Salar-Andreu, C.S.; Moreno-Murcia, J.A.; y Ruiz-Perez, L.M. (2018). Validación del Inventario Evolutivo Acuático IDEA de 6 a 12 meses / Validation on the Inventory of Evolutionary Aquatic Development IEAD (IDEA) in 6 to 12 month old babies. vol. 18 (71) pp. 555-576
Http://cdeporte.rediris.es/revista/revista71/artvalidacion944.htm
DOI: http://dx.doi.org/10.15366/rimcafd2018.71.010

VALIDATION OF THE INVENTORY OF EVOLUTIONARY AQUATIC DEVELOPMENT IEAD (IDEA) IN 6 TO 12 MONTH OLD BABIES

VALIDACIÓN DEL INVENTARIO EVOLUTIVO ACUÁTICO IDEA DE 6 A 12 MESES

Salar-Andreu, C.[1]; Moreno-Murcia, J.A.[2]; Ruiz-Pérez, L.M. [3]

[1] Profesor Asociado. Departamento Patología y Cirugía. Universidad Miguel Hernández de Elche (España) csalar@umh.es
[2] Catedrático de Universidad. Dpto. Psicología de la Salud. Universidad Miguel Hernández de Elche (España) j.moreno@umh.es
[3] Catedrático de Universidad. Dpto. Ciencias de la Actividad Física y del Deporte. Universidad Politécnica de Madrid (España) luismiguel.ruiz@upm.es

Spanish-English translator: Lorraine Mealing, lmealing.elc@gmail.com

ACKNOWLEDGEMENTS

This study was possible thanks to the willingness and help from parents and professionals from the different swimming pools in Spain, especially the parents, children and professionals from la 'Asociación Proyecto Vitae'; without them this study would not have been possible.

Código UNESCO / UNESCO code: 6199. Otras especialidades psicológicas / Other psychological specialties
Clasificación del Consejo de Europa / Council of Europe Classification: 15 Psicología del Deporte / Sport Psychology

Recibido 22 de agosto 2016 **Received** August 22, 2016
Aceptado 28 de octubre de 2017 **Accepted** October 28, 2017

ABSTRACT

There are very few instruments that evaluate children's overall development in an aquatic environment. This study aimed to create, design and validate an "Inventory of evolutionary aquatic development" IEAD (IDEA)) for 6 to 12 month old babies. Validation was made through two studies: the first study involved 211 babies (110 boys and 101 girls), while the second study involved 831 babies (448 boys and 383 girls). A scale was developed comprising 14 items grouped into four theoretical areas (social, cognitive, language and aquatics). Internal consistency as well as evidence of validity led to the conclusion that the

resulting scale could be an effective tool and could be used with certain guarantees in educational and research contexts.

KEY WORDS: Measurement, infancy, motor development, aquatic competence, aquatic activities, evaluation.

RESUMEN

Son escasos los instrumentos que evalúen el desarrollo global del niño en el medio acuático. El objetivo de este estudio fue crear, diseñar y validar un "Inventario del desarrollo evolutivo acuático (IDEA)" para bebés de 6 a 12 meses. La validación se llevó a cabo a través de dos estudios. En el primer estudio participaron 211 bebés, de los cuales 110 eran niños y 101 niñas, mientras que el segundo estudio estuvo compuesto por un total de 831 bebés (448 niños y 383 niñas) de 6 a 12 meses. Se diseñó una escala compuesta por 14 ítems agrupados en cuatro áreas teóricas (social, cognitiva, lenguaje y acuática). Tanto la consistencia interna como las evidencias de validez permiten concluir que la escala puede ser una herramienta eficaz y puede ser utilizada con ciertas garantías en contextos educativos y de investigación.

PALABRAS CLAVE: Medición, infancia, desarrollo motor, competencia acuática, actividades acuáticas, evaluación.

INTRODUCTION

To learn about young children in an aquatic environment we need instruments that permit an understanding of their behavior, which favour the development of individual programs providing families and professionals with information about the progress achieved, thereby evaluating the intervention strategy (FEAPAT[1], 2005).

Evolutionary development assessment in early childhood was a point of interest in study and research carried out in the 20th century. This effort resulted in the development of different tests, batteries, and observation and measurement scales for these ages (e.g. Hebbeler, Spiker, Bailey, Scarborough, Sangeeta, & Simeonsson, 2007). However, there are still very few instruments aimed at evaluating development in an aquatic medium during the first year of life, which means more studies should be carried out to address this area.

Historically, one of the strategies was to apply evolutionary scales used previously for other age groups, but adapted to younger children (Quiles, Van-der Hofstadt, & Quiles, 2004). However, it is now possible to find specific measurement instruments for younger children (Meisels & Atkins-Burnett, 2000). In early ages, evolutionary development was evaluated almost exclusively in the motor dimension (Berk, 2003). Once children master hand grip, walking or handling objects, and start to talk, the scales address other

[1] Federación Estatal de Asociaciones de Profesionales de Atención Temprana

dimensions (emotional, social, cognitive or affective), with a decrease in interest in motor behaviour (Rosenbaum, 2005), which is only given attention if the baby shows some type of difficulty.

The first instruments available for evaluating motor competence in early childhood (Barnett & Peters, 2004; Vallaey & Vandroemme, 1999; Wiart & Darrah, 2001) addressed specific groups in order to find out whether motor development followed established patterns (Burton & Miller; 1998; Burton & Rodgerson, 2001; Ikeda & Aoyagi, 2008; Lazslo & Bairstow, 1985; Ruiz, Rioja, Graupera, Palomo, & García, 2015). Others evaluated the sequence of change in the development of movement patterns (Gallahue & Ozmun, 2006; Haywood & Getchell, 2005). In recent decades, research in motor development has focused on evolutionary problems in children and teenagers' motor coordination (Gómez, Ruiz, & Mata, 2006; McCarron, 1997; Ruiz, 2005; Yoon, Scott, & Hill, 2006; Wiart, & Darrah, 2001). These instruments usually evaluate the quantitative aspects of motor competence, and focus on gross and fine coordination performance of children. The majority of them are aimed specifically at the early detection and evaluation of deficits in the development of the perceptual-motor system (Bruininks & Bruininks, 2005; Henderson, Sugden, & Barnett, 2012; Ruiz et al., 2015; Smits-Engelsman Henderson, & Michels, 1998; Zimmer, & Volkamer, 1987).

There are also other types of instruments which evaluate the qualitative aspects of motor competence, and focus their attention on the movements of different parts of the body while different motor tasks are being performed (Burton & Miller, 1998; McClenaghan, & Gallahue, 1985), or they globally analyze fundamental skills (Barnett, Ridgers, Zask, & Salmon (2015).

In the case of the first year of life, questions frequently arise about what should be recorded or measured to evaluate development and what progress indicators are the most suitable and valuable to determine this. Most batteries of questions focus on cognitive, language and motor areas (Barnand & Kelly, 1990; Cicchetti & Wagner, 1990; McCune, Kalmanson, Fleck, Glazewski, & Sillari, 1990), while others (Bayley, 2005; Brazelton, 1973) also pay attention to the psycho-social, affective-emotional or family aspects. It is for this reason that it is important that the evaluation gather information of all the dimensions (cognitive, social-emotional, language and motor), and thus, better understand the evolutionary process of the baby in this phase.

One of the areas where there is a marked lack of measurement instruments for evaluating evolutionary development is the aquatic medium. Specialists assert that newborns are able to adapt instinctively to water because of the "memory" of their foetal stage, when they were submerged in amniotic fluid (Diem, Bresges, & Hellmich, 1978; Le Camus, 1993). They also affirm that ocular and labyrinthine senses that babies experience in water, in both ventral and dorsal positions, are familiar because of the time spent in the cot and in the arms of an adult in similar positions (Sigmundsson & Hopkins, 2010; Martins, Costa, Marinho, & Barbosa, 2012; Moreno & de Paula, 2005). For this reason, the aquatic medium is a beneficial environment providing the conditions that favour and facilitate not only movement, but also interaction with peers, family and

objects, favouring tonic, phasic, verbal, gestural and affective aspects of children (Espejo, García, & Martínez, 2012).

The study of infant aquatic competence has been dealt with by several authors and from different points of view. Myrta McGraw (1935) is considered one of the first researchers to analyse the behaviour of children under the age of three in water. There are other researchers who have studied motor evolution in relation to water (Azemar, 1974; Erbaugh, 1979; Le Camus, 1974; Mayerhorfer, 1952), they have even come to refer to the study of aquatic competence as a concrete and specific area. (Langerdorfer & Bruya, 1995; Quan et al., 2015).

The interest in developing instruments that can provide data about motor competence in young children in both the terrestrial (Ruiz & Graupera, 2015; Ruiz et al., 2017) and the aquatic environment (Jorge, Edison, Roberta, & Victor, 2013) has increased. For example, in 2005 Moreno designed a series of instruments for measuring aquatic motor competence in 4 to 11 year old school children, later Moreno and Ruiz (2008) developed and validated a pictorial scale to evaluate perceived aquatic competence in 4 and 5 year old children. This effort has also been aimed at the design of instruments for measuring motor competence and mental adjustment in boys and girls with special needs *Water Orientation Test Alyn 2* (WOTA 2) (Tirosh, Katz-Leurer & Getz, 2008).

The main aim of this study was to contribute to this research effort in order to develop and validate an inventory for exploring the evolutionary development of 6 to 12 month-old babies in an aquatic environment.

Study 1

METHOD

PARTICIPANTS

The sample included 211 babies, 110 were boys and 101 were girls. Ages ranged between 6 and12 months, with a mean age of 8.6 months (*SD* = 1.9 months). The study was carried out in various regions of Spain (central, northeast and south) where various aquatic activity programs were developed in both public and private installations.

MEASURES

The final version of the *Inventory of Evolutionary Aquatic Development (IEAD)* is an instrument that permits evaluation of the basic aquatic competences in boys and girls between the ages of six and 12 months, and permits exploring babies' behaviour in a real and natural situation without any manipulation of the practice environment. The items are presented in a standard format which specify the situation, the materials required, the administration procedures, and the measure criteria for scoring responses.

The inventory contains 14 items grouped into four areas (Annex I): the personal/social/emotional area comprising three items (e.g. “Going into the water”); the communicative area comprising three items (e.g. “Associates words with actions or objects”); the cognitive area with three items (e.g. “Explores or investigates surroundings); and the area of aquatic motricity comprising five items (e.g. “Balance in dorsal floating”). We used a rubric as a system for valuing infants in the four points. For example, item AMA3, which deals with breathing control, where the child is encouraged to paddle and reactions to getting wet are observed: 1 corresponds to “*Doesn’t paddle and on perceiving the sensation of water on face gets frightened or cries*”; 2 corresponds to “*Paddles carefully and is bothered by the sensation of water on face*”; 3 corresponds to “*Paddles carefully, but on getting accidentally wet continues with the game without inhaling water”*; and 4 corresponds to “*Paddles with hands and/or legs and when water is splashed on face doesn’t get frightened, and enjoys the activity”.*

DEVELOPMENT OF INVENTORY

We followed a series of steps to ensure that the application procedures for the inventory and scoring were as objective as possible in the different areas. First, the inventory was constructed on the basis of an extensive bibliographical review, from which we selected the most important aspects which the different items revolved around. The items were prepared as a result of fieldwork by different university lecturers who are experts in this subject and semantic validation was made by three aquatic activity instructors. We also considered the structure of other instruments like the scales by Batelle and Bayley (De la Cruz & González, 1966; Bayley, 1977).

Based on these steps, a preliminary inventory was designed comprising 18 items grouped into 4 areas: social, cognitive, language and aquatic. Eight experts in evolutionary psychology, aquatic motricity and motor development evaluated these areas, checking their importance and pertinence, and their suitability for the required ages, which meant we were able to establish their criterion validity.

The items were presented on a five point Likert scale which valued each item: the clearness of the language, practical pertinence and theoretical relevance. The validity coefficient of content (CVc) was determined using the criterion by Hernández-Nieto (2002) and a 0.80 coefficient was obtained, indicating that the proposed content had satisfactory validity and concordance. According to the scale established for interpreting the different coefficient intervals, when CVc is equal to or greater than 0.80 and lower than 0.90, thevalidity and concordance are satisfactory. We checked that all items corresponded to what we were initially pursuing, except for three items, some graphic representations and their semantic modification, so the final scale had 15 items.

PROCEDURE

We contacted the directors of the sports centres that had accepted to participate in the study, as well as the monitors for aquatic stimulation and swimming for babies to inform them about the objective of the research and the activities to be evaluated. One of the authors (CSA) personally evaluated each of the children going through the different items on the inventory while observing the classes, without influencing the dynamics or development of the class. Participation was voluntary and participants remained anonymous, assigning a numbered code to each child and geographical region. Parents were previously informed about the nature of the study and signed an informed consent. Observation time for each child was approximately 30 minutes.

DATA ANALYSIS

To establish the factorial structure of the instrument, we carried out an exploratory factor analysis (EFA). Internal consistency of the instrument was also analysed using Cronbach's alpha coefficient. Data was analysed using SPSS 21.0 statistical software.

RESULTS

Exploratory Factor Analysis

We carried out an exploratory factor analysis of the main components with oblimin rotation. After a first analysis, item 4 ("manipulation") did not reach the minimum saturation established (.40).This item was eliminated and a new analysis was made, where the 14 items were grouped into four areas (Table 1): socio-emotional area comprising three items, communicative area comprising three items, the Cognitive area comprising three items, the aquatic motricity area comprising five items. These four factors obtained eigenvalues higher than 1.00 1.00 (4.48, 3.35, 2.59 and 2.20, respectively), explaining a total variance of 84.24% (29.87%, 22.37%, 17.29 and 14.70%, respectively).

Table 1. Inventory of Evolutionary Aquatic Development in 6 to 12 month old infants (IEAD 6-12)

Items	SEA	LA	CA	AMA
1. Going into the water	.73			
2. Responds to name, turning when called from any angle of the pool	.74			
3. Plays peek-a-boo	.78			
4. Associates words with actions or objects		.76		
5. Babbles expressively		.59		
6. Makes consonant-vowel sounds		.47		
7. Explores and investigates surroundings			.49	
8. Explores objects			.83	
9. Lifts a cup to get a toy			.65	
10. Movement/propulsion				.65
11. Plunging under water				.60
12. Breathing control				.37
13. Balance in dorsal floating				.83
14. Balance in Vertical position				.68

Note: SEA= Socio-emotional area, LA = Language Area, CA = Cognitive Area, AMA= Aquatic Motor Area

Internal consistency analysis

Cronbach's alpha coefficient obtained in each of the dimensions was .76, .87, .83 and .89, respectively, which can be considered very satisfactory.

Study 2

METHOD

PARTICIPANTS

In the second study, the sample included 831 6 to12 month old babies, 448 were boys and 383 girls (M = 8.68, ST = 2.27). With the same characteristics as study 1.

MEASURES

The final (IDEA) inventory was used as described in study 1.

PROCEDURE

The same procedure outlined in study 1 was used to gather information.

DATA ANALYSIS

To confirm the factor structure of the instrument we made a confirmatory factor analysis (CFA). We also analysed internal consistency of the instrument using Cronbach's alpha and obtained descriptive statistics (means and standard deviations) as well as bivariate correlations for all the variables. We used the statistical software SPSS 21.0 and AMOS 21.0 for the data analysis

RESULTS

Confirmatory factor analysis

A confirmatory factor analysis was made to examine the construct validity of the IDEA inventory. We considered a series of goodness of fit indices, based on the contributions from different authors (Bentler, 1990; Bollen & Long, 1993; McDonald & Marsh, 1990). These were: χ2, χ2/gl, RMSEA (Root Mean Square Error of Approximation), RMSR (Root Mean Square Residual) and incremental indices (IFI, CFI & TLI). These fit indices are considered acceptable when χ2/gl is lower than 5, the incremental indices (IFI, CFI and TLI) and the error indices r (RMSEA and/or RMSR) are lower than .05 (Bentler, 1990).

We used the maximum verisimilitude method together with the *bootstrapping* method, since the result of the Mardia multivariate coefficient was 61.56, which indicated a lack of normality. For this reason and in line with Finney and DiStefano (2006), we used the robust maximum verisimilitude (Byrne, 2001). After a first analysis, the global results of the model did not adjust adequately. Based on the modification of the indices, four interactions of standard errors were established (to be exact between errors of items 7 and 8; 8 and 9; 10 and 11; 13 and 14). A new analysis was then made with results that showed a better fit of the model: ((χ2 (40, N = 831) = 1374.14, *p* = .000; χ2/d.f. = 21.14; CFI = .90; IFI = .90; RSMR = .04).

Analysis of internal consistency

The results of internal consistency for each of the factors are as follows: .70 for the socio-emotional factor, .91 for the communicative factor, .79 for the cognitive factor and .80 for the aquatic motricity factor.

Descriptive analysis and bivariate correlations

The socio-emotional area was the area that presented a better result, followed by the cognitive area, the aquatic motricity area and the communication area. The data from the correlation analysis revealed that the four factors correlated positively with each other. (**Table 2**).

Table 2. Descriptive statistics and Correlations of all the Variables

Variables	*M*	*SD*	1	2	3	4
1. Socio-emotional	3.08	.87	-	.79**	.80**	.82**
2. Communication	2.80	.75	-	-	.81**	.82**
3. Cognitive	3.02	.75	-	-	-	.83**
4. Motricity	2.99	.75	-	-	-	-

Note: ** $p < .001$

DISCUSSION

The main aim of this study was to develop and validate an Evolutionary Inventory to explore motor competence in 6 to 12 month old babies in water. This research has resulted in the *Inventory of Evolutionary Aquatic development* (IEAD) for 6 to 12 month old infants. Its theoretically based design was finally confirmed by the psychometry carried out.

The resulting inventory comprises a total of 14 items grouped into four areas (Annex 1). The analysis of its factor structure through exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) as well as its reliability show very favourable and satisfactory results.

In the composition of the instrument, the socio-emotional area finally consisted of three items. These items evaluate the babies' competence in establishing significant social and emotional interactions, their attitude towards the task given, their relation with adults or peers, playing, rules, expressing feelings and their self-identity (e.g. "Responds to their name by turning when someone calls them from any corner of the pool"). The communicative area finally consisted of three item. These items are related to the verbal and non-verbal reception and expression of thoughts and ideas, competence in differentiating and comprehending the meaning of messages, sounds, grammar rules and the use of meaning in the aquatic environment (e.g. "Associates words with actions or objects"). The cognitive area finally consisted of three items. These items explore conceptual skills and competences, valuing perceptual differentiation, memory, reasoning and conceptual development (e.g. "Explores and investigates surroundings").

The aquatic motricity area contains five items. These items evaluate the babies' ability to use and control both gross and fine movements, including evaluation of movement, manipulation, balance, turning, space-time perception, immersion and breathing behaviours (e.g. "Dorsal balance").

Traditionally, scales like the one developed by Bayley (2005) and Brazelton (1973) have primarily evaluated cognitive, language, socio-emotional and motor competence aspects in a terrestrial environment in children with or without disabilities (Andraca, Pino, de la Parra, Rivera, & Castillo, 1998; García-

Navarro, Taraconte, Sarduy, Abdo, Galvizú, Torres, & Leal, 2000; Haywood & Getchell, 2005). In this study, the dimensions obtained have the same rigorous structure as these inventories, but in this case, they are transferred to an aquatic environment, having rigorous criteria validity, contents, reliability and adjustment for use by professionals who work with this age group. However, more studies are required to confirm the measure properties in different contexts, to check the psychometric goodness of the different areas, as well as evaluating it in a higher number of infants, and exploring differences between sexes in more detail.

The ease and simplicity in its application means it is possible to obtain information of a wide interest to those planning aquatic programs for these ages. On balance, this is an inventory that allows us to evaluate the evolutionary development of 6 to 12 month old babies in the aquatic medium, and where all areas of a baby's development are evaluated. Its use can contribute to both short and long term planning: short term results can be used to establish the strong and weak points, which would guide session planning and designing objectives; while long term would make it possible to check the participants' development.

Its application has been designed to obtain data in a formal situation but in an open environment where the baby's behaviour in the water is not influenced. Data collection requires the observation of babies in task-problem and interviews with carers (family relations). These two sources of information provide relevant data for making a complete evaluation of the different areas and competences of the infant. This in turn makes it possible, if appropriate, to apply each area independently in the educational and the clinical context. In this sense, all the items can be applied to different types of disorder through specifically created modifications, allowing for adaptations in cases of visual, hearing, cognitive and/or motor deficits. Likewise, the use of an evaluation system of four points means a sensitive evaluation can be made, which takes into account both the skills that participants begin to acquire and those that have been fully acquired, leading to an individual and personalised evaluation.

CONCLUSIONS AND PEDAGOGICAL CONTRIBUTIONS

Finally and as an overview of the relations found in our study, we point out the following conclusions that sum up the contributions of the study:

- The Inventory of Evolutionary Aquatic Development in 6 to 12 month old children was created and validated, allowing us to evaluate cognitive, social, language and aquatic motor areas.

- The scale has the following characteristics:

    - The procedures were established to obtain data through the application of tests in a structured situation but in an open environment without isolating the participant. Data collection is made through observing the task and interviews with carers (family). These

two sources provide data that allow for a complete evaluation of the different areas and abilities of the infant.

- The use of an evaluation system of four points means that a sensitive assessment can be made taking onto account both the skills that the participant is beginning to learn and those that are fully acquired. To facilitate evaluation, the scale is divided into four areas, so it is possible to apply each independently, if appropriate, in an educational and clinical context.

- The content for behaviours and developmental milestones are directly compatible with the normalized development of participants, as are the acquisitions of aquatic education programs.

- Thanks to the use of the scale both short and long term planning are possible. The short term results can be used for diagnosis, which would guide lesson planning and designing objectives. On the other hand, through tong term planning it is possible to check participants' evolution.

- It is applied individually and is specific.

BIBLIOGRAPHIC REFERENCES

1. Andraca, I., Pino, P., de La Parra, A., Rivera, F., y Castillo, F. (1998). Factores de riesgo para el desarrollo psicomotor en lactantes nacidos en óptimas condiciones biológicas. *Revista de Saúde Pública, 32*(2), 479-487. https://doi.org/10.1590/S0034-89101998000200006
2. Azemar, G. (1974). Le tout petit et l'eau: l'experience motrice de tout petit en melieu aquatique. *Education Physique et Sport*, 129-130.
3. Bayley, N. (1977). *Escalas Bayley de Desarrollo Infantil.* Madrid. TEA Ediciones
4. Bayle, N. (2005). Bayley Scales of Infant and Toddler Development. Socio-Emotional Scale. Third Edition. Psych Corp.
5. Barnard, K. E., y Kelly, J. F. (1990). Assessment of parent-child interaction. En S. J. Meisels y J. P. Shonkoff (Eds.), *Handbook of Early Childhood Intervention* (pp. 278-302). New York: Cambridge University Press.
6. Barnett, A., y Peters, J. (2004). Motor proficiency assessment batteries. En D. Dewey y D. E. Tupper (Eds.), *Developmental motor disorders: A neuropsychological perspective* (pp. 67-109). New-York: Guilford.
7. Barnett L. M., Ridgers N. D., y Salmon J. (2015) Associations between young children's perceived and actual ball skill competence and physical activity. *Journal of Science and Medicine in Sport*. DOI: 10.1016/j.jsams.2014.03.001 https://doi.org/10.1016/j.jsams.2014.03.001
8. Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin, 107*, 238-246. https://doi.org/10.1037/0033-2909.107.2.238
9. Berk, L. (2003). *Child Development* (6th edition). Boston: Allyn & Bacon.
10. Bollen, K. A., y Long, J. S. (1993). *Testing structural equation models*. Sage: Newbury Park, CA.
11. Burton, A. W., y Miller, D. E. (1998). *Movement skill assessment.* Champaign: Human Kinetics.
12. Burton, A., y Rodgerson, R. W. (2001). New perspectives on the assessment of movement skills and motor abilities. *Adapted Physical Activity Quarterly*, *16*, 347-365. https://doi.org/10.1123/apaq.18.4.347
13. Brazelton, T. B. (1973). *Neonatal Behavioral Assessment Scale*. Clinics in Developmental Medicine, No. 50, London: William Heinemann Medical Books. Philadelphia: J. B. Lippincott.
14. Bruininks, R. H., y Bruininks, B. D. (2005). *Test of Motor Proficiency*. Minneapolis, Minnesota: Pearson Assessments.
15. Byrne, B.M. (2001). *Structural equation modeling with Amos: Basic concepts, applications and programming*. Mahwah, NJ:Erlbaum.
16. Cicchetti, D., y Wagner, S. (1990). Alternative assessment strategies for the evaluation of infants and toddlers: An organizational perspective. En S. J. Meisels y J. P. Shonkoff (Eds.), *Handbook of Early Childhood Intervention* (pp. 246-277). New York: Cambridge University Press.
17. De la Cruz, M. V., y González, M. (1966). *Batelle, Inventario de Desarrollo*. Madrid: TEA.
18. Diem, L., Bresges, L., y Hellmich H. (1978). *El niño aprende a nadar*. Valladolid: Miñón
19. Erbaugh, S. J. (1979). The development of swimming skills of preschool

children. En C. H. Nadeau, W. R. Halliwell, K. M. Newell y G. C. Roberts (Eds.), *Psychology of motor behavior and sport* (pp. 79-94). Champaign: Human Kinetics.

20. Espejo, L., García, C. I., y Martínez, M. T. (2012). Efectividad de la hidroterapia en atención temprana. *Fisioterapia, 34*(2), 79-86. https://doi.org/10.1016/j.ft.2011.11.003
21. Finney, S. J., y DiStefano, C. (2006). Non-normal and Categorical data in structural equation modeling. En G. R. Hancock y R. O. Mueller (Eds.), *Structural equation modeling: a second course* (pp. 269-314). Greenwich, Connecticut: Information Age Publishing.
22. Gallahue, D. L., y Ozmun, J. C. (2006). *Understanding motor development. Infants, children, adolescents, adults.* New York: McGraw-Hill.
23. García-Navarro, M. E., Tacoronte, M., Sarduy, I., Abdo, A., Galvizú, L., Torres, A, y Leal, E. (2000). Influencia de la estimulación temprana en la parálisis cerebral. *Revista de Neurología, 31*, 716-719.,
24. Gómez, M., Ruiz, L. M., y Mata, E. (2006). Los problemas evolutivos de coordinación en la adolescencia: Análisis de una dificultad oculta. *Revista Internacional de Ciencias del Deporte. RICYDE*, *3*, 44-54. doi: 10.5232/ricyde2006.00303. https://doi.org/10.5232/ricyde2006.00303
25. Haywood, K., y Getchell, N. (2005). *Live spam motor development.* United States: Human Kinetics.
26. Hebbeler, K., Spiker, D., Bailey, D., Scarborough, A., Sangeeta, M., y Simeonsson, R. (2007). *Early intervention for infants and toddlers with disabilities and their families: Participants, services, and outcomes*. Final report of the National Early Intervention Longitudinal Study (NEILS). Menlo Park: SRI International.
27. Henderson, S. E., Sugden, D. A., y Barnett, A. L. (2012). MABC-2. *Batería de evaluación del movimiento para niños-2* (Adaptación española de L. M. Ruiz y J. L. Graupera). España: Pearson.
28. Hernández-Nieto, R. A. (2002). *Contribuciones al análisis estadístico*. Mérida, Venezuela: Universidad de Los Andes.
29. Jorge, A. B., Edison, Roberta, B., y Victor, H. A. (2013). Pilot study on infant swimming clases and aearly motor development. *Physical Development & Measurement.* Perceptual and motor skills, 117, *3*, 950-955. https://doi.org/10.2466/10.25.PMS.117x30z2
30. Langerdorfer, S. J., y Bruya, L. D. (1995). *Aquatic readiness. Developing water competence in young children*. Champaign: Human Kinetics.
31. Lazslo, J., y Bairstow, P. J. (1985). *Perceptual-motor behaviour. Developmental Assessment and Therapy*. New York: Praeger.
32. Le Camus, J. (1974). Aspects pedagogiques d'une experience d'aptation de jeune enfant au melieu aquatique. *Education Physique et Sport*, *129-130*, 42-50.
33. McClenaghan, B., y Gallahue, D. (1985). *Movimientos Fundamentales. Su desarrollo y Rehabilitación*. Buenos Aires: Panamericana.
34. Martins, M., Costa, A. M., Marinho, D. A., y Barbosa, T. M. (2012). Baby swimming and motor skills achievement. En *Book of Abstracts of the 6th International symposium Science & Swimming* (p. 4). Wroclaw.
35. Mayerhorfer, A. A. (1952). *Swimming movements in infants*. East

Germany: Leipzig University.
36. McCarron, L. T. (1997). *McCarron Assessment of Neuromuscular Development* (3ª ed.). Dallas, TX: McCarron-Dial Systems.
37. McCune, L., Kalmanson, B., Fleck, M. B., Glazewski, B., y Sillari, J. (1990). An interdisciplinary model of infant assessment. En S. J. Meisels y J. P. Shonkoff (Eds.), *Handbook of Early Childhood Intervention* (pp. 219-245). New York: Cambridge University Press.
38. McDonald, R. P., y Marsh, H. W. (1990). Choosing a multivariate model: Noncentrality and goodness of fit. *Psychological Bulletin, 107*, 247-255. https://doi.org/10.1037/0033-2909.107.2.247
39. McGraw, M. (1935). *Growth: A study of Jummy and Johnny*. New York: Appleton.
40. Meisels, S. J., y Atkins-Burnett, S. (2000). The elements of early childhood assessment. En J. P. Shonkoff y S. J. Meisels (Eds.), *Handbook of Early Childhood Intervention* (pp. 231-257). New York: Cambridge University Press. https://doi.org/10.1017/CBO9780511529320.013
41. Moreno, J. A. y De Paula, L. (2005). Estimulación acuática para bebés. *Revista Iberoamericana de Psicomotricidad y Técnicas Corporales, 20,* 53-82
42. Moreno, J. A. (2005) Desarrollo y validación preliminar de escalas para la evaluación de la competencia motriz acuática en escolares de 4 a 11 años. *RICYDE. Revista Internacional de Ciencias del Deporte*, 1(1), 14-27.
43. Moreno, J. A., y Ruiz, L. M. (2008). Aquatic perceived competence in children: Development and preliminary validation of a pictorial scale. *International Journal of Aquatic Research and Education, 2*, 313-329. https://doi.org/10.5232/ricyde2005.00102
44. Quan, L., Ramos, W., Harvey, C., Kublick, L., Langerdorfer, S. Lees, T.,… y Wenicki, P. (2015). Toward defining water competency: An American Red Cross definition. *International Journal of Aquatic Research and Education*, *9*, 12-23.
45. Quiles M. J., Van-der Hofstadt, C. J., y Quiles, Y. (2004). Pain assessment tools in pediatric patients: a review (2nd parte). *Revista de la Sociedad Española del Dolor, 11*, 360-369. https://doi.org/10.1123/ijare.2014-0066
46. Rosenbaum, D. A. (2005). The Cinderella of Psychology. The neglect of motor control in the science of mental life and behavior. *American Psychologist*, *60*(4), 308-317. https://doi.org/10.1037/0003-066X.60.4.308
47. Ruiz, L. M. (2005). *Moverse con dificultad en la escuela*. Sevilla: Wanceluen.
48. Ruiz, L. M., y Graupera, J. L. (2015). New measure of perceived motor competence for children ages 4 to 6 years. *Perceptual & Motor Skills, 101*, 131-148. doi: 10.2466/pms.101.1.131-148. https://doi.org/10.2466/pms.101.1.131-148
49. Ruiz, L. M., Rioja, N., Graupera, J. L., Palomo, M., y García, V. (2015). GRAMI-2: Desarrollo de un test para evaluar la coordinación motriz global en la Educación Primaria. *Revista Iberoamericana de Psicología del Ejercicio y el Deporte*,*10*(1), 103-111.
50. Ruiz, L.M., Barriopedro, M.I., Ramón, I., Palomo, M., Riojz, N., García, V. y Navia, J.A. (2017). Evaluar la Coordinación Motriz Global en Educación Secundaria: El Test Motor SportComp. *RICYDE. Revista Internacional de*

Ciencias del Deporte, *49*, 285-301. doi.org/10.5232/ricyde2017.04907 https://doi.org/10.5232/ricyde2017.04907

51. Sigmundsson, H., y Hopkins, B. (2010). Baby swimming: exploring the effects of early intervention on subsequent motor abilities. *Child: Care, Health and Development, 36*(3), 428-430. https://doi.org/10.1111/j.1365-2214.2009.00990.x
52. Smits-Engelsman B. C. M., Henderson, S. E., y Michels, C. G. J. (1998). The assessment of children with Developmental Coordination Disorders in the Netherlands: The relationship between the Movement Assessment Battery for Children and the Körperkoordinations Test für Kinder. *Human Movement Science, 17*, 699-709. https://doi.org/10.1016/S0167-9457(98)00019-0
53. Tirosh, R., Katz-Leurer, M., y Getz, M. (2008). Halliwick-based aquatic Assessment: Reliability and validity. *International Journal of Aquatic Research and Education*, *2*(3), 224-236. https://doi.org/10.25035/ijare.02.03.04
54. Vallaey, M., y Vandroemme, G. (1999). *Psychomotoriek bij kinderen.* Leuven: Acco.
55. Wiart, L., y Darrah, J. (2001). Review of four tests of gross motor development. *Developmental Medicine and Child Neurology, 43,* 279-285. https://doi.org/10.1017/S0012162201000536
56. Yoon, D., Scott, K., y Hill, M. (2006). Review of three tests of motor proficiency in children. *Perceptual & Motor Skills, 102***,** 543-551. https://doi.org/10.2466/pms.102.2.543-551
57. Zimmer, R., y Volkamer, M. (1987). *Motoriktest für vier- bis sechsjärige Kinder (manual)*. Testart: Motorik-Inventar.

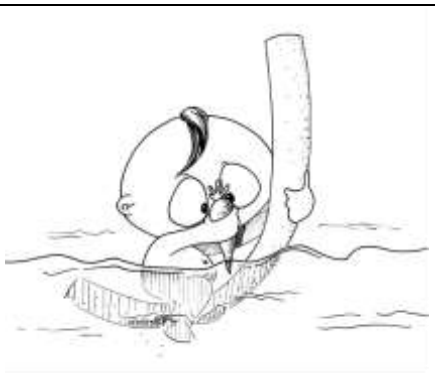
Número de citas totales / Total references: 59 (100%)
Número de citas propias de la revista / Journal's own references: 0 (0%)

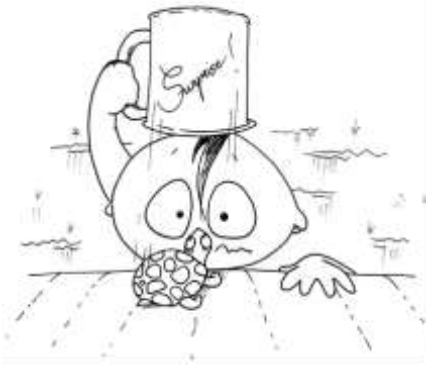
Annex I

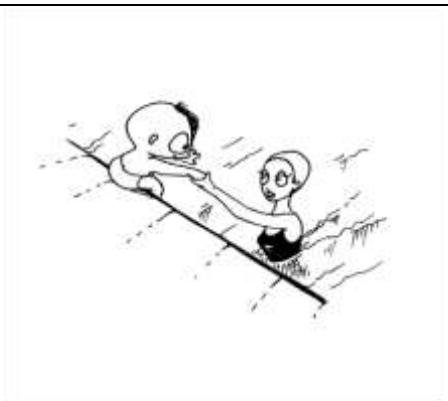
IEAD (Inventory of Evolutionary Aquatic Development) 6 to 12 month infants

Item and procedure	Illustration	Evaluation
SEA1 **Going into the water** The child goes into the pool in the arms of their carer and their reaction is observed		1. Cries as goes into the water 2. Looks afraid and holds on tightly to carer. Observes the pool, the toys and the other children. 3. Goes happily into the pool and looks happy, Observes the pool, the toys and the other children, participates moderately in the games. 4. Goes happily into the pool, remains free from the ledge, moves about and plays..
SEA2 **Responds to name turning when called from any corner of the pool** While playing in the water supported by a star made with noodle floats, the child's name is called and their response is observed. They can be called up to 3 times. Valuation is made on the child moving their head, eyes or by changing the position of their body at least 2 or 3 times. *Adaptation for hearing or emotional disorders:* The examiner will make an effort to attract the baby's attention. They will use a loud voice, sign language and other gestures and assess whether the baby follows with their head, eyes or changes position towards the examiner.		1. Doesn't respond. 2. Responds once when the interlocutor is opposite them. 3. Responds once to their name from another place or position, or twice when the interlocutor is opposite. 4. Always responds and from any place or position.

SEA3 **Plays peek-a-boo** The child is encouraged to play supported by the noodle floats placed in a star shape. Carer hides under the water and on coming out observes if the child looks towards where the carer peeps out, catching their attention by saying “peekaboo, cuckoo, here I am” .		1. Doesn’t play at all, is indifferent when carer pops out of water. 2. Behaves passively, observes the carer coming out but doesn’t interact or participate in the game. 3. Participates in the game sometimes, following with eyes and making expressions when carer appears near their field of vision. 4. Participates actively making expressions and asks to play the game.
LA1 **Associates words with actions or objects** After implementing certain games and actions during 2/3 classes, the baby is asked to point out, vocalize, do an action or look around to find the answer. Some examples could be: ‘Where are the balls?’ ‘Can you make bubbles with your hands?’ ‘Let’s see how you can make bubbles.’ ‘Can you put your foot in the water?’ *Adaptation for motor impairments:* If a child has a motor impairment that prevents them from doing the action, then the intention to do it will be assessed and, if there is intention, the carer will help them do it.		1. Does not respond to any action or word. 2. Only responds to one action. 3. Only responds to actions or looks for objects. 4. Responds to the action and the objects, looking for them or pointing to then or naming them.
LA2 **Babbles expressively** The child is observed in the water and is evaluated if he babbles expressively in the water.		1. Makes no sound. 2. Babbles sometimes 3. Babbles when asked to play or enjoys the action. 4. Always babbles.

LA3 **Makes sounds (consonants-vowels)** The child's vocabulary during the game is observed, noting whether they call out to their mummy/daddy/carer and whether after expressions like "call mummy", they repeat with a consonant-vowel sound.		1. Doesn't make any consonant-vowel sound. 2. Makes the consonant-vowel sound very few times or only sometimes. 3. Makes some sounds and almost always imitates those made to them. 4. Always makes sounds and imitates those made to them.
CA1 **Explores or investigates surroundings** The child is placed with the noodle floats in a star shape and their behaviour in the surroundings is observed.		1. Keeps still and doesn´t pay any attention to what is happening in the pool. 2. Observes the pool and what's happening in it. 3. Observes the pool and tries to take an object or interacts with a nearby object. 4. Approaches or asks to approach the rest of the children and tries to take the toys and interact with them.
CA2 **Explores objects** The child is placed with the noodle float in a vertical position, a floating toy is moved, if the child doesn't try to take the toy they are given it. *Adaptation for motor impairments:* If a child has a motor impairment that stops them from doing the action, the intention of doing it will be evaluated and if there is		1. Doesn't explore the toy. 2. Explores the toy for 0 to 8 seconds. 3. Explores the toy for 8 to 14 seconds.. 4. Explores the toy for more than 14 seconds..

an intention, the carer will help them do it.		
CA3 **Lifts a cup to be able to play with a toy.** The child is placed with the noodle float opposite a mat or the pool edge. A toy is moved on the mat to get their attention. When they are looking at it, it is covered with a cup. At the same time the carer says. 'The … is hidden.' 'Where's the …?' The cup is lifted and the carer says '… here's the …' The same procedure is repeated. The third time the cup isn't lifted waiting for the child to respond. *Adaptation for motor impairments:* If a child has a motor impairment that stops them from doing the action, the intention of doing it will be evaluated and if there is an intention, the carer will help them do it.		1. Shows no interest in getting the toy. 2. Looks at the cup and gestures for it to be lifted. 3. Tries lifting the cup but doesn't manage it. 4. Lifts the cup and gets the toy.

AMA1 **Movement/propulsion** The child moves around the pool supported by two noodle floats under their arms, with arms and legs free.		1. Maintains a parachute position with arms and legs stretched out and tense, without relaxing or initiating movement.. 2. Maintains a “colo” position, is held in carer’s arms and body adapts to movement. 3. Maintains a semi-flexed position, arms and legs are relaxed, they move, but cannot facilitate movement or make paddling movements. 4. Maintains a semi-flexed position, arms and legs move accompanying movement, paddling with hands and making cycling movement with legs.
AMA2 **Plunging into the water** Child sits on the edge of the pool and from inside the pool opposite them, the carer invites them to come in. *Adaptation for motor impairment*: The baby is placed in a sitting position on the edge of the pool with enough support to achieve a stable sitting position, either material support or support from carer. Their response will be assessed using any suitable means to do so: verbal response, gestures that show an intention to go or not go into the pool, or support from carer to do the action. If support from carer is needed, assessment will be made on the fear or intention of doing the action, not on the need for support		1. The child refuses to go into the pool. 2. The child goes into the pool supported by carer’s arms or forearms. 3. The child goes into the pool holding onto carer’s hands. 4. Child goes into the pool independently.

AMA3 **Breathing control** The child is encouraged to paddle and reactions to getting wet are observed.		1. Doesn't paddle and on perceiving the sensation of water on face is frightened or cries. 2. Paddles carefully and is bothered by the sensation of water on face. 3. Paddles carefully, but on getting accidentally wet, continues with the game without inhaling water 4. Paddles with hands and/or legs and when water falls on face, isn't frightened, enjoys the activity.
AMA5 **Dorsal balance** The carer supports the child's head and we evaluate if they maintain floating in dorsal position.		1. Doesn't accept the position and refuses to submerge ears in water, tries to get up bending neck, pelvis and trunk. 2. Maintains the position at a fixed point. 3. Accepts the position and stays on the noodle float. 4. Maintains floating in dorsal position independently.

AMA6 **Vertical balance** The child's behaviour is observed with the support of a noodle float.		1. Is unable to stay in this position with only the support of the noodle float. 2. Stays still with arms and legs stretched out with maximum tension. 3. Stays on the noodle float and can splash or take objects held out to them. 4. Stays on the noodle float and starts moving arms and legs to try moving towards and grasping the objects at a distance.