Evidence Summary for Pediatric Rehabilitation Professionals

Outcome Measures: The Bruininks-Oseretsky Test of Motor Proficiency, Second Edition (BOT-2)

1. Summary

Type: Norm-referenced
Purpose: Discrimination, planning, evaluation
Population: Children at risk for motor impairment
Age: 4 – 21 years
Time to Complete: 40 – 60 minutes for complete form; 15 – 20 minutes for short form
Equipment Needed: BOT-2 kit, stopwatch, table, two chairs, floor space for motor items

2. Overview

The BOT-2\(^1\) (2005) is a revision of the Bruininks-Oseretsky Test of Motor Proficiency\(^2\) (BOTMP) (1978). The primary applications of the BOT-2 are to:

a. Support diagnoses of motor impairments
b. Screen for motor impairment and determine the need for further assessment or intervention
c. Make placement decisions regarding physical education programs
d. Develop and evaluate motor training programs
e. Assist clinicians and researchers

The goals of revising the BOTMP and creating the BOT-2 were to:

a. Improve functional relevance of test content by removing items lacking functional relevance as well as reorganizing and expanding the BOTMP composite structure to include the following motor-areas:
   i. Fine manual control
   ii. Manual coordination
   iii. Body coordination
   iv. Strength and agility

b. Expand coverage of:
   i. Fine motor skills by separating the BOTMP’s visual-motor control subtest into two subtests: fine motor precision and fine motor integration
   ii. Gross motor skills by adding items to the running speed and agility subtest as well as the strength subtest

c. Improve measurement among 4 and 5 year olds by adding and modifying activities
d. Extend norms through age 21
e. Improve item presentation by:
   i. Minimizing scripted item instructions to allow flexibility and individualization of verbal instructions
   ii. Adding an easel with item photographs to provide method of describing items

f. Improve quality of kit equipment

The BOT-2 can be administered in 4 different ways: the complete form, the short form, select composites, or select subtests. The complete form provides the most reliable measure of overall
motor proficiency. The short form can be used to screen motor proficiency and determine the need for further assessment. Individual subtests or composites can and should only be used when the assessor already has knowledge of the examinee’s motor deficits and plans on using test results to develop a therapy program or evaluate change.¹

The BOT-2 is intended to be administered by occupational therapists, physiotherapists, psychologists and other professionals working in developmental adaptive physical education who have completed training regarding testing and measurement.¹

Administration of the BOT-2 involves administering each item of each subscale to all children. No basal or ceiling rules apply.

When scoring items, raw scores are converted to point scores by looking at the conversion chart included next to each item in the record form. When two trials are administered, the raw score from the best trial is used. Subtest total point scores are then calculated by summing the point scores from each individual item. Before completing any further calculations, the examiner must decide whether to compare the child’s score to combined or sex-specific norms. Once this is determined, scale scores can be determined as can composite standard scores and percentile ranks, and finally total motor composite scores. Confidence intervals and standard scores can also be calculated, and age equivalents and descriptive categories can be assigned.

Short form scores are calculated by converting raw scores to point scores and then calculating derived scores including a standard score, confidence interval, percentile rank, and descriptive category.

3. Standardization Sample

The BOT-2 was standardized on a normative sample of 1520 children between the ages of 4 and 21 years living in the United States in 2004 and 2005.¹ Stratification was based on age, gender, socioeconomic background as measured by parental education, ethnic background, geographical area, and educational placement.¹

4. Measurement Properties

a. Reliability

The BOT-2 has established reliability. Split-half reliability for internal consistency shows reliability coefficients for the subscale, composite, total motor composite, and short form scores that range from the high 0.70s to the mid 0.90s.¹

Test-retest reliability of the cognitive, language, and motor scales was assessed by testing 134 children twice by the same assessor over 7 to 42 days.¹ Correlation scores varied depending on the children’s ages. Scores ranged from 0.69 to the low 0.80s for the subscale scores, and from the mid to upper 0.80s for the total motor composite and short form reliability.¹

Inter-rater reliability was examined by having two assessors rate the same child at the same time. Results of 47 children show reliability coefficients ranging from 0.92 to 0.99.¹

Standard error of measurement and confidence intervals were also calculated.¹
b. Validity

The BOT-2 has established content validity. During the development of the BOT-2, items were reviewed by area experts and statistical analyses were conducted. Only items that were considered functionally relevant and had a moderate to strong relationship with their subtest were included in the BOT-2. Item fit for the new BOT-2 was also examined and results of statistical analyses were used to modify the BOT-2 until a good fit was found. The fact that the results of the BOT-2 are able to show gains in motor proficiency with age as well as expected sex differences in motor subtests also support the content validity of the BOT-2. Internal structure of the BOT-2 was also analysed and strong support is given for the four-motor areas included in the revised version.

Evidence of the BOT-2’s ability to support clinical diagnoses was examined by comparing scores for typically developing children and three clinical groups: developmental coordination disorder (DCD); mild to moderate mental retardation (MR); and high functioning autism/Asperger’s disorder. For children with DCD, BOT-2 scores were, on average, 5 to 7 points or 1.5 standard deviations below the norm. For children with mild to moderate MR, average BOT-2 scores were, on average, 20 points or 2 standard deviations below the norm. For children with high functioning autism/Asperger’s disorder, BOT-2 scores were 12.5 to 17 points below the norm. All clinical group results are consistent with current research regarding motor impairments in children within these three diagnostic groups.

Convergent validity of the BOT-2 was examined by examining relationships between this test and other measures of motor performance. The relationship between the BOTMP and BOT-2 was examined. Overall total motor composite and battery composite correlation is of 0.80. Correlations between similar fine and gross motor composites show correlations between -0.59 and 0.73, with the exception of the manual coordination composite which does not have an equivalent on the BOTMP and correlates best with the gross motor composite at 0.60. Correlations between subtests range between 0.45 and 0.73. These correlations reflect modifications and additions made in the creation of the BOT-2 and support the validity of the revised version.

The relationship of the the BOT-2 and the Peabody Developmental Motor Scales, Second edition, (PDMS-2) was examined for 4 and 5 year olds. Correlation between the BOT-2 total motor composite and the PDMS-2 total motor quotient is 0.73 with correlations between various composites and subtests ranging from 0.35 to 0.83. Overall, the strength of the relationship between the two tests further confirms the success of the modifications made to improve measurement in 4 and 5 year olds.

Lastly, the relationship between the BOT-2 fine motor subtests and the Test of Visual Motor Skills – Revised (TVMS-R) was examined and results indicate a correlation of 0.74.

5. Further Considerations

Due to the BOT-2 being only recently available, the only literature available regarding its use or psychometric
properties is found in the test’s manual. With time, further information regarding this edition’s strengths and limitations should become available through peer-reviewed publications.

References


This evidence summary is one part of a series on pediatric rehabilitation outcomes measures. Other summaries in this series include:

- Outcome Measures: A Primer
- Outcome Measures: The Alberta Infant Motor Scale (AIMS)
- Outcome Measures: The Bayley Scales of Infant Development, 3rd Ed. (BSID-III)
- Outcome Measures: The Developmental Test of Visual Perception, 2nd Ed. (DVPT-2)
- Outcome Measures: The Gross Motor Function Measures (GMFM)
- Outcome Measures: The Movement Assessment Battery for Children, 2nd Ed. (MABC-2)
- Outcome Measures: The Peabody Developmental Motor Scales, 2nd Ed. (PDMS-2)
- Outcome Measures: The Sensory Profile (SP)