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ASSESSMENT OF WATER SAFETY COMPETENCIES IN CHILDREN AND ADOLESCENTS AIMING AT THE PREVENTION OF DROWNING: AN ANALYSIS OF THE METHODOLOGIES APPLIED

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Undergraduate thesis presented to the Faculty of Physical Education and Physiotherapy at the Federal University of Amazonas (UFAM), as a requirement to obtain the title of Graduate in Physical Education.

Supervisor: Prof.ª Dra. Kelly de Jesus

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Dedicated to my mother, Liciane Gonçalves Maciel.

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“All good writing is swimming under water and holding your breath”
– F. Scott Fitzgerald

ABSTRACT

This study aimed to analyze and synthesize the scientific literature on the assessment methodologies applied to measure water competence and its relationship with drowning prevention in children and adolescents, with emphasis on the contextual variation of aquatic environments (controlled pools versus open water). A literature review was conducted in: SPORTDiscus, MEDLINE, EMBASE and PubMed using combination of terms related to aquatic competence, water safety skills, drowning prevention and assessment instruments. Studies were included if objectively measured the water competence including at least one component: motor skills, aquatic security knowledge, and risk/safety attitudes, in participants aged three to sixteen years old. A total of 20 articles met the inclusion criteria. The results revealed that most instruments focus predominantly on procedural motor skills and are applied almost exclusively in swimming pool environments. Only a limited number of tools assess cognitive and affective components, such as safety knowledge, fear, confidence, or risk perception. The review also identified a lack of assessments conducted in open-water settings, despite strong evidence that natural aquatic environments pose the greatest drowning risk. Furthermore, studies evaluating perceived and actual competence showed consistent discrepancies, indicating that overestimation of the water competence may influence unsafe behaviors. Ultimately, these results reinforce the need for assessment practices that reflect the real-world conditions in which aquatic risks occur, and tools that integrate motor, cognitive, and affective dimensions and reflect the ecological realities in which children engage with water.

Keywords: Water competence; water safety; drowning prevention; assessment tools; children; aquatic environment.

RESUMO

Este estudo teve como objetivo analisar e sintetizar a literatura científica sobre as metodologias de avaliação aplicadas para avaliar a competência aquática e sua relação com a prevenção de afogamentos em crianças e adolescentes, com ênfase na variação contextual dos ambientes aquáticos (piscinas controladas versus águas abertas). Foi realizada uma revisão bibliográfica em: SPORTDiscus, MEDLINE, EMBASE e PubMed, utilizando uma combinação de termos relacionados à competência aquática, habilidades de segurança aquática, prevenção de afogamentos e instrumentos de avaliação. Estudos foram incluídos se a competência em água foi medida objetivamente, incluindo pelo menos um componente: habilidades motoras, conhecimento em segurança aquática e atitudes de risco/segurança, em participantes de três a dezesseis anos de idade. Um total de 20 artigos atendeu aos critérios de inclusão. Os resultados revelaram que a maioria dos instrumentos foca predominantemente em habilidades motoras procedurais e é aplicada quase exclusivamente em ambientes de piscina. Apenas um número limitado de ferramentas avalia componentes cognitivos e afetivos, como conhecimento de segurança, medo, confiança ou percepção de risco. A revisão também identificou a falta de avaliações realizadas em ambientes de águas abertas, apesar das fortes evidências de que ambientes aquáticos naturais apresentam o maior risco de afogamento. Além disso, estudos que avaliaram a competência percebida e real mostraram discrepâncias consistentes, indicando que a superestimação da competência aquática pode influenciar comportamentos inseguros. Em última análise, esses resultados reforçam a necessidade de práticas de avaliação que reflitam as condições reais em que ocorrem riscos aquáticos, e ferramentas que integrem dimensões motora, cognitiva e afetiva, além de refletir as realidades ecológicas em que as crianças se envolvem com a água.

Palavras-chave: Competência aquática; segurança aquática; prevenção de afogamento; instrumentos de avaliação; crianças; ambiente aquático.

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LIST OF ABBREVIATIONS AND ACRONYMS

WC	Water Competence
SC	Swimming Competence
AC	Aquatic Competence
PAC	Perceived Aquatic Competence
RAC	Real Aquatic Competence
NPAE	Negative prior aquatic experiences

SUMMARY

1 INTRODUCTION

In 1995, Langendorfer and Bruya introduced the term water competence into their text Aquatic Readiness: Developing Water Competence in Young Children. The authors defended the importance of the global development of aquatic skills, emphasizing that knowledge, values and attitudes are also part of the notion of water competence.

In this sense, water competence is defined as “the sum of all personal aquatic movements that help prevent drowning, as well as the associated water safety knowledge, attitudes, and behaviors that facilitate safety in, on, and around water” (Moran, 2013, p. 4). This more inclusive term replaces the concept of ‘swim and survive’ with its currently limiting inference that swim = safe. Stallman and colleagues in 2017 recommended that swimming ability is promoted as a necessary component of water competence but understanding that ability alone is [often] not sufficient to prevent drowning.

Contemporary research consistently frames water competence as a multidimensional construct, composed of interdependent motor (procedural), cognitive (conceptual) and affective/attitudinal components that collectively determine how individuals behave in, on, and around water. Pinto and Moreno-Murcia (2023) propose that aquatic competence emerges through the interaction of “knowing how to act” (procedural), “knowing about the environment and its risks” (conceptual), and “knowing how to regulate oneself” (attitudinal), emphasizing that these elements operate holistically in dynamic aquatic contexts. According to Stallman et al. (2017), water competence involves not only swimming technique but also the knowledge and attitudes necessary to recognize hazards and respond effectively in unexpected or high-risk situations.

This means that technical motor performance alone, especially when assessed exclusively in pools, cannot adequately represent a learner’s real capacity to avoid drowning in open water. Integrating these three dimensions is therefore essential for evaluating whether assessment instruments truly reflect the protective skills required for drowning prevention. In the context of this study, analyzing whether

existing tools assess procedural abilities, safety knowledge, and risk/safety attitudes across different aquatic environments is crucial for understanding their alignment with the broader concept of water competence.

“Drowning is a significant, complex, and multifaceted phenomenon, which has at its heart, the way in which humans interact with their aquatic environment” (Moran, 2013, p. 7). This complexity highlights the need for instructional approaches that incorporate environmental variability, behavioral responses, and contextual decision-making into aquatic education. It is crucial to equip young people with key water skills through a well-designed aquatic curriculum to protect them from drowning and engage them in the long term in aquatic physical activities. In this context, in the teaching of swimming aimed at children, the continuous evaluation of aquatic skills is essential, and the programs must be adapted to the reality of learners, their exposure to water environments, and the risks they may encounter, since drowning episodes still represent a recurrent problem (POTDEVIN, F. et al. 2025).

Furthermore, because most drownings occur outside controlled pool environments (SOBRASA, 2023), it is important to understand whether current assessment methodologies consider different aquatic contexts such as rivers, lakes, and seas. Evaluating children's abilities exclusively in pools risks producing incomplete representations of their actual competence and may fail to reflect the environmental challenges associated with drowning events.

Thus, the central question of this study emerges: What methodologies for assessing aquatic competencies (including skills, knowledge, and attitudes) are used, and is there an assessment regarding the drowning prevention in children and adolescents, considering different aquatic settings (pools, rivers, lakes, and sea)?

2 OBJECTIVES

2.1 GENERAL OBJECTIVE

To analyze and synthesize the scientific literature on the assessment methodologies applied to measure aquatic competence and its relationship with drowning prevention in children and adolescents, with emphasis on the contextual variation of aquatic environments (controlled pools versus open water).

2.2 SPECIFIC OBJECTIVES

To identify and describe the different methodologies for assessing water competence reported in the literature for children between 03 and 16 years old.

To analyze the effectiveness of instruments that address drowning prevention in controlled environments (swimming pools) with those that act in open water contexts (rivers, lakes, sea).

Evaluate how the assessment instruments address the components of aquatic competence: motor skills (procedural), safety knowledge (conceptual) and risk/safety attitudes (attitudinal) in different contexts.

Identify research gaps and future recommendations for the development of evidence-based drowning prevention programs.

3 JUSTIFICATION

Aquatic research has been divided into two distinct but interrelated fields: aquatic movement research and drowning prevention research. This division has resulted in missed opportunities for cooperation and innovation, even though both areas share the same goal — reducing drowning incidents and improving human interaction with the aquatic environment. There is a “moral obligation” for researchers, educators, and practitioners to collaborate, share methods, and build unified evidence base capable of influencing policies and practices in aquatic education and safety (STALLMAN, 2013).

Within this context, the present study is justified by the need to synthesize and analyze existing methodologies used to assess aquatic competence in children and adolescents, particularly regarding their effectiveness in promoting drowning prevention and water safety knowledge.

Investigating these methods contributes to bridging the existing gap between theoretical understanding and practical application in aquatic literacy, since swimming programs often fail to train instructors to provide the most effective teaching. Instructors fail to address the most relevant methodological issues when teaching, how many even understand the relationship between learning to swim and drowning prevention? Inexperienced teaching causes ineffectiveness in pedagogy and learning, in fact, by committing the cardinal sins of teaching, they may even contribute to drowning rather than prevent it (i.e., failing to help learners adequately judge their own skill levels and capabilities) (STALLMAN, 2019).

In this way, assessment helps guide teachers in their instruction so that they can adjust their planning to see what the children need to learn and emphasize the role of evaluation in increasing students’ awareness of their own learning and progress (CHRÓINÍN; COSGRAVE, 2013).

4 THEORETICAL FRAMEWORK

4.1 WATER COMPETENCE

In 1995, Langendorfer and Bruya introduced the term water competence into their text Aquatic Readiness: Developing Water Competence in Young Children. The authors defended the importance of the global development of aquatic skills, emphasizing that knowledge, values and attitudes are also part of the notion of aquatic competence.

Water competence is defined here as “the sum of all personal aquatic movements that help prevent drowning, as well as the associated water safety knowledge, attitudes, and behaviors that facilitate safety in, on, and around water.”(Moran, 2013, p. 4). This more inclusive term replace the concept of ‘swim and survive’ with its currently limiting inference that swim = safe. Stallman and colleagues in 2017 recommended that swimming ability is promoted as a necessary component of water competence, but understanding that ability alone is [often] not sufficient to prevent drowning.

Moreno-Murcia & Rita Pinto (2023) explains that Moran (2006a) has played an important role in the inclusion of the ecological perspective in aquatic education and his main focus has been on drowning prevention, showing some evidence of the importance of the link with the environment. More recently, Moreno-Murcia & Ruiz (2019) presented aquatic competence as an integral part of motor competence, in which its development goes beyond drowning prevention. Considering the human being in a holistic way in different contexts, there is a very powerful potential impact on training and personal development (cognitive, motor, social and emotional) when learning in the aquatic environment is included and valued, as it is necessary to go beyond know-how.

Stallman et al. (2017) argues that pedagogical practice, learning and training need to be updated to help individuals acquire ‘physical, cognitive and affective competencies which together make a person water competent and thus less

susceptible to the risk of drowning'. They proposed 15 water competencies (Figure 1) considered essential to reduce risks of drowning.

In this sense, teaching competency should not be seen as the only main objective in drowning prevention models, but rather as a complement to situations designed to help learners feel comfortable in a variety of aquatic environments, learners need representative tasks that can acquire the fundamental aquatic skills they need to transfer them to other environments (e.g., sea, rivers, lakes) (PINTO; MURCIA, 2023).

It is then understood that water competence results from a dynamic set of interactions between individual aspects, the specific demands of aquatic tasks and the characteristics of the environment. Thus, this concept is not restricted to swimming motor skills, but involves a complex relationship between the personal qualities of each swimmer, the goals and challenges imposed by different aquatic contexts (LANGENDORFER, 2015).

Figure 1- Proposed water competencies by Stallman et.all 2017

Water Competencies			
1	Safe entry competence a) Entry into water b) Surface and level off	9	Clothed water competence
2	Breath control competence Integrated and effective breathing	10	Open water competence
3	Stationary surface competence a) Buoyancy control: floating b) Treading water	11	Knowledge of local hazards competence
4	Water orientation competence a) Roll from front to back, back to front b) Turn, L & R, on front & back	12	Coping with risk competence - awareness, assessment, avoidance
5	Propulsion competence a) Swim on front b) Swim on back and/or side	13	Assess personal competence
6	Underwater competence a) Surface dive b) Underwater swimming	14	Rescue competence a) Recognize a drowning person b) Assist a drowning person safely
7	Safe exit competence	15	Water safety competence a) Attitudes b) Values
8	Personal flotation device (PFD/lifejacket) competence		

4.2 WATER COMPETENCE AND THE DROWNING PREVENTION

The relationship between water competence and drowning prevention has been widely discussed in the literature, especially in view of the alarming global mortality data. According to the World Health Organization (2024), there are approximately 300,000 drowning deaths per year globally, with children under five years representing nearly one quarter of these cases. Most of these fatalities occur in low- and middle-income countries.

In low-income countries, such as Bangladesh, drowning is identified as the leading cause of death among children aged 1 to 17 years (28.6 per 100 000 child-years) and reaches even more worrying levels in the 1 to 4 age group (86.3 per 100 000 child-years) (Rahman et al., 2008). These data make it clear that just knowing how to swim is not enough to avoid accidents. In Bangladesh, for example, only 7% of children over 4 years old who drowned knew how to swim, revealing that motor skills alone do not guarantee safety.

This finding confirms the perspective defended by Moran (2013), according to which water competence is the sum of all personal aquatic movements that help prevent drowning, as well as the associated water safety knowledge, attitudes, and behaviors that facilitate safety in, on, and around water. He further defends that the development of aquatic competence must consider the main factors that lead to drowning, structuring teaching beyond "swimming to survive" with its currently limiting inference that swim = safe.

The ecological approach discussed by Guignard et al. (2020) reinforces this understanding by proposing that learning occurs in contexts representative of real risk conditions. The authors argue that training exclusively in swimming pools (stable, controlled, and predictable environments) may not favor the ‘far’ transfer from practice environments to natural, dynamic environments, where most drownings occur. Thus, aquatic competencies should encompass swimming, but in addition to many different functional actions, in varied locations, including at the water surface and underwater.

Pinto & Moreno-Murcia (2023) expand this understanding by proposing aquatic competence as a holistic construction, based on the knowledge of " to be, to know and to do", influenced by the socio-cultural environment, the aquatic environment, the self and by others. From this perspective, drowning prevention does not depend only on physical skills, but know what to do (attitudinal), awareness (conceptual knowledge about oneself, about the aquatic environment and awareness of the culture of the place) and self-wisdom to know how to be (awareness of personal and social values).

Therefore, the literature converges on the conception that water competence is essential for drowning prevention, but only when understood in a broad and contextualized way. Developing technical skills without forming risk awareness, without working on attitudes and without exposing students to environmental variations results in incomplete and potentially dangerous preparation. The challenge of contemporary educational programs is precisely to integrate these dimensions in a coherent way, ensuring that children and adolescents acquire skills capable of protecting them in the real aquatic environments where drowning occurs.

4.3 INSTRUMENTS FOR ASSESSING WATER COMPETENCE

Given the multidimensional nature of drowning prevention, it is essential that assessment tools reflect more than isolated swimming distances or times. Historically, many organizations have relied on arbitrary distance-based criteria (e.g., swimming 25–200 m) to define whether someone “can swim.” However, these measures do not adequately represent the range of competencies needed for drowning-prevention contexts, especially in open water, under cold stress, or in unexpected immersion events (MORAN, 2013).

Langendorfer critiques the notion of “swimming skill” as a static attribute, emphasizing instead that “swimming” is an emergent and dynamic state of behavior dependent not only upon certain individual characteristics such as sufficient buoyancy, fitness, body proportions, and a state of consciousness, as well as

sufficient and prior experience in the water and motivation to swim, plus the presence of a water environment (Langendorfer, 2011). This conceptual shift demands assessment tools capable of capturing a wider spectrum of skills and capacities.

Aquatic professionals still argue about which criteria do we judge that the child can swim but, believe and know swimming is much more than performing rote motions. The causes of drowning must dictate especially what we teach, content, and to a lesser degree, how we teach (STALMAN, 2008), and assessment tools should follow this logic. In the research conducted by Stallman (2008) noticed that the common attitude toward evaluation was that it was both necessary to assist in further planning and to keep a continuous overview of each child's progress. On the other hand, assessments were rarely used formatively to guide individualized instruction or to propose program revisions.

Implementing assessment is a major part of teaching and constitutes a vehicle by which all pupils' progress might be plotted, therefore, it is the teacher's responsibility to choose the assessment instrument with characteristics most appropriate to the teaching context and, above all, consistent with the program's objectives (HIND e PALMER, 2007).

Current instruments vary widely in structure, objectives and applicability, and although they contribute to different dimensions of water competence, they do not yet fully reflect the complexity required for effective drowning prevention. The specialized literature points to the need for integrated, contextualized and validated instruments, capable of contemplating multiple dimensions of water competence and assessing the real capacity of children and adolescents to act safely in different aquatic environments. This research aims to identify instruments capable of contemplating multiple dimensions of water competence and that address components such as motor skills (procedural), safety knowledge (conceptual) and risk/safety attitudes (attitudinal) in different contexts.

5 METHODS

5.1 SEARCH STRATEGY

For this review, an initial search strategy was conducted to find scientific literature related to the measurement of water competence in children and adolescents in the following electronic databases: SPORTDiscus with Full Text (EBSCO), MEDLINE Complete (EBSCO), EMBASE, PubMed.

The following search terms were used: 'aquatic skill'; 'aquatic competence'; 'water safety skills'; 'drowning prevention'; 'test', 'instrument'; 'assessment', 'measurement', 'questionnaire'. Different combinations of these search terms were performed using the Boolean search method (including OR/AND) in the databases.

In addition to electronic databases, reference lists identified in articles were also used to ensure, as far as possible, that all appropriate studies were considered for inclusion. An example of the search strategy in one of the databases (PubMed) is shown in Figure 2.

Figure 2 - Search strategy used in the PubMed database.

PICO	Descriptors
#1 - População	"child"[Title/Abstract] OR "children"[Title/Abstract] OR "adolescent*"[Title/Abstract]
#2 - Intervenção	"aquatic competence"[Title/Abstract] OR "swimming skills"[Title/Abstract] OR "swimming competence"[Title/Abstract] OR "aquatic skill"[Title/Abstract]
#3 - Controle	"scale"[Title/Abstract] OR "assessment"[Title/Abstract] OR "instrument"[Title/Abstract] OR "tool"[Title/Abstract] OR "questionnaire"[Title/Abstract] OR "measurement"[Title/Abstract] OR "development"[Title/Abstract]
#4 - Outcome	water safetyskills[Title/Abstract] OR "water safety"[Title/Abstract] OR "drowning prevention"[Title/Abstract] OR "survival swimming"[Title/Abstract]
#5	#1 AND #2 AND #3 AND #4

5.2 INCLUSION AND EXCLUSION CRITERIA

Studies were included in the review if they: (a) targeted toddlers, infants, children or adolescents, (b) were original research articles in English or Portuguese

languages, c) objectively measured the water competence including at least one component: motor skills, aquatic security knowledge, and risk/safety attitudes.

Articles that met at least one of the following criteria were excluded: (a) duplicate, (b) unavailability of the full text, (c) was oriented towards competitive swimming or did not use evaluative protocols related to swim abilities, (d) were specifically aimed at populations with pathologies or disabilities, (e) if none of the components of aquatic competence are evaluated *(including skills, knowledge, and attitudes)*.

Thus, the objective of the review was to identify studies that used scales, tests, evaluation sheets, checklists and other evaluation protocols developed with the purpose of collecting information about the water competence (including skills, knowledge, and attitudes), and assessments regarding the drowning prevention in children and adolescents, considering different aquatic settings (pools, rivers, lakes, and sea).

5.3 STUDY SELECTION AND DATA EXTRACTION

The search process was based on the evaluation hierarchy of studies by journal title (removing duplicates), abstract, full article review upon including or excluding the paper according to the inclusion and exclusion criteria (Figure 3). Additional studies were found based on article references and added to the database when meeting the inclusion criteria.

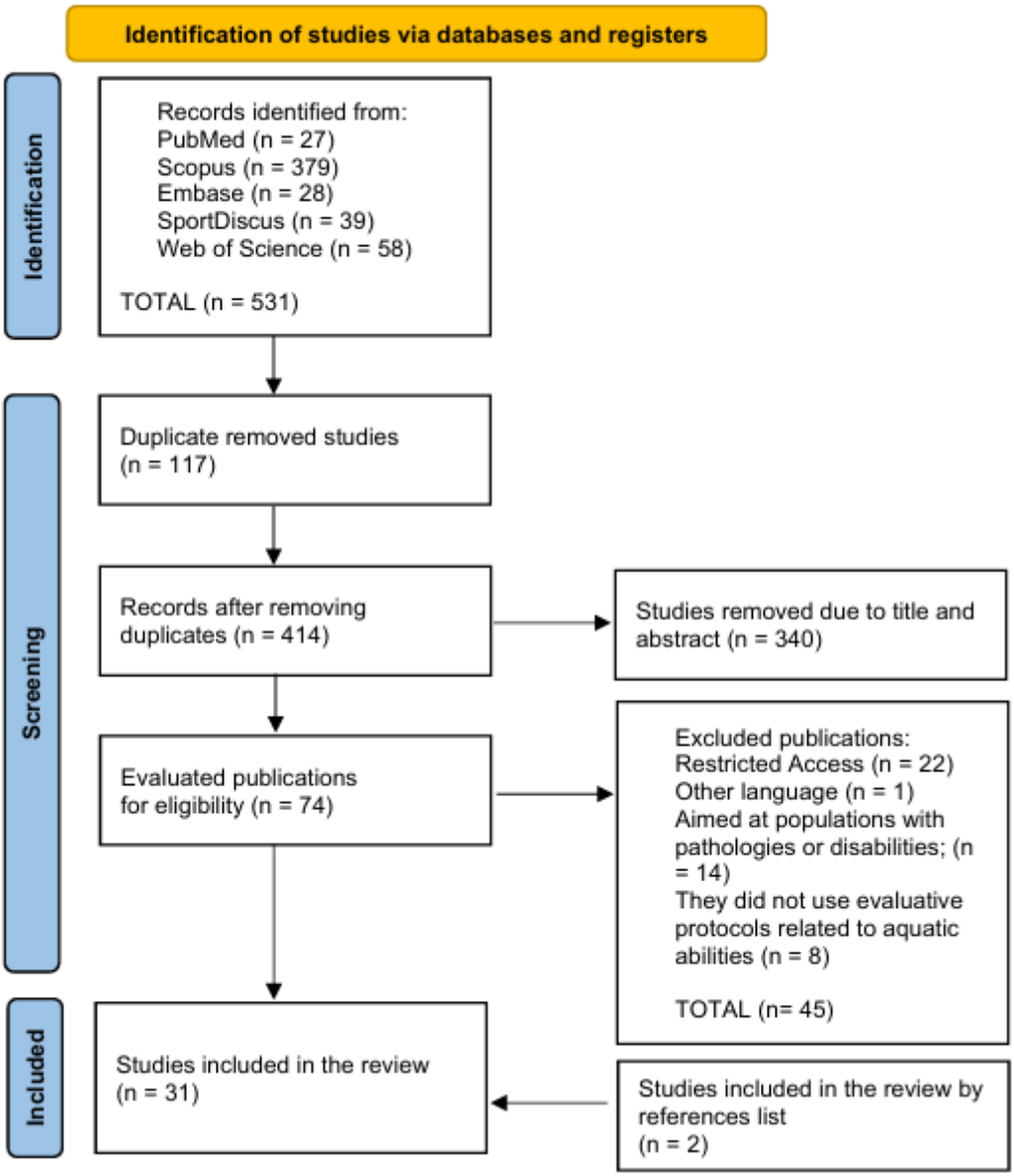
In the screening stage, 117 duplicate studies were removed, 340 studies were excluded based on the evaluation of the title and abstract. Based on the exclusion criteria 22 studies were removed duo to (i) unavailability of the full text; 2 (ii) other language; 14 (iii) were specifically aimed at populations with pathologies or disabilities; 8 (iv) did not use evaluative protocols related to aquatic abilities.

From the 31 articles selected, the author and three investigators, specialized in swimming, extracted the following data independently: the study aims, population,

age, type of study, mode of observation, instruments, evaluation characteristics, grading system, evaluated elements of WC and conclusions.

After data extraction, the researchers analyzed the collected data, so the articles that would be part of the research were selected and would proceed to further discussion.

Figure 3 – Search flowchart and selection process for the articles for review.



6 RESULTS AND DISCUSSION

The final sample consisted of 20 studies. The instruments identified in these publications are presented in Figure 4 with the study aims, instruments, sample, mode of observation, grading system, and evaluated elements of WC. The analyses revealed variability in how aquatic competence was assessed, both in terms of the components included (procedural, conceptual, attitudinal) and the contexts in which evaluations were carried out. This section discusses these findings considering the study's specific objectives, highlighting convergences, limitations, and contributions from the selected instruments.

A first point that became evident concerns the predominance of procedural (motor) assessments. Most instruments focused on observable aquatic skills such as flotation, propulsion, gliding, breath control, or underwater displacement. Tests such as the Actual Aquatic Skills Test (MERTENS et al., 2022), the Swimming Competence Assessment Scale (SUNDAN et al., 2025), and checklists based on Langendorfer and Bruya's developmental framework (LANGENDORFER; BRUYA, 1995; ROCHA et al., 2018; COSTA et al., 2012) exemplify this category. These instruments were typically applied in swimming pools and aimed at documenting swim skill progression through structured scoring systems.

In contrast, a smaller group of studies focused exclusively on perceived aquatic competence, assessing how competent children or parents believe the child to be. Instruments such as the Pictorial Scale of Perceived Water Competence (MORGADO et al., 2023), the Perceived Aquatic Competence survey (COSTA et al., 2020), and parent-report questionnaires (SANTIBAÑEZ-GUTIÉRREZ et al., 2022; STANLEY; MORAN, 2017) focus in this approach.

These studies consistently showed that perceived competence tends to be overestimated. Stanley and Moran (2017) found that many parents classify their children as competent swimmers even when objective evidence does not support this perception. This discrepancy is particularly problematic in drowning-prevention contexts because, as Costa et al. (2020) demonstrated, children who believe they are competent may take greater risks, especially in open-water environments.

Potdevin (2022) highlighted that the more parents perceived their children's progress as successful, the lower their perception of the risk of drowning, and the weaker their supervision attitudes when their offspring were near the water.

Some studies also employed instruments dedicated to assessing water safety knowledge, which reflects the conceptual dimension of aquatic competence. The National Water Safety Quiz (PEDEN et al., 2017) is an example of a tool designed to evaluate understanding of environmental hazards, safety signs, and safe behaviors in aquatic settings.

Components of the Victorian Water Safety Certificate (CALVERLEY et al., 2025) likewise included items related to knowledge of safety procedures. Although these tools provide valuable insights into what children know about risks and safe actions, they represent a minority among all identified instruments. This scarcity reinforces concerns previously discussed by authors such as Moran (2013), who argues that drowning prevention must integrate "the associated water safety knowledge, attitudes, and behaviors that facilitate safety in, on, and around water" (p. 4).

A smaller but significant group of studies used multidimensional assessment instruments, which evaluated more than one component of water competence simultaneously. The Scale to Measure Aquatic Competence in Children (SMACC), validated by Moreno-Murcia and colleagues (2020b; 2024), stands out , it is composed of three main and integrated dimensions Motor, Socio-affective and Cognitive dimensions, the children gives confidence and autonomy in the aquatic environment, in addition to the ability to perform a variety of basic movements in the water.

Similarly, the Victorian Water Safety Certificate includes survival sequences, underwater tasks, rescue, and water safety knowledge. (CALVERLEY et al., 2025). These multidimensional assessments are more closely aligned with contemporary understandings of aquatic competence as a holistic construct (PINTO; MORENO-MURCIA, 2023; LANGENDORFER, 2015) and therefore represent an important direction for future research and educational practice.

Another important set of findings relates to instruments assessing affective or attitudinal dimensions, such as fear, confidence, and behavioral regulation. The Scale to Measure Fear of the Aquatic Environment (MORENO-MURCIA et al., 2020a), can be a complement of great interest for measuring children's aquatic competence since it can provide valuable information regarding factors that may influence the actual aquatic competence itself. Studies such as Gil-Mardona et al. (2022) also highlighted that pedagogical strategies that emphasize games and positive experiences contribute to both affective adjustment and motor progression.

This dimension is particularly relevant considering the instructor's role is fundamental, as pedagogical decisions strongly shape children's emotional responses and sense of security in the water. Play-based strategies are particularly effective in facilitating adaptation and reducing fear, enabling learners to gradually overcome emotional barriers. When instructors recognize and address these fears, they can structure lessons more effectively to support children's confidence and progression (COELHO et al., 2025).

In relation to the second specific objective, which aimed to analyze assessments conducted in controlled environments with those applied in open-water settings, the studies showed a clear predominance of pool-based evaluations. While pools offer standardized and safe conditions, they may not represent the complexity of natural aquatic environments. Only a few studies addressed assessments in rivers, lakes, or coastal settings. Button et al. (2020) reported that participation in structured open-water education programs improved children's environmental awareness and risk perception.

Likewise, Sundan, et al. (2025) argue that future research should also explore if and how swimming competence transfers across different aquatic environments and examine the impact of these environments on the performance of specific aquatic skills, a more unpredictable and dynamic setting that may challenge the application of aquatic skills learned indoor swimming pools. This finding aligns with the ecological perspective discussed by Guignard et al. (2020), who argue that aquatic learning should occur in design of learning environments where adaptive

behaviors may be developed, acquired and then transferred to more complex aquatic contexts.

In summary, the synthesis of the selected studies shows that although current instruments contribute to understanding children's aquatic behaviors, important gaps remain regarding the multidimensional and contextual nature of water competence. Literature consistently highlights a shortage of validated tools capable of integrating motor, cognitive, and affective components, despite the widely accepted understanding that water competence is a holistic construct (STALLMAN et al., 2017; PINTO; MORENO-MURCIA, 2023; LANGENDORFER, 2015). These limitations become even more evident given the scarcity of assessments conducted in open-water environments, where drowning is most likely to occur (MORAN, 2013; WHO, 2024).

Figure 4 - Methodologies for assessing WC reported in the literature

Authors (Years)	M Rocha, H. A. 2018	Sundan et al. (2025	Vogt, T & Staub ., 2020	Moreno-Murcia J.A et al., (2020a)	Moreno-Murcia, J.A et al (2020b)
Study aims	Determine the effect of deep versus shallow water differences on developing aquatic skills.	Quantify AC nationally (9–10 yrs).	To develop an easy-to-apply assessment tool that quantifies the evaluation of basic aquatic skills.	To design and validate an instrument for evaluating fear of the aquatic environment.	To design and analyze the validity of the Scale to Measure Aquatic Competence in Children.
Instruments	Observation checklist based on Langerdorfer and Bruya (1995).	Swimming Competence Assessment Scale (SCAS)	Online survey (for peers).	Scale to Measure Fear of the Aquatic Environment (SFAE).	SMACC; Perceived Aquatic Competence Questionnaire;
Sample	21 elementary school-aged children 4.70 ± 0.51 yrs.)	2421 children (9–10 yrs)	22 children (6.95 ± 1.03 years)	384 children aged between 3 and 5 years.	444 schoolchildren between three and six years old.
Mode of observ	The children were divided into two distinct classes performed on a different water depth	Observation form, a coding sheet, and a set of procedures.	Video recorded from standardized.	A researcher assessed each child while observing the swimming lessons.	Performance-Based Assessment and Direct Observation.
Grading system	Increasing levels of complexity as suggested by Langendorfer and Bruya (1995): enable to perform at stage 1, rudimentary movements at stage 2 and fundamental movements at stage 3 that precede the specific motor skill acquisition.	Binary (competent / not competent).	Scoring Nature (passed or failed) pre-defined evaluation criteria specific to each task.	The evaluations were appropriate for the children's age range (3 to 6 years) and the results were reliable and valid.	5-point rating scale (rubric) used for direct observation to score a child's Actual Aquatic Competence.
Evaluated components of WC	17 aquatic motor skills: water entry (Sk1); water orientation and adjustment at vertical position (Sk2); breath control - immersion of the face and eye opening (Sk3); horizontal buoyancy (Sk4); body position at ventral gliding (Sk5); body position at dorsal gliding (Sk6); body position at longitudinal rotation in gliding (Sk7); body position at front and back somersaults (Sk8); leg kick with breath control at ventral body position, with flutter boards (Sk9); and without any flutter device, (Sk10); leg kick with breath control at dorsal body position with flutter boards (Sk11); and without any flutter device (Sk12); feet-first entry (Sk13)…	Entry, Swim-on front, surface dive, float rest, swim-on-back, water exit. AC = essential skills for safe aquatic participation	(1) submerging by holding breath, (2) submerging with adapted exhalation, (3) floating with one additional skill, (4) floating with two additional skills and (5) jumping into the water.	Motor Skills (gliding, submerging the head, floating, jumping into the pool, and entering/exiting the water alone) ; Socio-affective (the child's enthusiasm, willingness to participate, and ability to interact with peers and the teacher in the aquatic environment); Cognitive (the child's ability to follow instructions, recognize danger, differentiate water characteristics and adapt to changes in the environment.	Motor Skills (breathing, floating, displacement, manipulation), Socio-Affective (interaction, self-confidence), and Cognitive (autonomy, time-space perception).

Authors (Years)	Mertens, L. 2022	Santibañez-Gutierrez A. 2022	Button, C. 2020	Stanley, T. Moran, K. 2017	Peden, A. E. 2017
Study aims	Investigate the inter-rater and intra-rater reliability of the Actual Aquatic Skills Test (AAST)	Investigate children's swimming competence in primary schools of districts in Vojvodina, Serbia.	Assess the effectiveness of teaching children water safety knowledge and skills in open water environments.	Explore the relationship between perceived swimming competency and risk of drowning in an open water environment.	Determine Australian primary school children's water safety knowledge through an online interactive tool.
Instruments	Actual Aquatic Skills Test (AAST)	SC questionnaire designed by Chan et al.	Performance-based approach - six different water safety tasks.	Self-report, written questionnaire with 18 close-ended questions.	online National Water Safety Quiz (NWSQ)
Sample	134 children between 6 and 9 years	2,778 students of 10.73 ± 2.1 years old,	98 children (7-11 years old)	309 parents or caregivers of primary aged children (5 – 11 years)	4,215 children aged between 10 and 12 years.
Mode of observation	Test video.	Parent-assisted self-reported questionnaire	Participants were typically tested in small groups of 2 to 6 children.	To be completed by the parents in their own time at home.	Online self-administered quiz.
Grading system	PSPWC manual: 1- the child is not able to perform the aquatic skill, 2- the child is partly able to perform the aquatic skill and thus still in progress, and 3-the child is able to correctly perform the aquatic skill.	Maximum swimming distance (in meters) was reported as distance without resting and using a general stroke.	The assessors marked competency scores also recorded the participant's ranking of task difficulty after they had completed all six tasks.	Different scales analyzing: Swimming competence, Water safety attitudes, Sense of safety when swimming in open water for themselves and their children.	From the NWSQ results, a score was calculated as a percentage of the number of answers correct out of the possible maximum number of points.
Evaluated components of WC	1 Lying down in a prone position using hands on the bottom to move forward; 2. Standing and submersion in the water; 3. Blowing bubbles under water; 4. Catching an object under water; 5. Floating on the back; 6. Floating on the front; 7. Water entry by slide; 8. Pushing from the wall and gliding under water; 9. Leg propulsion on the back; 10. Leg propulsion on the front; 11. Water entry by jumping; 12. Water entry by diving; 13. Water exit by climbing out; 14. Vertically treading water; 15. Turning from the front to the back in an aligned position; 16. Changing Direction while swimming on the front; 17. Turning from the back to the front.	Poolside kicking; Kicking with kickboard; Holding breath underwater; Floating; Treading water; Swimming underwater.	1.Knowledge (Quiz) 2. Safe entry/exit & buoyancy 3. Submersion 4. Obstacle course 5. Simulated rescue 6. Propulsion	Asked participants about whether they could swim, when they had last swum the distance in a pool and in open water, asked regarding the swimming competence of their children, water safety attitudes, sense of safety when swimming in open water.	Aquatic Centre; Water Safety Signs; Beach Safety; Home Water Safety; Backyard Swimming Pool; Boating Safety; CPR; Farm Water Safety; Lake Water Safety; Personal Awareness; Rescues; River; Swimming

Figure 5 – Continued

Authors (Years)	Sundan, Lorås & Haga (2025	Gil-Mardona et al., 2022	Morgado et al. 2023	Costa et al. (2020)	Calverley et al., 2025
Study aims	To obtain insights into the interplay between these settings, thereby enriching our understanding of swimming competence within a broader context.	To verify whether a program of initiation to the aquatic environment composed of motor games is effective.	To examine the face validity of the PSPWC tool	To analyze the relationship between perceived aquatic competence and real aquatic competence.	To understand the perspective of both parents and children regarding the child's NPAE on the AC.
Instruments	Swimming Competence Assessment Scale (SCAS).	Aquatic Motor Competence Scale.	Pictorial Scale of Perceived Water Competence (PSPWC).	Perceived Aquatic Competence – PAC and RAC.	Victorian Water Safety Certificate assessment criteria.
Sample	198 children (age = 9.73, SD = 0.43.	Seventeen students between 4 and 5 years old.	One hundred and twenty Belgian children aged from 5 to 8 years.	105 children from 6 to 10 years.	Parents' children (aged 10–12 years).
Mode of observ	Direct observation, capturing individual performances	Completed by a single researcher on two occasions (pre and post)	Children identified elements ordering from least competent to most.	Structured interview conducted by the principal investigator.	Assessment guidelines for evaluating VWSC competencies.
Grading system	Each aquatic skill was assessed on a scale ranging from 1 to 4, encompassing distinct levels of mastery: very low (1), low (2), high (3), and very high (4).	The scale is composed of 16 items, and the response to it is dichotomous (Yes or No), valued in subsequent statistical analyses as 1 (No) and 2 (Yes).	The pictorial scale was constructed based on a three-level progression for each aquatic situation/skill.	The RAC was converted in a scoring scale, similar to the one described by Langendorfer and Bruya to evaluate aquatic readiness	Children were categorized as either "achieved" or "did not achieve" for each VWSC competency.
Evaluated components of WC	Entry into water, Swim on front, Float / rest, Surface dive, Swim on back, Exit water	Nine items that assess aspects related to the attitude shown by the children in contact with the aquatic environment, seven items referring to more advanced aquatic motor skills related to respiratory control, flotations in different positions and displacements related to actions with the head in immersion.	Water entry, water exit, immersion, water orientation (or balance), buoyancy, propulsion and breath control.	Sk1—entry (jump or diving) in deep water; Sk2—after immersion, recover to the water surface, get alignment, and swim; Sk3—dive from the swimming pool edge and swim underwater; Sk4—know at least in a rudimentary sense the front crawl and backstroke; Sk5—controlled and relaxed breathing; Sk6—change body position (from dorsal to ventral and vice-versa); Sk7—change swimming direction; Sk8—floating.	Water safety knowledge, swimming, underwater, Lifesaving, Continuous survival sequence.

Figure 6 - Continued

Authors (Years)	Olaisen et al. (2018)	Costa, A .M et al., (2012)	Invernizzi, P.L et al 2021	Valentini, N.C et al., 2022	Moreno-Murcia J.A et al., (2024)
Study aims	Evaluate the effectiveness of a swim skill acquisition intervention among Latino youths.	To analyse the differences between teaching methods in deep and shallow water swimming lessons.	To investigate whether different teaching methodology may influence the perceptions of aquatic	To translate the Aquatic Readiness Assessment (ARA) from English to Portuguese.	To investigate the effects of guided discovery instruction on the competence levels.
Instruments	test instrument not formally evaluated with 75 individual items.	Table and Questionnaire from Langendorfer (1995;1987).	Aquatic motor competence test (Langerdofer et.al 2012);	Likert Scale for Language Clarity and ARA.	(SMACC) by Moreno-Murcia et al.
Sample	149 children (age 3–14)	98 children aged 4 years old and 32 swimming instructors.	100 children of 5–6 years old.	464 children from newborn to 13 years old.	385 students aged 3 to 5 years.
Mode of observ	A single tester (completing both the baseline and follow-up tests),	Observation table of aquatic motor skills and questionnaire.	Two weekly lessons of 50 min duration each.	Structured and Standardized direct observation.	Frontal (above and under surface) as well as lateral perspectives.
Grading system	Computed scores derived from a child's change in skills, from the time of baseline testing to the time of the final swimming skill assessment	Includes three, four or even five levels of complexity, depending on the category.	Child's "grade" or level of actual aquatic motor skill. On Perceived Motor Competence children assign scores to the pictorial scale items.	The validity enrolled using the 5-point Likert scale. Each child's performances were scored by two raters individually in real-time.	A five-item rating rubric. The rating system uses a scale from 1 to 5. 1 typically represents the lowest level of competence and 5 represents the highest level.
Evaluated components of WC	Water safety, flotation and endurance, at five levels of increasing skill acquisition.	Water entry, water orientation and adjustment at vertical position, breath control - immersion of the face in water and eye opening, horizontal buoyancy, ventral gliding, longitudinal rotation in gliding, body position at front and back somersaults, leg kicking with breath control at ventral body position with and without flutter boards, leg kicking with breath control at dorsal body with and without flutter boards…	Water entry, breathe control and immersion, buoyancy, arm propulsion action, arm recovery action, leg action, combined movement.	Water orientation and adjustment, water entry, breath control, body position, arm propulsion action, arm recovery action, leg action, combined action.	Breathing, water entry evaluated in three dimensions Motor skills, Cognitive and Socio-affective

Figure 7 - Continued

7 CONCLUSION

This study aimed to analyze and synthesize the scientific literature on the assessment methodologies applied to measure aquatic competence and its relationship with drowning prevention in children and adolescents, with emphasis on the contextual variation of aquatic environments. The review identified 20 instruments and analyzed the patterns of how water competence has been assessed.

It was identified that most existing instruments prioritize procedural motor skills, with far fewer tools addressing cognitive elements such as safety knowledge or affective components such as fear, confidence, and behavioral regulation. Very few instruments were applied in open-water contexts, revealing strong predominance of pool-based evaluations. Moreover, studies comparing perceived and actual competence demonstrated frequent overestimations, reinforcing the importance of including parents in learning to swim schemes to make them aware of drowning, as motor progress shown by children may have adverse effects.

Taken together, the findings indicate that the current landscape of water-competence assessment does not fully meet the pedagogical, ecological, or preventive demands highlighted in specialized literature. There is a need for assessment practices that reflect the real-world conditions in which aquatic risks occur, and tools that integrate motor, cognitive, and affective dimensions and reflect the ecological realities in which children engage with water. Developing such tools will not only ensure greater ecological validity but also support evidence-based educational programs capable of preparing children and adolescents for the dynamic and unpredictable contexts where drowning risk is highest.

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