have all been negatively associated, to various degrees, with poor motor proficiency" (p. 907). In that way, children facing DCD are at risk of poor cardiovascular health (Faught, Hay, Cairney, & Flouris, 2005).

Moreover, DCD has also negative social and emotional impacts. Although a strong relationship between motor proficiency and social-emotional variables in preschool children has not been found (Piek, Bradbury, Elsley, & Tate, 2008), it has been well documented in those of school age (Cummins, Piek, & Dyck, 2005; Schoemaker & Kalverboer, 1994).

Taking into consideration the negative effects of DCD, the early identification of young children suspected of having DCD, followed by proper intervention, is very important, with a view to improving those children's physical, emotional and social health In order to do so, accurate screening tools are needed. Regarding preschool age, among the most utilized are the Bruininks–Oseretsky Test of Motor Proficiency (BOTMP) (Bruininks, 1978; Bruininks & Bruininks, 2005), the Movement Assessment Battery for Children (M-ABC) (Henderson & Sugden, 1992; Henderson, Sugden, & Barnett, 2007) and the "Motorik Test fuer 4–6 jaehrige Kinder" (Motor Proficiency Test for Children between 4 and 6 years of age, MOT 4–6) (Zimmer & Volkamer, 1987). Those batteries have been used in numerous studies; nevertheless they are costly (BOTMP, M-ABC) or time consuming (MOT 4–6, BOTMP). This latter feature may cause problems in the assessment of preschoolers, since children at this age are not able to concentrate for more than 10–15 min (Baake, 2004). Additionally, all of those batteries create a rigid evaluation environment which is not recommended for preschoolers (Eggert, 2000), who need more flexible methods of evaluation (Cardenas, 2004; Schönrade & Pütz, 2001).

A motor screening test is needed, which is particularly designed for preschool children, ecologically valid and sensitive to the child's level of comfort, time- and cost-effective and one that could be easily administered and scored by educational staff in preschool settings. Thus, the purpose of the present study was to develop a new motor screening tool for 4 to 6-year-old children and to assess its factorial validity. The "Democritos Movement Screening Tool for preschool children" (DEMOST-PRE©) (Kambas, Venetsanou & Gavriilidou, in press) aims at providing preschool educators, clinicians and researchers with information regarding the screening of the motor proficiency of children aged 4–6 years.

The DEMOST-PRE© requires little time to administer (total administration is less than 15 min) a feature which is very valuable in the educational daily life. Moreover, it is cost effective as its administration can be conducted with apparatus common to the preschool setting and requires very few specialized materials. However, the unique feature of the DEMOST-PRE© is that each of the tasks included is presented through a fairytale. This feature significantly contributes to the avoidance of creating rigorous measurement environment and also motivates children's participation. Furthermore, it was hoped that such a tool, appropriate for preschool children and easily administered by any preschool professional in any preschool setting, would contribute to the efforts of establishing motor screening as a part of the preschool educational system.

## 2. Materials and methods

### 2.1. Test development

The development of the Democritus Motor Screening Tool for Preschool Children (DEMOST-PRE©) was initiated with the selection of the test items. This process was based on two resources: (1) research findings on motor development and (2) previously designed motor assessment tools for preschool children [i.e. the BOT (Bruininks, 1978), the M-ABC (Henderson & Sugden, 1992) and the MOT (Zimmer & Volkamer, 1987)]. The criteria for item selection were the following: (a) to be appropriate for preschool age, (b) to be representative of the main areas of motor development, (c) to be gender- and culture-free, (d) to require simple and cheap equipment that is familiar to children and (e) to be objectively measured.

These sources provided 20 items for selection, representing the main areas of motor development: speed of movement; agility and orientation in space/time; dynamic and static balance; flexibility; body coordination; rhythmic ability; upper limb coordination; visual motor coordination; response ability; aiming and anticipation.

#### 2.1.1. Content validity

Content validity is "the degree to which elements of an assessment instrument are relevant to and representative of the targeted construct for a particular assessment purpose" (Haynes, Richard, & Kubany, 1995, p. 239) and it must be taken into account in the construction phase of any test (Groth-Marnat, 2003).

To examine the content validity of the DEMOST-PRE© the Lawshe's (1975) method was adopted. Lawshe (1975) recommends three criteria for the evaluation of the assessment instruments items, scored on a 3-point scale: "not necessary" (0 points), "useful but not essential" (1 point), "essential" (2 points). In the current study, an item could be graded with two points when it was considered "essential" for screening purposes in children aged 4–6 years.

As not only the robustness of the rating is improved by increasing the number of experts but also the exclusion of rater outliers is facilitated (Haynes et al., 1995), a panel of eight experts was used. All of the experts had obtained a PhD, five were members of a University Staff, two were physical educators and one was a paediatrician. The average period of their experience on motor assessment was 19.3 years. Only items with above 80% agreement among the experts as being "essential" were maintained. During this phase, twelve items were selected, since the remaining eight ones received low agreement.

*2.1.2. Face validity*

Face validity "concerns the extent to which a test or measure appears to measure what it purports to measure" (Sim & Arnell, 1993, p. 104) and it is based on the opinions of those administering a test (Rothstein, 1985). Although some researchers discourage the use of the term "face validity" (Cook & Beckman, 2006) and others state that it is the weakest form of validity (Trochim, 2001), this type of validity can provide information about the characteristics of the assessment instrument that are completely omitted in the more technical psychometric properties. For example, how much fun a test is for children (an aspect considered in a face validity procedure) is of high importance as it facilitates the encouragement of children's cooperation and best performance (Campbell, 1993).

The face validity of the DEMOST-PRE© was assessed by a panel of 15 potential test users. Among them, there were five physical educators, ten preschool teachers, two doctors and three physical therapists. Their average experience with preschool children was 15.6 years. The aforementioned raters reported that the instructions for the administration of most of the items were clear, the evaluation form easy to complete and they stated that the test can provide a brief picture of preschoolers' motor development status. Only three items presented them with difficulty in assessing children's performance. Two of those items were deleted and one was modified, resulting in a final item count of nine.

The feature of the test that they found very attractive was the short stories with which each item is presented, as they can make the measurement seem more like a game rather than a strict evaluation process.

*2.1.3. Final structure of the DEMOST-PRE©*

The previously mentioned validity process concluded in that the final items of the test battery should be the following: Tapping; Jumping repeatedly sideways; Running; carrying and placing a ball in a box; Toe-to-heel walking in a backward direction; Overhead toss to a specific target; Picking up coins and placing them in a box; Stepping though three vertical hoops; Catching a bean bag; Standing jump over a stick. A more detailed description, specifying the necessary equipment, can be available on request.

Each of the tasks is presented in the form of a fairytale so as to avoid creating a rigid evaluation environment and also to motivate children's participation. Before the administration of the test-items, a hand preference test is conducted.

The scoring system of the test is very simple and common in motor assessment tools. The raw score of each task (e.g. time, number of jumps, etc.) is recorded and after the measurement it is converted to a point – score in such a way that the higher the score, the better the performance. Those nine point scores are then added to yield the battery score (DEMOST-PRE total score).

For converting raw scores (e.g., steps, seconds, etc.) to a common set of values, raw data were transformed to categories as described in the DEMOST Manual (Kambas et al., in press). For this purpose, a visual binning procedure with equal percentiles option was employed. In this procedure different numbers of cut points were selected, depending on the mean and standard deviation of each raw score.

All the above scores can be used to supply information regarding the examinee's motor proficiency, although only the total score should be used for research purposes. The administration of the test takes approximately 15 min.

*2.2. Factorial validity of the DEMOST-PRE©*

*2.2.1. Participants*

Four hundred and thirty-five children (238 boys and 197 girls) aged 48–71 months ($M$ = 60.48 months, SD = 6.98) who had never been referred for any developmental delay, participated in the study. In order to compose a sample representative of the general population in Greece, the method of stratified sampling was used to select the participants from a number of randomly selected public schools (stratification on sex; age; geographical area and ethnicity), according to the latest national census (2001). The aforementioned children were divided into four groups according to their age [48–54 months ($n$ = 92), 54–59 months ($n$ = 92), 60–65 months ($n$ = 125) and 66–71 months ($n$ = 126)]. Participants verbally assented to take part in the study and written informed consent had been obtained from their teachers, parents and legal guardians before children were allowed to participate in the study.

*2.2.2. Procedure*

The data was collected from 2008 to 2009 and all experimental procedures were approved by the Institutional Review Board for investigations involving human subjects. Children were individually assessed on the DEMOST-PRE© in an indoor area, by two skilled examiners.

Prior to data collection, intra-rater and inter-rater reliability had been tested on a small number of children ($n$ = 30) who did not participate in the study. Specifically, to check the inter-rater reliability, one half of the children were assessed by one examiner, while the other observed the measurement process. Both examiners scored each child's performance simultaneously, but without informing each other about their rating. For the tasks requiring stopwatches, two identical, soundless ones were utilized. Furthermore, in order to minimize the comments to the examinee that could influence the observing examiner's rating, guidance for using general phrases, such as "good effort", etc. had been given. When half of the children completed the test, the examiners alternated their roles. To investigate the intrarater reliability, the administration of the DEMOST-PRE© in the aforesaid children was videotaped. One month later, each examiner watched the video with his/her administration of the battery and re-scored examinees' performance.

**Table 1**
Rotated factor loadings of DEMOST-PRE ($N = 435$).

| DEMOST's items | Factor 1 (gross motor control) | Factor 2 (visual-motor control) |
|---|---|---|
| Tapping | .008 | .741 |
| Jumping repeatedly sideways | .729 | .297 |
| Running and carrying and placing a ball in a box | .670 | .306 |
| Toe-to-heel walking in a backward direction | .618 | .350 |
| Overhead toss to a specific target | .159 | .662 |
| Picking up coins and placing them in a box | .308 | .498 |
| Stepping through three vertical hoops | .676 | −.130 |
| Catching a bean bag | .447 | .539 |
| Standing jump over a stick | .782 | .072 |

For both inter-rater and intra-rater reliability, the intraclass correlation coefficient (ICC) was used, according to Shrout and Fleiss' model (1979). The ICC values for the inter-rater reliability were found to be .90 (95% CI), while for the intra-rater reliability of the two examiners were .94 (95% CI) and .95 (95% CI) respectively, revealing excellent reliability (Cicchetti, 1994).

*2.2.3. Statistical analysis*

A principal components exploratory factor analysis (PC) with varimax rotation was performed on the data of all 435 participating children to determine the factor structure underlying the DEMOST-PRE© items.

*2.2.4. Results*

Regarding factor analysis, the PC method with a Kaiser-Meyer-Olkin index of .85 yielded two components (factors) explaining 54.1% of the variance. An examination of both, the scree plot and the eigenvalues (>1) suggested a two factor solution. The first component explained 33.2% of the variance, and consisted of five items (*jumping repeatedly sideways, running and carrying and placing a ball in a box, toe-to-heel walking in backward direction, stepping through 3 vertical hoops, standing jump over a stick*). This component could be labelled as "Gross Motor Control".

The second component explained 20.9% of the variance and encompassed all other items that were implemented in the factor analysis (*tapping, overhead toss to a specific target, picking-up coins and placing them in a box, catching a bean bag*). This component could be named "Visual-Motor Control".

Using the original item-retention cut-off value of ≥.30 we found that items 6, and 8 had secondary loadings on the first component and items 3 and 4 on the second component. The factor structure of the DEMOST-PRE© is presented in Table 1.

## 3. Discussion

The aim of the present study was the development of a motor screening test for children aged 4–6 years, named DEMOST-PRE©, as well as the assessment of its factorial validity. In order for its final structure to be determined, the content and the face validity criteria were examined. For that purpose, in the first phase, a panel of experts evaluated the items proposed by the authors for their substantiality for screening purposes in preschool age, while in the latter one a panel of potential test users evaluated the DEMOST-PRE© administration features. Through this process, nine items were selected to constitute a quick and usable tool that can aid clinicians and educators to validly screen children's motor proficiency (Kambas et al., 2007). The procedures used for the examination of content and face validity criteria offer initial evidence that the items constituting the DEMOST-PRE represent the main areas of motor development and can be objectively measured, providing a brief picture of preschoolers' motor development status.

Concerning the factorial validity of the DEMOST-PRE©, the results revealed two factors explaining the 54.1% of the variance, a finding that is common in relevant studies (Hassan, 2001; Kambas & Aggeloussis, 2006; Kambas, Aggeloussis, Proviadaki, Mavromatis, & Taxildaris, 2004). The first factor explained 33.2% of the variance, and consisted of five items (*jumping repeatedly sideways, running and carrying and placing a ball in a box, toe-to-heel walking in backward direction, stepping through three vertical hoops, standing jump over a stick*). This factor could be labelled as "Gross Motor Control". The second one explained 20.9% of the variance and encompassed all other items that were implemented in the factor analysis (*tapping, overhead toss to a specific target, picking-up coins and placing them in a box, catching a bean bag*). This factor could be named "Visual-Motor Control". From the emergence of these two factors, one might assume that it would be both correct and useful to use the "gross motor control" and "visual-motor control" sub-scores resulting from the sum of the respective individual items scores, apart from the total score. Certainly, such an opportunity could possibly improve and simplify the designing of educational contents aiming at the improvement of specific weaknesses. Besides, this practice is widespread and has been adopted in several assessment tools (Bruininks, 1978; Bruininks & Bruininks, 2005; Henderson & Sugden, 1992; Henderson et al., 2007).

However, if the aforementioned data regarding those two factors are carefully studied, we strongly believe that the use of the sub-scores will not be supported. Starting with the second factor, the skills that support it are clearly visual-motor;

however, some of them are fine motor while some other are not exclusively fine motor. A similar picture appears in the first factor consisting of five skills that are quite different in order to be improved through similar contents.

Besides, it is known that even ostensibly identical skills are supported by different abilities (Drowatzky & Zuccato, 1967), so their improvement requires specific contents. In the case of using the sub-scores for research purposes, the loss of information is expected to be great, especially for a battery with only nine items. Moreover, the constructs reported in the manuals of several assessment batteries (Bruininks, 1978; Bruininks & Bruininks, 2005; Henderson & Sugden, 1992; Henderson et al., 2007) are not always confirmed for all age groups by the research findings (Hassan, 2001; Kambas & Aggeloussis, 2006).

Apart from the aforesaid, the finding of secondary loadings is interesting as it reinforces the opinion according to which, in that age period, there is no clear differentiation in children's performances based on theoretical motor constructs (gross vs. fine motor proficiency, etc.) (Hattie & Edwards, 1987). However, the loading on two such different factors further enhances the opinion which supports the use only of the total score for research purposes and the individual item scores (not the two sub-scores) for educational or therapeutic purposes (Zimmer & Volkamer, 1987).

However, due to the unique characteristics of preschoolers as examinees (inconsistent performance, short concentration, caution with strangers) (Gallahue, 1983) apart from the technical adequacy of an assessment tool, very important criteria for its selection are the ease of its application and its ecological validity (Zittel, 1994). The assessment of a preschool aged child should be a positive experience for both the examinee and the examiner and as a result the assessment tool should contribute to the maximizing of comfort level (Bonder, 1985). The tasks included in the DEMOST-PRE© are easily conducted and scored, while the evaluation form is easily recorded allowing the examiner to move fast from one item to the other, so that the assessment does not present gaps. This fact, in combination with the limited span of time required for the assessment to be completed (approximately 15 min), as well as the presentation of the tasks through short fairytales, significantly contributed to the stimulation of children's interest and secured their cooperation, transforming the examination into a fun experience. Moreover, the fact that the test equipment consists of familiar material and the measurement can be conducted in the familiar environment of kindergarten maximizes the DEMOST-PRE©'s ecological validity and ensures that accurate information about children's motor performance is gathered.

All the above characteristics of the DEMOST-PRE© make it promising for preschool aged children's assessment. However, further research is needed in order for more validity criteria to be checked, the reliability of its scores to be examined, as well as age norms to be computed using data of a larger standardization sample.

## Appendix A

The Democritos Movement Screening Tool for preschool children© (DEMOST-PRE©) (Kambas, Venetsanou, Gavriilidou, in press).

| Nr | DEMOST-PRE© Items | Scoring | Transformation |
|---|---|---|---|
| 1 | Throwing a dice | Hand preference | Non evaluated |
| 2 | Tapping | Nr of dots in 15″ | 0–9 |
| 3 | Jumping repeatedly sideways | Nr of successful jumps | 0–18 |
| 4 | Carrying and placing a ball in a box | Time in sec. | 0–4 |
| 5 | Toe-to-heel walking backwards | Nr of successful steps | 0–22 |
| 6 | Overhead toss to a specific target | Nr of successful tosses | 0–11 |
| 7 | Picking up and placing coins in an area | Time in sec. | 0–4 |
| 8 | Stepping through vertical hoops | Nr of successful trials | 0–2 |
| 9 | Catching a bean-bag | Nr of successful catches | 0–5 |
| 10 | Standing jump over a stick | Nr of successful jumps | 0–4 |
| | Total Motor Score | – | Sum of point scores |

## References


American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders (4th ed., text revision)*. Washington, DC: Author.

Baake, D. (2004). *Die 0-5 jährigen. Einführung in die Probleme der frühen Kindheit*. Weinheim: Beltz.

Barnhart, R. C., Davenport, M. J., Epps, S. B., & Nordquist, V. M. (2003). Developmental coordination disorder. *Physical Therapy, 83*, 722–731.

Bonder, B. (1985). The Foundation–Standardized assessments: Ethical principles for use. *American Journal of Occupational Therapy, 39*, 473–474.

Bruininks, R. (1978). *Bruininks–Oseretsky test of motor proficiency: Examiners manual*. Minessota: American Guidance Service.

Bruininks, R. H., & Bruininks, B. D. (2005). *Bruininks–Oseretsky test of motor proficiency* (2nd ed.). Minneapolis, MN: Pearson Assessment.

Cairney, J., Hay, J. A., Faught, B. E., & Hawes, R. (2005). Developmental coordination disorder and overweight and obesity in children aged 9–14 y. *International Journal of Obesity, 29*, 369–372.

Campbell, S. (1993). Commentary on measurement validity in physical therapy research. *Physical Therapy, 73*, 110–113.

Cardenas, B. (2004). *Diagnostik mit Pfiffigunde – Ein kindgemäßes Verfahren zur Beobachtung von Wahrnehmung und Motorik*. Dortmund: Verlag Modernes Lernen.

Cicchetti, D. (1994). Guidelines, criteria, and rules of thumb for evaluating normed and standardized assessment instruments in psychology. *Psychological Assessment, 6*(4), 284–290.

Cliff, D., Okely, A., Smith, L., & McKeen, L. (2009). Relationships between fundamental movement skills and objectively measured physical activity in preschool children. *Pediatric Exercise Science, 21*, 436–449.

Cook, D., & Beckman, T. (2006). Current concepts in validity and reliability for psychometric instruments: Theory and application. *The American Journal of Medicine, 119* 166.e7–166.e16.

Cummins, A., Piek, J. P., & Dyck, M. J. (2005). Motor coordination, empathy and social behaviour in school-aged children. *Developmental Medicine and Child Neurology, 47*, 437–442.

Drowatzky, J. N., & Zuccato, F. C. (1967). Interrelationships between selected measures of static and dynamic balance. *Research Quarterly, 38*, 509–510.
Eggert, D. (2000). *Diagnostisches Inventar motorischer Basiskompetenzen (Diagnostic inventory of basic motor competencies)*. Dortmund: Borgmann.
Faught, B. E., Hay, A. J., Cairney, J., & Flouris, A. (2005). Increased risk for coronary vascular disease in children with developmental coordination disorder. *Journal of Adolescent Health, 37*, 376–380.
Fisher, A., Reilly, J., Kelly, L., Montgomery, C., Williamson, A., & Paton, J. (2005). Fundamental movement skills and habitual physical activity in young children. *Medicine and Science in Sports and Exercise, 37*, 684–688.
Gallahue, D. (1983). Assessing motor development in young children. *Studies in Educational Evaluation, 8*, 247–252.
Geuze, R., Jongmans, M. J., Schoemaker, M., & Smits-Engelsman, B. (2001). Clinical and research diagnostic criteria for developmental coordination disorder: A review and discussion. *Human Movement Science, 20*, 7–47.
Graf, C., Koch, B., Kretschmann-Kandel, E., Falkowski, G., Christ, H., Coburger, S., & Dordel, S. (2004). Correlation between BMI, leisure habits and motor abilities in childhood (CHILT-project). *International Journal of Obesity and Related Metabolic Disorders, 28*(1), 22–26.
Groth-Marnat, G. (2003). *Handbook of psychological assessment* (4th ed.). New Jersey: John Wiley & Sons Inc.
Hassan, M. M. (2001). Validity and reliability for the Bruininks–Oseretsky Test Of Motor Proficiency-Short Form. *Perceptual and Motor Skills, 92*(1), 157–166.
Hattie, J., & Edwards, H. (1987). A review of the Bruininks–Oseretsky test of motor proficiency. *British Journal of Educational Psychology, 57*, 104–113.
Haynes, S., Richard, D., & Kubany, E. (1995). Content validity in psychological assessment: A functional approach to concepts and methods. *Psychological Assessment, 7*(3), 238–247.
Henderson, S. E., & Sugden, D. A. (1992). *Movement assessment battery for children manual*. London: The Psychological Corporation Ltd.
Henderson, S. E., Sugden, D. A., & Barnett, A. L. (2007). *Movement assessment battery for children-2 second edition [Movement ABC-2]*. London, UK: The Psychological Corporation.
Kambas, A., Aggeloussis, N., Proviadaki, E., Mavromatis, G., & Taxildaris, K. (2004). Elegxos tis esoterikis domis kai esoterikis sinohis tis desmis Bruininks-Oseretsky-Test of Motor Proficiency (olokliromeni morfi) se pedia prosxolikis kai protosxolikis ilikias. (Internal structure and consistency of the Bruininks-Oseretsky-Test of Motor Proficiency-complete form in preschool and primary school children). *Anasitiseis sti Fisiki Agogi (Inquiries in Physical Education and Sport: E-journal, 2*(2), 163–172.
Kambas, A., & Aggeloussis, N. (2006). Construct validity of the Bruininks–Oseretsky Test Of Motor Proficiency-Short Form for a sample of Greek preschool and primary school children. *Perceptual and Motor Skills, 102*, 65–72.
Kambas, A., Michalopoulou, M., Fatouros, I., Christoforidis, C., Manthou, E., Giannakidou, D., Venetsanou, F., Haberer, E., Chatzinikolaou, A., Gourgoulis, V., & Zimmer, R. (2012). The relationship between motor proficiency and pedometer-determined physical activity in young children. *Pediatric Exercise Science, 24*, 34–44.
Kambas, A., Venetsanou, F., & Aggeloussis, N. (2007). Preliminary study of reliability of the Democritos-Psychomotor Assessment Tool for preschool children. *Paper presented at the 11th Annual Congress of the European College of Sport Science* Retrieved from https://ecss2007.cc.jyu.fi/schedule/proceedings/pdf/1276.pdf.
Kambas A., Venetsanou F., & Gavriilidou Z. (In press) Dimokritos Ergaleio Kinitikis Anihnefsis gia Paidia Prosxolikis Ilikias, DEKA-PRO©: Egxeiridio Odigion. (The Democritos Movement Screening Tool for preschool children©, DEMOST-PRE©). Manual.(in Greek).
Kirby, A., Sugden, D., Beveridge, S., & Edwards, L. (2008). Developmental coordination disorder (DCD) in adolescents and adults in further and higher education. *Journal of Research in Special Education Needs, 8*(3), 120–131.
Lawshe, C. H. (1975). A quantitative approach to content validity. *Personne Psychology, 28*(4), 563–575.
Losse, A., Henderson, S. E., Eiman, D., Knight, E., & Engmans, M. (1991). Clumsiness in children: Do they grow out of it? A 10-year follow up study. *Developmental Medicine and Child Neurology, 33*, 55–68.
Piek, J. P., Bradbury, G. S., Elsley, S. C., & Tate, L. (2008). Motor coordination and social–emotional behaviour in preschool-aged children. *International Journal of Disability, Development and Education, 55*(2), 143–151.
Rivilis, I., Hay, J., Cairney, J., Klentrou, P., Liu, J., & Faught, B. E. (2011). Physical activity and fitness in children with developmental coordination disorder: A systematic review. *Research in Developmental Disabilities, 32*(3), 894–910.
Rothstein, J. M. (1985). Measurement and clinical practice: theory and application. In J. M. Rothstein (Ed.), *Measurement in physical therapy*. New York, NY: Churchill Livingstone Inc.
Schoemaker, M. M., & Kalverboer, A. F. (1994). Social and affective problems of children who are clumsy: How early do they begin? *Adapted Physical Activity Quarterly, 11*, 130–140.
Schönrade, S., & Pütz, G. (2001). *Die Abenteuer der kleinen Hexe (The adventure of the young witch)*. Dortmund: Borgmann.
Shrout, P., & Fleiss, J. (1979). Intraclass correlations: Uses in assessing rater reliability. *Psychological Bulletin, 86*(7), 420–428.
Sim, J., & Arnell, P. (1993). Measurement and validity in physical therapy research. *Physical Therapy, 73*, 102–115.
Trochim, W. M. K. (2001). *The research methods knowledge base* (2nd ed.). Cincinnati, OH: Atomic Dog Publishing.
Williams, H. G., Pfeiffer, K. A., O'Neill, J. R., Dowda, M., McIver, K. L., Brown, W. H., & Pate, R. R. (2008). Motor skill performance and physical activity in preschool children? *Obesity, 16*(6), 1421–1426.
Wrotniack, B. H., Epstein, H. E., Dorn, J. M., Jones, K. E., & Kondilis, V. A. (2006). The relationship between motor proficiency and physical activity in children. *Pediatrics, 118*, 1758–1765.
Zimmer, R., & Volkamer, M. (1987). *Motoriktest für vier–bis- sechsjahrige Kinder (Motor proficiency test for children between 4 to 6 years of age). Manual*. Weinheim: Betz.
Zittel, L. (1994). Gross motor assessment of preschool children with special needs: Instrument selection considerations. *Adapted Physical Activity Quarterly, 11*, 245–260.