INSTRUMENTS OF ASSESSMENT FOR FIRST TWO YEARS OF LIFE OF INFANT

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Abstract

Introduction: the developmental assessment of infants seeks to identify and classify early developmental delay and/or schedule an intervention. This assessment is considered inefficient when performed only by professional clinical judgment. Thus there are numerous assessment scales to help professionals in this process, requiring a greater knowledge of their advantages and disadvantages. Objectives: to identify and analyze instruments used for assessment of infant development from zero to two years old. Methods: a search was made in the most important databases in the area, in the manual of the instruments used for evaluation and books of Pediatric Physical Therapy. The following data of each standardized instrument were extracted: general characteristics, psychometrics, theoretical basis of each instrument, validity of the instruments for Brazilian children and accessibility of the instruments to the physiotherapist in Brazil. Results: articles about TIMP, DUBOWITZ, MAI, AIMS and BAYLEY-III were selected. The TIMP presents the best indices of reliability and sensitivity for the evaluation of pre-term infants in the four first months of life, however it takes long time to apply and depends on the emotional state of the infant. DUBOWITZ is an instrument that is easy and quick to use although it is not easily found in Brazil. The literature suggests a reevaluation of the MAI instrument as it presents limited psychometric properties, especially a poor validity of construct. AIMS proved to have the best psychometric properties and conditions for clinical use. Bayley III is one the best instruments with high psychometric properties, however it is not of common use in Brazil probably because of the high cost of its application kit. Conclusion: for pre-term infants up to 4 months the TIMP seems to be the instrument of choice, but for longer follow-up up to 18 months, AIMS is the best option, and above this age the Bayley-III scale is adequate as it presents very good psychometric properties.

Key words: child development; infant; assessment; reproducibility of tests; physioterapy.

INTRODUCTION

Early childhood (zero to two years) is a period of sensory and motor changes marked by intense interaction with the infants environment, and this is therefore a critical period for child development. Thus from, appropriate assessment of a child’s development it is essential of delays and deficiencies should be detected. This assessment must be reevaluated by the use of valid and reliable scales and not only by clinical judgment, since less than 30% of developmental disorders are detected by clinical consultation. It should also be observed that in practice physical therapy for the assessment of infants is not yet to highly systematized. The importance of using tests standardized infants is unquestionable as this may facilitate therapeutic intervention to minimize future sequelae.

The choice of a test must be based on its psychometric properties, the theory of reference, the validity and accessibility of instruments, which includes the cost of the instrument, the need for training and duration of application, time. Professionals report difficulty in using of the these scales due to the few of instruments of assessment that are have been standardized for Brazilian children, which hinders access to and understanding of the psychometric properties of the tests. So don’t make use of diagnostic measures standardized and proven efficacy to analyze motor function and determine if there is deviations development. Add also that the scales are standardized to international.
Instruments of assessment for first two years of life of infant

METHODS

Assessment instruments to be reviewed were included because they are standardized assess motor development of infants aged zero two years and to be instruments used in research and clinical practice in Brazil. Were excluded from assessment instruments not used in Brazil, which did not cover the age range (zero to two years) and scientific articles that intervention not detailing the tests.

We searched for articles on the following computerized databases: PubMed, Lilacs, Scielo, Google scholar and PEDro. The strategy of MeSH search terms included: “Child Development” and “Newborn Screening”, “Child Development” and “Assessment instruments” and “Motor Developmental Delay “, names of instruments known to those authors of this review and its respective authors. There was no data restriction to include articles, however there constraint language, and articles that were analyzed in Portuguese, English and Spanish. Were selected 78 articles, these 49 were excluded and were included 29 articles. This total, 12 articles referred to the AIMS instrument, eight to TIMP, seven to scale Dubowitz, seven to scale Bayley and six to MAI. Were also used manuals instruments and books in the field of Pediatric Physical Therapy. Were extracted from each of the selected instruments: general characterization of instrument (simplicity, cost, suitability, advantages and disadvantages); psychometric properties (validity, reliability, sensitivity, specificity); theoretical assumption; validity for Brazilian infants and accessibility of instruments for the physiotherapist in Brazil.

RESULTS

Were selected the instruments: TIMP, Dubowitz, MAI, AIMS and the Bayley III.

Test of Infant Motor Performance (TIMP)

The Test of Infant Motor Performance (TIMP) was created by Campbell et al. 1993 aiming to identify motor delay or deficits functional in preterm infants. It can be applied in preterm infants from 32 weeks and the term until the age of four months. Presents 42 items and 13 relate to observation of spontaneous activity the baby and 29 others refer to specific behaviors to be noted, using handling techniques. Presents good psychometric properties. Content validity was determined through a review of literature related to expert opinion, pilot studies and reviews content. To construct validity was
performed the Rash analysis which identified test
discriminates infants with low and high risk for
motors deficits. The concurrent validity was tested
with AIMS, identifying at three months correlation
coefficient r=0.641 (Table 2). The inter-observer
reliability is 0.9512, the intra-observer varies from
0.98 to 0.991 and the test-retest is 0.89. It has high
sensitivity (0.92) but low specificity (0.76) 4
(Table 2).

The first version at TIMP was developed with
neuromaturacional aspects, however the current
version adds an ecological character as which is
based on natural movements triggered by babies
in their day-to-day 3. Not there validation testing
for Brazil. The duration for applying is 20 to 40
minutes and the test provides equipment needed
for its administration. There is need for training from
a DVD instructional and reading the manual
(Table 1). The manual and the test cost $ 601.

Neurological Examination of the Dubowitz Full-
term Newborn (Dubowitz)
This neurological assessment of preterm
infants and the full term was created in 1981 by
Dubowitz and Dubowitz, aiming to detect
neurological deficits and neurobehavioural. The age
group ranges from preterm infants under one year
old 13. The instrument is composed of 15 items that
assess muscle tone, six items of primitive reflexes,
ine nine items neurobehavioral and six status categories
behavior (Table 1). It is not necessary to apply all
items examining whether the conditions infant not
permit14. After administration infants are classified
as normal, borderline or abnormal 5. The application
time test ranges from 10 to 15 minutes.

The intra-examiner reliability is above 96%,
has good sensitivity (88%); but poor specificity
(34%) 14,15 (Table 2). The content validity was
established through pilot study and literature
reviews with experts in the area 14 (Table 2). Presents
as reference neuromaturacional theory because its
content relates if the maturation of the central
nervous system, having assessment items focused,
for example, in primitive reflexes. It is an instrument
that requires no formal training due to simplicity
fill the test 14,15. The instrument is not validated for
Brazil and there is limited access because little
information by internet (Table 1).

Movement Assessment of Infants (MAI)
The test was created in 1980 by
physiotherapists North America to assess the
neuromotor function in infants under one year of
age, mainly high-risk infants. Assesses four areas
of development (tone, reflexes primitive, automatic
reactions and rectification voluntary movements)
through 65 items. Each item is scored in a specific
way and if the score of an item differs from what is
considered normal the infant receives a risk point
3,5,16. As the greater the risk score is worse infant
prognosis17. It has no normative scores, however
were created performance profiles for 4 and 8
months, with a score more than 13 at four months
total is indicative of deficit neuromotor, mostly
cerebral palsy, to eight months a score greater than
ten is cerebral indicative of cerebral palsy.

The reliability and validity of the MAI are low:
inter-observer reliability from 0.72 to 0.91, test-
retest 0.76 to 0.79, and low specificity (72% at
four months and 59% at eight months), however
has high sensitivity (83% at four months and 96%
at eight months) 18,19 (Table 2). Its content validity
was determined from literature review and the risk
scores of high-risk infants (Table 1). The validity
construct presents that the instrument discriminates
infants with normal and abnormal development in
preterm infants, but not the done to even healthy
full-term infants. The concurrent validity was carried
out using the Bayley, with \( r = 0.63 \) at four months
for full-term babies and preterm. It has good
predictive validity for the diagnosis cerebral palsy
(CP) in North American1, with 81% identity of CP to
four months, however it was detected a high number
false positive (44%) 6, presenting low sensitivity
(Table 2).

The MAI was built from the perspective of
neuromaturacional theory, with little emphasis the
observation of spontaneous movement of infant and
environmental context 5. Although not there
validation test for Brazil, the MAI is being used in
country 3, 5, 16. The test presents a manual and
requires no specific equipment, however, requires
some skill of the examiner (Table 1). The application
environment should be pleasant, with ample space
and its duration can vary 60 90 minutes whereas
the time for completing test 3, 5, 14 (Table 1).

Alberta Infant Motor Scale (AIMS)
Instrument of assessment published in 1994
by physiotherapists Canadians who identifies infants
aged zero to 18 months with developmental delay
motor. It is easy to apply and quick administration
(20 to 30 minutes) 6, 14 (Table 1). The environment
for assessment MUST be peaceful and pleasant. The
assessment is made of infants at different postures
and appraiser establishes the most primitive and
the most evolved for this infant, thus defining a
window of motor skills. Each item receives one score
when the ability was observed and zero score if
there was not seen by the examiner. This score is
summed and added the age of the infant being
transferred to a graph of percentile performance of
lactente 6. The higher the percentiles lower the
chance of delayed development motor 10, 19.

The instrument presents items related to two
theories studied3,15. The neuromaturacional theory
determined the sequence of the items motors while
the theory of dynamical systems based the
importance of observing the infant’s movement
spontaneous during free interaction with its
ambiente 4 (Table 1). The AIMS was validated
recently for the Brasil20 and also to monitor the
development brazilian preterm infant 21. According
to his authors there is no need for training its
application, however, it is necessary for the professional have knowledge about children development (Table 1). There is a manual guidance which costs $ 80, available for purchase at Internet.3.

**Bayley Scales of Infant Development III (BSID III)**

In 1953 was created the first version that was reviewed in 1993 and 2005 and named Bayley Scales of Infant Development III.5 Aims to detect developmental delays and comprises across five domains (cognitive scale, motor, language, social and emotional behavior adaptive) 22,23. It is an instrument the U.S. developed for the age group between one and 42 months with duration of application ranging from 30 to 90 minutes depending on the age of the child and ability of the evaluator (Table 1). It can be applied even in preterm infants, HIV children, or with autistic syndrome or Down.22-24. The scale consists of 72 items gross motor and fine motor for 66 itens,22, the language domain consists of 97 items and the cognitive scale by 91items. The environment for the examination should be quiet, well ventilated and illuminated, with enough space for the child walk, run and jump. The score is to provide one point for a child’s behavior observed and zero for not observed behavior.10,22.

Has good reliability and validity.22,25 Content validity was conducted through literature review, expert opinion and pilot studies. The validity of construct established that the constructs become more differentiated with age. The validity concurrent was performed with a motor development scale Peabody II, yielding r=0.85 to 0.97 (Table 2). The interrater reliability is r=0.75 (motor) and r=0.96 (mental). The test-retest reliability was r=0.78, r=0.87 (mental) and r=0.55 to 0.90 (behavioral) (Table 2) 24.

The BSID III is considered an assessment that addresses both concepts theory neuromaturacional, such as the development sequence cephalocaudal and near distal as the dynamic theory as it indicates the importance functionality and the interaction of subsistemas.22. The instrument has not been validated for Brazil, however the use of this scale is possible, while still be little used. The BSID is expensive, U.S. $ 1,075, it requires use of specific kit with stimulus materials that includes a manual. There is a need for a training professionals10,22 for application (Table 1).

**DISCUSSION**

This review identified five instruments to assess development of infants zero to two years old, preterm or full-term that have different psychometric properties, theoretical and clinical applicability, besides financial costs varied. The choice of an instrument should be based the appropriateness of the objectives of the researcher/practitioner, in the population being assessed, the properties psychometric testing and accessibility the physiotherapist.

Newborn preterm exhibit different development patterns when compared with full-term infants, justifying the use of assessments built specifically for this population. The instruments

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Aspects evaluated</th>
<th>Age range</th>
<th>Time to administer</th>
<th>Validity in Brasil</th>
<th>Training</th>
<th>Theoretical Basis</th>
</tr>
</thead>
<tbody>
<tr>
<td>TIMP</td>
<td>Gross motor</td>
<td>32 weeks of IG</td>
<td>20 to 40’</td>
<td>no</td>
<td>yes</td>
<td>Neuromaturacional theory and sand dynamic systems</td>
</tr>
<tr>
<td>DUBOWITZ</td>
<td>0 to 12 months</td>
<td>10 to 15’</td>
<td>no</td>
<td>no</td>
<td></td>
<td>Neuromaturacional theory</td>
</tr>
<tr>
<td>MAI</td>
<td>Fine and gross motor</td>
<td>0 to 1 year old</td>
<td>60 to 90’</td>
<td>no</td>
<td>no</td>
<td>Neuromaturacional theory</td>
</tr>
<tr>
<td>AIMS</td>
<td>Gross motor</td>
<td>0 to 18 months</td>
<td>20 to 30’</td>
<td>yes</td>
<td>no</td>
<td>Neuromaturacional theory and dynamic systems</td>
</tr>
<tr>
<td>BAYLEY III</td>
<td>Fine and gross motor, language, cognition, behavior and emotional social</td>
<td>1 to 42 months</td>
<td>30 to 90’</td>
<td>no</td>
<td>yes</td>
<td>Neuromaturacional theory and dynamic systems</td>
</tr>
</tbody>
</table>

AIMS, Alberta infant motor scale; BAYLEY III, Bayley scales of infant-version II; DUBOWITZ, Neurological assessment of the preterm and full-term newborn infant; MAI, Motor assessment infant; TIMP, Test of infant motor performance;——: item not found in literature.
Table 2: Validity and reliability of instruments of assessment in the first two years of life

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Content</th>
<th>Construct Validity</th>
<th>Concurrent Validity</th>
<th>Sensitivity Validity</th>
<th>Specificity</th>
<th>Test-retest</th>
<th>Intrarater</th>
<th>Interrater</th>
</tr>
</thead>
<tbody>
<tr>
<td>TIMP</td>
<td>Literature review, pilot study with experts, review of content</td>
<td>Discriminates infants with low and high risk of motor problems</td>
<td>AIMS (3 meses)</td>
<td>r = 0,64</td>
<td>r = 0,92</td>
<td>r = 0,76</td>
<td>ICC = 0,98</td>
<td>ICC = 0,95</td>
</tr>
<tr>
<td>DUBOWITZ</td>
<td>Literature review, pilot study with experts</td>
<td>---</td>
<td>---</td>
<td>88%</td>
<td>34%</td>
<td>r &gt; 36%</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>MAI</td>
<td>Literature review; risk scores based on high risk infants</td>
<td>Discriminate normal from abnormal development in preterm infants, but not the same in healthy full-term infants</td>
<td>Bayley (4 months)</td>
<td>83 % to 4 months</td>
<td>72% to 4 months; r = 0,63 and 96% to 8 months</td>
<td>a 0,79</td>
<td>a 0,91</td>
<td></td>
</tr>
<tr>
<td>AIMS</td>
<td>Literature review, pilot study with experts</td>
<td>Discriminate normal development of abnormal and suspicius</td>
<td>Bayley</td>
<td>r = 0,98</td>
<td>77,3 to 65,5 at 4 months</td>
<td>ICC = 0,99</td>
<td>0 a 18 m</td>
<td>(ICC = 0,99)</td>
</tr>
<tr>
<td>BAYLEY III</td>
<td>Literature review, pilot study with experts</td>
<td>Constructs are differentiated with age, there is a correlation of items within each scale</td>
<td>Peabody -2:</td>
<td>r = 0,85 - 0,97</td>
<td>---</td>
<td>r = 0,78</td>
<td>r = 0,75</td>
<td></td>
</tr>
</tbody>
</table>

AIMS, Alberta infant motor scale; BAYLEY III, Bayley scales of infant-version III; DUBOWITZ, Neurological assessment of the preterm and full-term newborn infant; MAI, Motor Motor assessment infant; TIMP, Test of infant motor performance; ---: item not found in literature; r, Pearson coefficient , ICC; intraclass correlation coefficient.

Dubowitz, TIMP and the MAI, are specific to infants who were born prematurely and must, therefore, be used in follow-up programs. Also, knowing stability and the predictive ability of an instrument can be determinant for infants born prematurely as its results can be used to indicate the need intervention and inform parents prognosis your child. However it should be done cautiously because existing instruments do not appear to be capable of detecting all variations development in the first year of life. The plasticity of a child can lead changes in brain function and thereby explain the difficulty of predicting an outcome with overall accuracy. These predictions are more effective in the case of infants with severe disabilities such as cerebral palsy. In milder cases the influence of environmental factors, social and biological and the interaction of these impediments to that prediction.

The TIMP, among the instruments analyzed, presents better reliability and sensitivity in the first three months of life, is designed for evaluation of abnormalities precoces. Thus it has been used in studies randomized controlled of intervention achieving detect significant differences between groups. However, its application is delayed and depends on the emotional state of lactente. Already Dubowitz test is a quick and easy application although not very accessible to the physiotherapist Brazilian. Presents well intraexaminer correlation and reliability, and is an effective method and sensitive to reveal changes neuromotor of preterm infants and full-term. Molteno et al (1995) stated that the presence of four or more deviations in the Dubowitz indicate a poor prognosis for the infant and a greater likelihood of development deficits. A disadvantage test is to simply focus on neurological aspects, without performing a global assessment of infant and not have to worry that the interaction infants in their environment and context.

The MAI is a test developed to identify and monitor early intervention, however several studies have questioned its appropriateness these objetivos. The instrument is shown to be sensitive to the identification of abnormalities four months of age, with moderate scores specificity. Cardoso et al (2004) has found that the MAI presents clinical usefulness for the detection of cerebral palsy in infants preterm Brazilians, although this test was more specifically to discriminate infants with development normal compared those patients with Cerebral Palsy. The test exhibits a limited...
psychometric base and a poor validity construct. The literature suggests that items MAI are reassessed, suitable for the age group, making the instrument shorter and less stressful for infants.

Already the AIMS assessments among surveyed presents the best psychometric properties and conditions for use. It is the best predictor atypical motor development, has the highest reliability. It has the advantage of being easily applicable, since it is a fast, allied a manual for easy understanding. It is one of tests commonly used in the country being validated for Brazil by Sacanni and col. Almeida et al (2008) demonstrated that this test is also valid and reliable for use in brazilian infants at risk.

The Bayley-III scale is among the best instruments of assessment child development. The results obtained by the sub-scales mental and motor are useful to provide family feedback about your child’s development, serving to monitor the progress of treatment of children with motor disorders. It still useful for making decisions on intervention early. Data from this scale are considered valid, reliable and objective, and extensively used in scientific research. Although it is widely used abroad, the Bayley III is yet little used in Brazil for being an instrument tiring fot the children, costly, requiring specific training, usually offered in the USA.

Considering the target population, the properties psychometric tests analyzed, the theoretical benchmark, validity and accessibility of instruments in Brazil, for assessment of infants preterm up to four months of life, TIMP seems be the best choice. As for infants up 18 months, AIMS presents the results reliable, and above this age, the Bayley-III can achieve the proposed goals efficiently. However it is important to note that only AIMS has been validated for the Brazilian population. Assuming that cultural factors and environmental stimuli such as the caregiver may influence child development, results all these tests must be interpreted carefully, taking into consideration environmental aspects of specific each child. Furthermore, studies of validation instruments which have the best psychometric properties are fundamental, of order to be culturally adapted and used without restriction to the Brazilian population.

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Instruments of assessment for first two years of life of infant


