Evidence Summary for Pediatric Rehabilitation Professionals

Outcome Measures: The Gross Motor Function Measure (GMFM)

1. Summary

**Type:** Criterion-referenced

**Purpose:** Evaluation

**Population:** Children with cerebral palsy (CP)

**Age:** 5 months to 16 years with motor skills at or below the level of a typical 5 year old.

**Time to Complete:** 45 – 60 minutes for GMFM-88; less for GMFM-66

**Equipment Needed:** Mat, bench, toys, and access to five stairs

2. Overview

The purpose of the GMFM is to evaluate motor skills in children with cerebral palsy (CP). Two versions of the GMFM exist: the original 88 item GMFM (GMFM-88) and the more recent 66 item GMFM (GMFM-66). The GMFM-88 consists of five dimensions: (A) lying and rolling; (B) crawling and kneeling; (C) sitting; (D) standing, and (E) walking, running, jumping. Items tested on the GMFM are skills that typical children would achieve by the age of 5 years.

The GMFM-66 consists of 66 of the items in the GMFM-88. Improvements to the newer version include:

a. Ordering of items according to difficulty
b. Change in scale properties to an interval scale which allows for better interpretability of total scores and change scores
c. Decrease in administration time
d. Use of a computer scoring system that calculates total score, standard error, and can estimate total score even if some items have not been tested

Limitations of the newer version (GMFM-66) may include:

a. Less items in the lower dimensions which may make the GMFM-66 less descriptive for children functioning at lower levels
b. Need for computer and software to score
c. Need to learn to interpret item maps

The GMFM-66 and GMFM-88 are intended to be administered by pediatric physiotherapists with experience assessing children’s motor skills. It is recommended that the GMFM be first administered in its entirety without orthoses or mobility aids. Afterwards, specific dimensions can be re-assessed to determine the effect of orthoses and/or mobility aids.

For both tests, children are scored on all test items and each item receives a score of 0 to 3 with specific descriptors for each score. A score of 3 indicates a more advanced performance than a score of 0. When scoring, items which are not tested should be marked as such (NT) in contrast to a true score of 0 which is given when a child does not initiate an item. To determine a final score for the GMFM-88, percent scores are calculated for each dimension of the test and averaged to
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obtain a total test percentage score.\textsuperscript{1} Scoring the GMFM-66 involves entering all scores into a computer program, the Gross Motor Ability Estimator (GMAE), which will calculate an interval-level total score as well as standard error and confidence intervals, and allows tracking of scores over time, calculation of change in score between assessments, and plotting of an item map.\textsuperscript{1} Of note, the GMFM-66 can be scored even when some items have not been administered (hence the importance of differentiating between items "not tested" and those with a score of 0); however, the more items actually tested, the more accurate the estimate score.\textsuperscript{1}

3. Standardization Sample

The GMFM-88 was validated on a sample of children 5 months to 16 years of age.\textsuperscript{1} The manual provides scores and change scores for 652 children with CP on the GMFM-88 and the GMFM-66, classified by age and severity.\textsuperscript{1}

4. Measurement Properties

a. Reliability

i. GMFM-88

The GMFM has established reliability. Intra-class correlation (ICC) scores for inter-rater reliability of the GMFM-88 indicate strong correlations of 0.87 to 0.99 when 11 children were scored by a pair of therapists.\textsuperscript{2} Test-retest reliability scores of the GMFM-88 were assessed using intra-class correlation; reliability scores ranged from 0.92 to 0.99 when 10 children were assessed twice within one week.\textsuperscript{2}

ii. GMFM-66

Internal consistency of the GMFM-66 was established using Rasch analysis, which demonstrated the unidimensional nature of the measure.\textsuperscript{1}

Test-retest reliability of the GMFM-66 was assessed by having 19 children with CP assessed twice, one week apart, by the same therapist. Results indicate that the newer GMFM has a high level of stability over time (ICC = 0.99).\textsuperscript{3}

b. Validity

i. GMFM-88

The GMFM-88 has established content and construct-related validity. Content validity, including face validity, was established through feedback received from pediatric therapists on the early versions of the test.\textsuperscript{1} The examination of construct related validity included comparing GMFM-88 scores with the Gross Motor Function Classification System (GMFCS), with results indicating a high level of correlation between the GMFM-88 and the GMFCS scores ($r = -0.91$),\textsuperscript{4} as well as with gait parameters including cadence ($r = 0.79$) and normalized velocity ($r = 0.72$).\textsuperscript{5} More specific comparisons were completed comparing gait velocity with dimension D (standing) ($r = 0.91$) and dimension E (walking, running, jumping) ($r = 0.93$) of the GMFM-88.\textsuperscript{6}

Scores on the GMFM-88 were measured over time and compared to change as judged by parents ($r = 0.54$), treating therapist ($r = 0.65$), and a videotaped evaluation ($r = 0.82$).\textsuperscript{2}
Known-groups analyses indicated that the GMFM was able to determine a large change in children recovering from an acquired brain injury, a moderate change in typical children under the age of 5 years, and a small change in children with CP. As anticipated, there was a larger change score in typical children 3-5 years of age than in typical children under the age of 3 years. The gradient of change in scores fits the results found in the literature regarding change in motor abilities in these subgroups.

Examination of responsiveness of the GMFM-88 was completed by examining GMFM scores over 6 months in children expected to have stable scores (mean change = 1.3) and children expected to change (mean change = 6.2). Scores on the GMFM were not significantly different after 6 months in the stable group yet they did reflect a significant difference in the group of children expected to change.

The GMFM-88 has also been validated for use in children with osteogenesis imperfecta and with Down syndrome. When using the GMFM-88 with children with DS, parent report for items not seen by the assessor should be given credit as these reported scores have been shown to have better reliability, validity, and responsiveness for this population. The GMFM-88 has also been used but not validated with children with developmental delay, acquired brain injury, and acute lymphoblastic leukemia.

ii. GMFM-66

The GMFM-66 has established content and construct-validity.

Face validity of the GMFM-66 was established by examining the hierarchy of items and by comparing GMFM-66 total scores for different groups of children to ensure that they made clinical sense.

Construct validity was established by evaluating GMFM scores for children over 12 months of age. Results showed that, as expected, scores changed in relation to age and severity of motor disability, and that younger children made greater gains that older children.

5. Further Considerations

Bjornson and colleagues repeated the original GMFM-88 reliability measurements and original validity study and confirmed the GMFM-88’s strong inter-rater reliability (0.87 to 0.99), test retest reliability (0.76 to 1.00), and ability to measure change over time. Nordmark and colleagues also evaluated the reliability of the GMFM-88 and suggested that the test had acceptable inter-rater (0.77 to 0.88) and intra-rater reliability (0.68).

Shi and colleagues examined the reliability and validity of the GMFM-66 in 298 children under the age of 3 years of age with CP and confirmed the GMFM-66’s strong inter-rater reliability (0.97) and test-retest reliability (0.98).

The GMFM-88, and more recently the GMFM-66, have been used extensively in research surrounding the effectiveness of many interventions for children with CP including: rhizotomy, intrathecal baclofen, physical therapy, horseback riding, therapeutic electrical stimulation, orthoses, strength training, bodyweight support treadmill training, and muscle tendon surgery.
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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 Bruininks-Oseretsky Test of Motor Performance, 2nd Ed. (BOT-2)
- Outcome Measures: The Developmental Test of Visual Perception, 2nd Ed. (DTVP-2)
- Outcome Measures: The Movement Assessment Battery for Children, 2nd Ed. (MABC-2)
- Outcome Measures: The Peabody Developmental Motor Scale, 2nd Ed. (PDMS-2)
- Outcome Measures: The Sensory Profile (SP)