Seção: Sport Psychology

The Erbaugh Scale: validity and reliability of an instrument to assess children's aquatic competence

Rossane Trindade Wizer[1,3], Cristian Zanon[2], Flávio Antônio de Souza Castro[3]

[1]Instituto Federal de Educação, Ciência e Tecnologia do Rio Grande do Sul, Alvorada, RS, Brazil; [2]Universidade Federal do Rio Grande do Sul, Instituto de Psicologia, Departamento de Psicologia do Desenvolvimento e da Personalidade, Porto Alegre, RS, Brazil; [3]Universidade Federal do Rio Grande do Sul, Escola de Educação Física, Fisioterapia e Dança, Grupo de Pesquisa em Esportes Aquático, Porto Alegre, RS, Brazil.

Associate Editor: Paulo Henrique Guerra, Universidade Estadual Paulista "Júlio de Mesquita Filho", Rio Claro, SP, Brazil. E-mail: paulo.guerra@unesp.br.

Abstract - Aim: The aim of this study was to perform a cross-cultural validation of the Erbaugh Scale, developed to assess children's aquatic competence. **Methods:** The authors translated the Erbaugh Scale to Brazilian Portuguese and tested it in Brazil with respect to internal consistency as well as content, criterion, and construct validity. The translation was performed by four professionals, and the content validation was performed by three researchers and five swimming teachers. Two teachers participated in the reliability analysis. Moreover, 368 children, from 36 to 72 months of age, participated in the study. **Results:** The original Erbaugh Scale was reduced from 68 to 47 items distributed in six aquatic tasks. The items were clear and relevant, with satisfactory values for the total content validity coefficient (clarity = 0.87; relevance = 0.91) and for the percentage of agreement between the judges (clarity = 87%; relevance = 75%). Factor analysis indicated a unifactorial solution, and the factor loadings of the tasks presented satisfactory values (0.558-0.956). The Scale correctly predicted and identified the aquatic competence of different age groups and previous aquatic experience. Considering internal consistency, Cronbach's alpha was 0.91. The intraclass correlation coefficients for intra- and inter-rater reproducibility were excellent (0.92-1.00), and there were no intra- and inter-rater differences ($p > 0.05$). **Conclusion:** The Erbaugh Scale proved to be valid and reliable for application in children in the context of teaching swimming.

Keywords: swimming, children, validation, assessment.

1. Introduction

Swimming lessons expand children's aquatic competence[1-3]. It is believed that increasing aquatic competence offers protection against the risk of drowning[4,5], although many drowning victims can swim[6]. According to Brenner et al.[6], as children gain confidence in their aquatic skills, they become involved in more risky situations in this environment. Similarly, children's parents who practice swimming tend to overestimate their children's aquatic competence and reduce supervision in this environment[7]. In this way, assessment becomes an important tool to analyze the development of aquatic competence, as well as to provide information to parents and teachers about the actual competences of children in the aquatic environment. According to Chan et al.[8], there is a gap regarding the assessment of children's aquatic competence levels. The same authors also argue that the lack of instruments that provide reliable measures to assess aquatic competence can be considered a factor that enhances the risks of the relationship between the practice of swimming, the increase in aquatic competence, and the risk of drowning[8].

In a sequence of studies, Erbaugh[1,9-11] researched the abilities that constitute the aquatic development of preschool children and created the Erbaugh Scale (ES). The ES comprises six tasks: (i) Entry: Jump tasks, (ii) Locomotion: Tasks in the prone position; (iii) Locomotion: Tasks in the supine position; (iv) Locomotion: Leg movement; (v) Diving Tasks (from the pool's edge); and (vi) Tasks of searching for objects at the bottom of the pool (Erbaugh, 1981). Regarding the validity of the instrument, only data referring to the objectivity and reproducibility of the ES were reported by the author of the instrument. Erbaugh[9] evaluated 57 children between 2 and 6 years old and found intraclass correlation coefficients (ICC) between 0.98 and 0.99, as well as an inter-rater agreement between 85.9% and 96.4%. The results for consistency between trials and consistency between days were ≥ 0.94 and 0.84, respectively. Although the ES has rele-

vant characteristics to assess children's aquatic competence, there is no evidence to ensure the validity of the measurements. As researchers and professionals should base their decisions on results obtained from assessment instruments, it becomes relevant to submit the ES to the validation process. This procedure would make it possible to obtain valid and accurate measurements to represent a child's water competence level.

Logan et al.[12] highlighted the importance of an instrument being aligned with the operational definition of the evaluated construct. Considering aquatic competence, the differential of the ES lies in the fact that it considers the distance traveled by the child and the characteristics of the movement performed. This aspect highlights the concern of the author of the Scale with aquatic safety. The ES could provide information about the characteristics of the movement pattern, as well as how much the child can sustain this movement pattern over the distance covered. Therefore, this study aimed to carry out the cross-cultural adaptation of the ES, through translation to Brazilian Portuguese, and the analysis of validity based on content, internal structure, relationship with other variables, and reliability analysis.

2. Methods

2.1. Participants

The translation process was performed by two English-Portuguese translators and two swimming teachers with experience in the English language. In addition, three researchers with a PhD, experts in the field of swimming pedagogy, participated in the process of the ES content validation. Five swimming teachers, each with at least 10 years of experience, participated in the face validation phase. Two other experienced professionals in the application of the ES, and this study's first author analyzed the scale's reliability.

A total of 368 children (aged 36 to 72 months, with or without experience in swimming lessons) participated in the study; they were categorized by age (three groups) and by previous aquatic experience (PAE - experience with swimming lessons; four groups) as follows:

Age:

(i) 36 to 47 months (n = 75);
(ii) 48 to 59 months (n = 138); and
(iii) 60 to72 months (n = 155); and by

PAE:

(iv) < 1 month (n = 70);
(v) 1 to 6 months (n = 95);
(vi) 7 to12 months (n = 70); and
(vii) > 12 months (n = 133).

The sample size was calculated by using the GPower 3.1 application (input: F test for four PAE groups; medium effect size = 0.25; alfa = 0.05; power = 0.95). The minimum estimated sample size for each group was defined in n = 70. Data regarding the child's motor experiences and PAE were obtained through a form answered by the parents/guardians. This research was submitted for evaluation by the Local Research Ethics Committee and approved (number 2.532.306). In addition, it followed the determinations of resolution 466/2012 of the National Health Council.

The ES was applied in swimming schools, clubs, and in condominiums with swimming pools. For this endeavor, prior contact was made with the establishments to inform them of the objectives and procedures of the research. Upon obtaining the consent of each establishment, the child's parents or guardians were informed about the purpose of the research and the activities that would be carried out with the child. When parents agreed to participate, they signed the Free and Informed Consent Form they had been given. In addition to parental consent, the child's verbal consent was obtained.

2.2. Measures

The ES constitutes an assessment tool that requires observational techniques. It was designed to assess the aquatic competence of children from 24 to 72 months; however, in this study, it was decided to assess children from 36 to 72 months. For children under 36 months, many swimming schools usually require the presence of parents in the pool, and this situation would make it difficult for the evaluator to perform the test as prescribed. The original ES comprises 68 items divided into six tasks. All tasks are related to the child's aquatic competence; in this case, it was expected that a one-factor solution would be found for the data obtained from the ES. Items are organized and numbered in the order of difficulty. Thus, for the first task, which corresponds to Entry: Jump tasks, there are 18 items. The first level of execution (the simplest) receives a score of 1, and the last (the most complex) of the items receives a score of 18[10]. Each item is described considering the characteristics of the movement of the upper and lower limbs and the body position and provides information about the distance covered[10]. The original ES tasks are described in Table 1.

The assessment can typically be completed within 15-20 min. Erbaugh (1981) pointed out that two or three attempts at each task are enough to verify the child's performance. According to Erbaugh[10], a greater number of attempts can make the test tiring, which can lead to a decrease in performance.

2.3. Design and procedures

A double-back reverse independent translation procedure was adopted[13]. First, two translators translated the instrument from English to Brazilian Portuguese. Subsequently, two other translators back-translated it to the original language. It is important to highlight that the

Table 1 - Description of Erbaugh Scale Tasks and original number of items.

Tasks	Description	Number of ítems
Entry: Jump tasks	It refers to how the child performs the task of entering the water.	18
Locomotion: Tasks in the prone position	It refers to the way the child stands and moves in the prone position.	14
Locomotion: Tasks in the supine position	It refers to the way the child stands and moves in the supine position.	15
Locomotion: Leg movement	It refers exclusively to the pattern of leg movement performed by the child in the prone position.	14
Diving tasks	It refers to the way the child performs the movement of entering the pool by jumping from the edge towards the water. It differs from "Tasks of Jumping" because the contact with the aquatic environment is carried out primarily with the head or belly.	3
Tasks of searching for objects at the bottom of the pool	It refers to the ability to search for objects that are submerged in the bottom of the pool.	4

translation of assessment instruments also involves committee analysis[13]. For this step, all translators were invited by the first author to a meeting in which the four versions were compared with the original version of the instrument. The versions were revised, and semantics adjusted in unanimous agreement. This procedure resulted in a final translated and edited version of the ES.

For content validity, three experts used a Likert-type scale to assess language clarity and the relevance of all motor items. They had five response options, namely: (5) very clear/relevant; (4) somewhat clear/relevant; (3) neutral; (2) not really clear/relevant; and (1) not at all clear/relevant. Items with very low scores were reworded or deleted and sent back to the experts for review. To strengthen the evidence related to the instrument's content, five swimming teachers were invited to perform the same procedure.

Two evaluators applied the ES in the 368 children. One of them, who had experience in teaching aquatic skills to children, remained in the pool and was responsible for applying the instrument to each child. The other evaluator remained on the edge of the pool and was responsible for operating a video camera to obtain images for each test applied. All evaluations were recorded for later analysis. The order for applying the tasks was suggested by the author of the instrument to assess children with little experience in the aquatic environment (first, Tasks of searching for objects at the bottom of the pool; second, Locomotion: Tasks in the prone position; third, Locomotion: Tasks in the supine position; fourth, Locomotion: Leg movement; fifth, Entry: Jump tasks; sixth, Diving Tasks)[10]. This order was maintained regardless of the child's PAE because the task of searching for objects at the bottom of the pool contributes to the establishment of a bond between the evaluator and the child, facilitating the application of the instrument.

In those tasks that required control of the distances covered, colored ethylene vinyl acetate (EVA) bands, each measuring 0.5 m, were used side by side, until reaching 6 m at the side edge of the pool. The color difference provided by the EVA bands enabled the visualization of the distance traveled by the child during the analyses of the videos. One meter was added between the place where the child started the test and the beginning of the placement of the EVA bands. The objective was to disregard the child's height and to minimize the effects of the edge impulse at the beginning of the task. Subsequently, the evaluator analyzed the images obtained and scored the child's performance in each of the ES tasks.

Among the 368 children, 27 children with < 1 month of PAE were drawn and evaluated monthly until the acquisition of independent displacement in the aquatic environment. For feasibility purposes, a maximum period of 6 months for evaluations was established. This step aimed to seek evidence of ES validity based on the relationship with other variables. This process verified the instrument's power to accurately predict future aquatic competence based on the result of the first assessment. A predictive study indicates the strength of the relationship between test scores and criterion scores that are obtained later[14]. So, independent displacement in the aquatic environment was used as an aquatic competence criterion because it is an important skill to be achieved by children in this environment[15]. In this sense, the child's displacement for 3 m without external assistance (people and materials) and being able to raise their head, at least once, to inhale without interrupting the swim, was interpreted as independent displacement. To analyze the scale's reliability, the same evaluator analyzed 30 randomly selected tests, with an interval of 30 days after the first analysis. In addition, two professionals with experience in the use of the ES were invited to independently analyze the same 30 tests.

2.4. Statistical procedures

2.4.1 Validity evidence based on content

For the data obtained from the PhD judges, the content validity coefficients (CVC) were calculated for clarity and relevance. Values > 0.7 were considered acceptable[16].

The agreement percentage was used to analyze the responses obtained from the five swimming teachers. No cut-off point was established for these values. The procedure of rigorous analysis of the items that obtained < 60% agreement was adopted. According to Borsa et al.[17], the objective of the assessment by the target audience is to analyze the adequacy of the items and the structure of the instrument, therefore, no statistical procedure is required at this stage of validation.

2.4.2 Validity evidence based on internal structure

The Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity were used to verify the possibility of applying factor analysis to the research data. Hair et al.[18] consider a value > 0.5 in the KMO test to be adequate. For Bartlett's test of sphericity, $p < 0.001$ must be found. Principal axis factor was used as the extraction method, and no rotation was applied. Eigenvalues > 1 and inspection of the scree plot were used to the factor retention. Factor loadings > 0.5 were considered satisfactory[19].

2.4.3 Validity evidence based on the relationship to other variables

Pearson's correlation test was used to correlate the result obtained in the first assessment with the time it took the child to acquire independent displacement in the aquatic environment, based on the monthly assessments carried out. The instrument's predictive capacity was analyzed by using the Z-score. The Z-score was calculated for each task and for the total sum in each of the assessments performed. To interpret the results, $r < 0.1$ is considered very low; between 0.1 and 0.39 is considered low; between 0.4 and 0.69 is considered moderate; between 0.7 and 0.89 is considered high; and between 0.9 and 1 is considered very high[20]. Analysis of variance (ANOVA) with Levene's test, Tukey's post hoc test, and the eta-square (eta^2) statistic was used as effects size (age and PAE groups).

2.4.4 Reliability

Internal consistency was analyzed by using Cronbach's alpha. Values were categorized according as[19]: < 0.70 is not acceptable; between 0.70 and 0.79 is reasonable; between 0.80 and 0.89 is good; and > 0.90 is excellent. According to Hair et al.[18], item-total correlation values > 0.5 should be considered, as well as item-item values above 0.3. In the present study, the correlation between each task and the ES as well as the correlations between tasks were used to analyze the instrument's internal consistency.

The inter- and intra-rater scores were analyzed by Intraclass Correlation Coefficient (ICC). These values were calculated based on the mean measurements. Absolute agreement and a two-way mixed model were used. For interpretation of ICC values the categorization was: < 0.40 is poor; between 0.40 and 0.59 is reasonable; between 0.60 and 0.74 is good; and > 0.75 is excellent[18]. Student's t-test for paired samples was used to compare data obtained by the same evaluator. To compare the data obtained from the three evaluators, one-way ANOVA with the Bonferroni post hoc test was applied. An alpha of 0.05 was used in the statistical analyses, which were performed in the SPSS v.20.0 and in GraphPad Prisma 8.0.

3. Results

3.1. Validity evidence based on content

In the committee review, some items were deleted, others were reformulated, and others were separated, resulting in a reduction from 68 to 65 items. The evaluation of the items by the PhD judges involved three stages, until satisfactory CVC values were found (> 0.7). At the end of this process, the ES had 47 items. Regarding face validity, agreement percentages of 87% (60%-100%) and 75% (40%-100%) were found for the clarity and relevance of the ES items, respectively. In Table 2 it is possible to observe the changes that occurred in the number of items

Table 2 - Changes in the number of items on Erbaugh Scale (ES) resulting from the content validity process. CVC: content validity coefficient.

Tasks	Number of items (original)	Number of items (after committee review)	Number of items (after PhD judges review)	CVC clarity	CVC relevance
Entry: Jump tasks	18	12	5	0.84	0.95
Locomotion: Tasks in the prone position	14	13	10	0.84	0.92
Locomotion: Tasks in the supine position	15	14	10	0.90	0.88
Locomotion: Leg movement	14	11	9	0.88	0.87
Diving tasks	3	8	6	0.84	0.89
Tasks of searching for objects at the bottom of the pool	4	7	7	0.90	0.96
Overall	68	65	47	0.87	0.91

in each task and the CVC for clarity and relevance for each task and for the total ES.

3.2. Validity evidence based on internal structure

The KMO index was 0.896 and Bartlett's sphericity test was significant ($p < 0.001$). The scree plot indicated a one-factor solution for this set of items. This solution produced a factor with an eigenvalue of 4.431 and explained 73.8% of the total variance. The tasks with their respective factor loadings are shown in Table 3.

3.3. Validity evidence based on the relationship to other variables

The ES proved to be able to predict the aquatic competence of children between 36 and 72 months old. The data showed a significant, negative, and moderate correlation between the values obtained in the 1st, 2nd, and 3rd assessment and the moment when the child acquired independent displacement in the water (higher for the 1st assessment, shorter time to acquire the target skill). It is important to highlight that the correlation values increased in each assessment. In addition, the values obtained in the 1st assessment showed a positive and strong correlation with the scores obtained in the second assessment, and the same occurred between the second and third assessments. Between the 1st and 3rd assessments, the correlation was positive but moderate. Table 4 shows these results.

Regarding discriminant validity, the ANOVA showed that the aquatic competence values increased from the youngest to the oldest age group [$F(2; 356) = 73.99$; $p < 0.001$; $eta^2 = 0.29$] as well as from the least to the most experience [$F(3; 356) = 27.90$; $p < 0.001$; $eta^2 = 0.19$]. However, the group of children with 7-12 months of experience showed no difference when compared with the group with up to 6 months of experience ($p = 0.185$) and when compared with the group with > 12 months of experience ($p = 0.190$). There was no interaction between the age and experience groups [$F(6; 356) = 1.47$; $p = 0.185$; $eta^2 = 0.02$]. The means and standard deviations for the different age and experience groups are presented in Figure 1.

Table 3 - Erbaugh Scale tasks and their respective factor loadings.

Erbaugh scale tasks	Factor loads
Entry: Jump tasks	0.869
Locomotion: Tasks in the prone position	0.956
Locomotion: Tasks in the supine position	0.816
Locomotion: Leg movement	0.913
Diving tasks	0.558
Tasks of searching for objects at the bottom of the pool	0.833

Table 4 - Pearson correlation for analysis between the moment of acquisition of independent displacement and the results of monthly assessments.

	Moment (p-value)	Z-score T1 (p-value)	Z-score T2 (p-value)
Z-score T1	-0.56 (0.002)		
Z-score T2	-0.64 (<0.001)	0.73 (<0.001)	
Z-score T3	-0.68 (<0.001)	0.60 (<0.001)	0.84 (<0.001)

3.4. Reliability

The internal consistency of the scale, assessed using Cronbach's alpha, was 0.91. The task-total correlation indicated values between 0.537 and 0.913, while the task-task correlation indicated values between 0.463 and 0.905.

Table 5 presents intra-rater (ICC and paired t-test results) and inter-rater (ICC and ANOVA results) assessments. There were no significant differences in the intra-rater data. Regarding the Entry: Jump tasks, it was not possible to calculate the ICC and the t-test, because the standard error of the difference was zero. Regarding the inter-rater data, no statistical differences were found.

4. Discussion

In the context of swimming teaching, the skills that represent aquatic competence are defined arbitrarily by professionals in the area, so their selection tend to have little representation in broader contexts. Thus, the objectives of this study were to adapt the ES to Brazilian Portuguese and to investigate the ES validity and reliability, used to assess the aquatic competence of children between 36 and 72 months old. Regarding the translation of the instrument, the procedure adopted made it possible to reduce biases inherent to the process when only one translator is involved[13,21]. According to Beaton et al.[21], the participation of translators with practical knowledge about

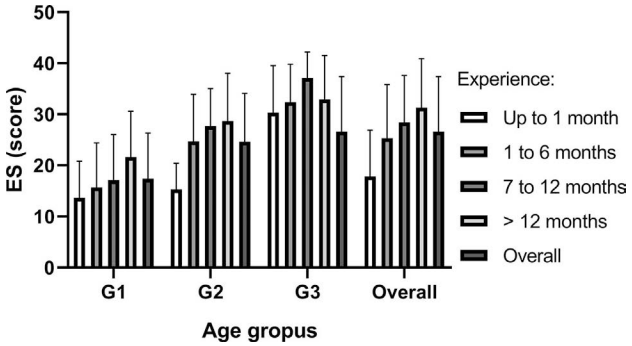

Figure 1 - Means and standard deviations for the values of aquatic competence by age range and previous aquatic experience (PAE) obtained in the Erbaugh test. G1 36-47 months, n = 75 (up to 1 month, n = 21; 1 to 6 months, n = 17; 6 to 12 months, n = 11; more than 12 months, n = 26); G2 48-59 months, n = 138 (up to 1 month, n = 28; 1 to 6 months, n = 42; 6 to 12 months, n = 24; more than 12 months, n = 44); G3 60-72 months, n = 155 (up to 1 month, n = 21; 1 to 6 months, n = 36; 6 to 12 months, n = 35; more than 12 months, n = 63).

Table 5 - Intraclass correlation coefficient (ICC) values for intra-rater assessment and paired t-test result for comparison of intra-rater data and ICC values for inter-rater assessment and one-way ANOVA result for comparison of inter-rater data.

	Intra-rater assessment		Inter-rater assessment	
	ICC	**t-test results**	**ICC**	**ANOVA results**
Entry: jump tasks	1.00	-	0.99	F(2.87) = 0.01 p = 0.98
Locomotion: tasks in the prone position	0.99	t(29) = -0.57 p = 0.57	0.98	F(2.87) = 0 .17 p = 0.84
Locomotion: tasks in the supine position	0.99	t(29) = 1.00 p = 0.32	0.98	F(2.87) = 0.84 p = 0.98
Locomotion: leg movement	0.99	t(29) = 0.00 p = 1.00	0.98	F(2.87) = 0.014 p = 0.95
Diving tasks	0.99	t(29) = -1.43 p = 0.16	0.92	F(2.87) = 0.004 p = 0.30
Tasks of searching for objects at the bottom of the pool	0.99	t(29) = -1.43 p = 0.16	0.98	F(2.87) = 1.21 p = 0.08
Overall	0.99	t(29) = -1.27 p = 0.21	0.99	F(2.87) = 0.09 p = 0.91

the construct on the committee allows meeting the criterion of experiential equivalence.

The search for evidence based on content aims to verify the relevance and representativeness of the items based on the opinions of individuals with solid knowledge in the area[22]. The Entry: Jump tasks were the most modified among the ES tasks because the items were very similar, a factor that made it difficult to identify the child's level on the ES. Changes were made by the experts in an attempt to establish more accurately the difference among items. On the other hand, the task of searching for objects at the bottom of the pool underwent the fewest changes. In general, CVC > 0.70 for each item and > 0.84 for the average of the items in relation to clarity and relevance indicate that the ES has satisfactory validity indexes of content[16].

Regarding face validity of the ES, the mean values of agreement for clarity and relevance are adequate; however, when observed in isolation, the values are not ideal, with minimum values of 60% for clarity and 40% for relevance. According to Borsa et al.[17], it is important to note that during the assessment process by the target population, no statistical procedure is performed, but the adequacy of the items and the structure of the instrument must be assessed (whether the terms are clear, whether they are in accordance with reality, whether they are well written, etc.). Thus, after evaluating the ES items by the target audience, a qualitative analysis was carried out and adaptations were made to make the items clearer and more relevant.

In this regard, it is relevant to discuss the study by Quan et al.[23], in which a few institutions responsible for offering aquatic programs around the world were contacted to answer what skills are needed to move in a deep pool. Quan et al.[23] aimed to identify common components in the responses to synthesize and standardize the concept of aquatic competence. The authors highlighted the lack of consensus on the skills that represent the aquatic competence construct, and this lack of consensus was represented in the results of the present study, in which low agreement was found among swimming teachers, especially regarding the relevance of the items.

Regarding factor analysis, the eigenvalue (4.431) explains 73.8% of the total variance. Furthermore, analysis of the scree plot reinforced that the one-factor solution satisfies the data model presented. Although there are no validation studies regarding the internal structure of the ES, a one-factor solution was expected because the ES tasks constitute basic aquatic skills[8]. Factor loadings were used to assess the weight of each variable in relation to the aquatic competence factor/construct. They ranged from 0.558 (Diving tasks) to 0.956 (Locomotion: Tasks in the prone position). These results indicate that the variables used to represent aquatic competence constitute appropriate indicators. Lower factor loading in the Diving tasks was expected because, during the data collection, diving is a task that does not correspond to the cultural repertoire of movements taught in swimming lessons for children aged 36-72 months. Similar results were found previous studies[1,3].

According to Erbaugh[1], diving tasks are developed later compared with the other tasks of the ES. Erbaugh[1] also pointed out that children at this age usually show progress in diving tasks only after 2 years of swimming lessons. In this regard, it is noteworthy that Diving tasks are initiated at the edge of the pool. Due to this specificity, they can also be related to land motor skills, such as the ability to jump. The ability to jump has not yet reached a mature stage in children aged 3-5 years[24]. This immaturity is manifested, for example, in the reduced flexion of the joints in preparation for the jumping movement and shorter flight phase[25]. From that, two justifications are suggested for the children's lower performance on the diving task. The first is related to the children's limited experience in performing the task. The second is related to the immaturity of children, who at this age have not yet developed a mature pattern of jumping.

Regarding the validity evidence based on the relationship to other variables, the instrument proved to be able to predict future behaviour based on the result obtained in the first assessment. Although the correlation was moderate, it was statistically significant, that is, the higher the initial assessment result, the sooner the children

acquired the in-water independent displacement. As corroboration of this prediction, the values obtained in the second assessment showed a positive and strong correlation with scores obtained in the first assessment, and this value was even stronger between the third and second assessments. These results suggest a tendency for children with greater aquatic competence in the first assessment to follow this same pattern in relation to other children in the following assessments. This result contributes to the practical field of swimming pedagogy because the teacher will be able to identify, from the test result, the need for differentiated pedagogical resources to optimize the development of the student's aquatic competence.

The results also revealed that the correlation became stronger at each assessment, showing the importance of experience in the development of aquatic competence[1,3]. This result suggests that increased experience in an aquatic environment contributes to the identification of the moment of acquisition of independent displacement. This is because the beginning of the water skills learning process is marked by wide instability of motor, cognitive, and emotional behaviour resulting from the variability of stimuli to which each child was submitted during development[26]. The experience in formal swimming classes enables the consolidation of acquired water skills, making the correlation between the test score and the acquisition of independent swimming stronger at each assessment.

Regarding discriminant validity, the instrument proved to be able to differentiate groups by age and experience. These results corroborated those by Erbaugh[1], who used the ES to assess the aquatic competence of children with different amounts of experience. Those with PAE maintained higher scores in all assessments over a period of 8 months compared with children belonging to the group with no previous experience in swimming lessons. Rocha et al.[2] also reinforced the role of experience in the development of aquatic competence, regardless of the characteristics of the environment in which the classes are held. Regarding the role of age in the development of aquatic competence, Erbaugh[1] correlated age with the aquatic performance of 56 boys and 61 girls. The results showed a moderate correlation between age and aquatic performance. In addition, it is pointed out that younger children need more time to reach a certain skill level in an aquatic environment than older children[27]. However, in terms of age, younger children with more experience in the aquatic environment reach competence in certain skills before their older peers[27]. This result suggests that both age and experience in swimming lessons exert influence on the child's aquatic competence.

Analysis of the internal consistency of a scale indicates whether the tasks that make up the instrument measure the same construct[13]. Cronbach's alpha (0.91) as well as the values obtained from the task-task correlation (between 0.463 and 0.905) and task-total (between 0.537 and 0.913) suggest that all tasks of the ES deal with the same construct. However, in both situations, the lowest values were found in the Diving tasks (task-total = 0.537; task-task = 0.463). The ICC values for inter- and intra-rater reproducibility were excellent, and no inter- or intra-rater differences were found. Previous study[28] analysed the values for intra-rater assessment, and these were satisfactory (kappa > 0.67), however, the values for inter-rater agreement were very low (kappa < 0.51). Although ICC were used in the present study, the values were excellent[19] for both cases, suggesting that the changes made in the content of the ES had a positive impact on its reliability.

While children with different experiences in the aquatic environment participated, we believe that this study represents the Brazilian population in the age range (36 to 72 months). On the other hand, differences in pedagogical conduct among teachers, based on their training in different locations, can be indicated as a limitation of the present study, especially in relation to the results of the older age groups. It is important to highlight that the results are not sufficient to develop comparison parameters. In this sense, it is not yet possible to categorize levels of water competence. For these cut-off points and levels to be identified, it is recommended that research be carried out to standardize data of the ES.

5. Conclusions

Based on the data obtained, it is possible to affirm that the Brazilian version of the ES, now with 47 items, presents satisfactory evidence regarding content, criterion, and construct validity, as well as reliability. Therefore, it can be used, after teacher training, to assess the aquatic competence of Brazilian children between 36 and 72 months of age. With this result, we seek to contribute to the area of swimming pedagogy, offering an instrument that allows the identification of the level of aquatic competence of children aged 36-72 months for teachers and researchers in the area. The use of valid and reliable measures in this context provides the possibility to assess the teacher's pedagogical practice, to develop effective teaching strategies, and to inform parents and students about the child's level of competence in water.

References

1. Erbaugh SJ. Effects of aquatic training on swimming skill development of preschool children. Percept Mot Ski. 1986a;62(2):439-46. doi
2. Rocha HA, Marinho DA, Garrido ND, Morgado LS, Costa AM. The acquisition of aquatic skills in preschool children: deep versus shallow water swimming lessons. Motricidade. 2018;14(1):66-72. doi
3. Zhu W, Erbaugh SJ. Assessing change in swimming skills using the hierarchical linear model. Meas Phys Educ Exerc Sci. 1997;1(3):179-201. doi

4. Asher KN, Rivara FP, Felix D, Vance L, Dunne R. Water safety training as a potential means of reducing risk of young children's drowning. Inj Prev. 1995;1:228-33. doi
5. Yang L, Nong QQ, Li CL, Feng QM, Lo SK. Risk factors for childhood drowning in rural regions of a developing country: a case-control study. Inj Prev. 2007;13(3):178-82. doi
6. Brenner RA, Saluja G, Smith GS. Swimming lessons, swimming ability, and the risk of drowning. Int J Inj Contr Saf Promot. 2003;10(4):211-6. doi
7. Morrongiello BA, Sandomierski M, Spence JR. Changes over swim lessons in parents' perceptions of children's supervision needs in drowning risk situations: "his swimming has improved so now he can keep himself safe". Health Psychol. 2014;33(7):608-15. doi
8. Chan DKC, Lee ASY, Hamilton K. Descriptive epidemiology and correlates of children's swimming competence. J Sports Sci. 2020;38(19):2253-63. doi
9. Erbaugh SJ. Assessment of swimming performance of preschool children. Percept Mot Ski. 1978;46(3):1179-82. doi
10. Erbaugh SJ. The development of swimming skills of preschool children over a one and one-half year period. Thesis, University of Wisconsin, Madison; 1981.
11. Erbaugh SJ. Effects of body size and body mass on the swimming performance of preschool children. Hum Mov Sci. 1986b;5(4):301-12. doi
12. Logan SW, Ross SM, Chee K, Stodden DF, Robinson LE. Fundamental motor skills: a systematic review of terminology. J Sports Sci. 2018;36(7):781-96. doi
13. Vallerand RJ. Vers une méthodologie de validation trans-culturelle de questionnaires psychologiques: implications pour la recherche en langue française. Can Psychol. 1989;30 (4):662-80. doi
14. American Educational Research Association, American Psychological Association, and National Council on Measurement in Education. Standards for educational and psychological testing. Washington, DC, American Psychological Association; 2014.
15. Langendorfer SJ. Considering drowning, drowning prevention, and learning to swim. Int J Aquatic Res Educ. 2011;5 (3):236-43. doi
16. Chiquetti EMS, Valentini NC, Saccani R. Validation and reliability of the test of infant motor performance for Brazilian infants. Phys Occup Ther Pediatr. 2020;40(4):470-85. doi
17. Borsa JC, Damásio BF, Bandeira DR. Cross-cultural adaptation and validation of psychological instruments: some considerations. Paidéia. 2012;22(53):423-32. doi
18. Hair JF, Black WC, Babin BJ, Anderson RE. Multivariate data analysis (7th ed.). Upper Saddle River, Pearson Education; 2014.
19. Cicchetti DV. Guidelines, criteria, and rules of thumb for evaluating normed and standardized assessment instruments in psychology. Psychol Assess.1994;6(4):284-90. doi
20. Schober P, Boer C, Schawarte LA. Correlation coefficients: appropriate use and interpretation. Anesth Analg. 2018;126 (5):1763-8. doi
21. Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the process of cross-cultural adaptation of self-report measures. Spine. 2000;25(24):3186-91. doi
22. Messick S. Meaning and values in test validation: the science and ethics of assessment. ER. 1989;18(2):5-11. doi
23. Quan L, Ramos W, Harvey C, Kublick L, Langendorfer SJ, Less TA, *et al*. Toward defining water competency: an american red cross definition. Int J Aquatic Res Educ. 2015;9(1):12-23. doi
24. Chan-Viquez D, Hasanbarani F, Zhang L, Anaby D, Turpin NA, Lamontagne A, *et al.* Development of vertical and forward jumping skills in typically developing children in the context of referent control of motor actions. Dev Psychobiol. 2020;62(6):711-22. doi
25. Labiadh L, Ramanantsoa M, Golomer E. Preschool-aged children's jumps: imitation performances. J Electromyogr Kinesiol. 2010;20(2):322-9. doi
26. Parker HE, Blanksby BA, Quek KL. Learning to swim using buoyancy aides. Pediatr Exerc Sci. 1999;11(4):377-92. doi
27. Anderson DI, Rodriguez A. Is there an optimal age for learning to swim? Journal of Motor Learning and Development. 2014;2(4):80-9. doi
28. Wizer RT, Franken M, Castro FAS. Within and between observer agreement in a protocol for aquatic skills assessment in children. Rev Bras Ciênc Mov. 2016;24(1):101-7. doi

Corresponding author

Flávio Antônio de Souza Castro. Universidade Federal do Rio Grande do Sul, Escola de Educação Física, Fisioterapia e Dança, Porto Alegre, RS, Brasil.
E-mail: souza.castro@ufrgs.br.

Manuscript received on October 6, 2022
Manuscript accepted on December 27, 2024