

Dajana Zoretić ^{1*}
Klara Šiljeg ¹
Bojan Jorgić ²



VALIDATION OF NEWLY CONSTRUCTED QUESTIONNAIRE FOR WATER MOVEMENT COMPETENCIES

VALIDACIJA NOVO OBLIKOVANEGA VPRAŠALNIKA ZA KOMPETENCE GIBANJA V VODI

ABSTRACT

The aim of this study was to construct and validate a questionnaire for assessing movement competences in water. Water competences encompass all forms of movement in water that contribute to drowning prevention and are closely linked to understanding water safety, as well as behaviors and attitudes that ensure safety in aquatic environments. Properly defining these competences can contribute to greater public awareness of the importance of early swimming education and the acquisition of key skills necessary for safe movement in water. The study involved 684 students from the University of Zagreb, including 344 male and 340 female participants. For the purpose of the research, a 22-item questionnaire was developed to assess the importance of various aspects of water competences. Data analysis confirmed satisfactory internal consistency of the questionnaire, with Cronbach's alpha coefficient of $\alpha \geq 0.7$. The highest average score was obtained for statement Q12, which emphasizes the importance of breathing, breath control, and managing shortness of breath as key components of movement competences in water ($M=4.63$). Based on the results, it can be concluded that the developed questionnaire represents a valuable tool for assessing water competences, demonstrating acceptable validity and reliability. Raising awareness of the importance of swimming skills is essential not only for individual safety in water but also for enabling enjoyment in activities that the aquatic environment offers. Early education and systematic development of movement skills in water can have a significant impact on reducing the risk of drowning and promoting safe behavior in aquatic settings.

Keywords: teaching; swimming; students; assessment

¹University of Zagreb, Faculty of Kinesiology Croatia

²Faculty of sport and physical education, University of Nis, Serbia

IZVLEČEK

Cilj te študije je bil oblikovati in validirati vprašalnik za ocenjevanje kompetenc gibanja v vodi. Vodne kompetence zajemajo vse oblike gibanja v vodi, ki prispevajo k preprečevanju utapljanja ter so tesno povezane z razumevanjem vodne varnosti, vedenjem in odnosi, ki zagotavljajo varnost v vodnem okolju. Ustrezna opredelitev teh kompetenc lahko prispeva k večji ozaveščenosti javnosti o pomenu zgodnjega učenja plavanja in pridobivanja ključnih veščin, potrebnih za varno gibanje v vodi. V raziskavi je sodelovalo 684 študentov Univerze v Zagrebu, od tega 344 moških in 340 žensk. Za potrebe raziskave je bil razvit vprašalnik z 22 postavkami, namenjen ocenjevanju pomena različnih vidikov vodnih kompetenc. Analiza podatkov je potrdila zadovoljivo notranjo skladnost vprašalnika, pri čemer je bil Cronbachov alfa koeficient $\alpha \geq 0,7$. Najvišjo povprečno oceno je dobila trditev Q12, ki poudarja pomen dihanja, nadzora diha in obvladovanja kratke sape kot ključnih sestavin kompetenc gibanja v vodi ($M = 4,63$). Na podlagi rezultatov lahko sklepamo, da razviti vprašalnik predstavlja dragoceno orodje za ocenjevanje vodnih kompetenc, saj izkazuje sprejemljivo veljavnost in zanesljivost. Ozaveščanje o pomenu plavalnih veščin je bistveno ne le za individualno varnost v vodi, temveč tudi za uživanje v aktivnostih, ki jih ponuja vodno okolje. Zgodnje učenje in sistematičen razvoj gibalnih veščin v vodi lahko pomembno vplivata na zmanjšanje tveganja za utapitev ter spodbujanje varnega vedenja v vodnih okoljih.

Ključne besede: poučevanje, plavanje, študenti, ocenjevanje

Corresponding author:* Dajana Zoretić

Faculty of Kinesiology, University of Zagreb, 10000 Zagreb, Croatia

E-mail: dajana.zoretic@kif.unizg.hr

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INTRODUCTION

Competences can be defined as common knowledge, abilities, skills associated with a high effect at work (Schippmann et al., 2000). When it comes to defining motor competences, it can be defined as the mastery of physical skills and movement patterns (Castelli & Valley, 2007). Swimming is a physical activity that have many health benefits across all ages and can be used in recreation, therapy as well in sports performance. Recent research showed that motor competence can differentiate children's swimming ability (Gllareva et al., 2020). By conducting research on water competences, most authors try to find out what are the key elements for achieving the necessary competences. Insufficiently acquired swimming skills, i.e. inadequate knowledge about the risks of swimming, is a risk in itself. Therefore, proper education and methods of evaluating that knowledge are important, in order to prevent possible risks in terms of the safe use of swimming as knowledge and applied practical skills. Water competences can be defined as the sum of all movements in the water that help prevent drowning (Moran et al., 2012). It is related to knowledge about water safety as well as attitudes and behaviors that will facilitate safety in and around the water. Defining waters competences in this way aims to raise the awareness of the population and point out that swimming lessons should be started at an early stage of childhood. The ability to swim is promoted and presented as a necessary component of adequate movement in water, but with the understanding that the ability to swim alone is often not enough to prevent drowning (Brenner et al., 2006). Encouraged by this, most of the studies that today deal with the management of this technique seek to discover and present the basic and most important competences of movement in water.

Experts strive to raise the level of awareness and knowledge of the population about the importance of swimming competences in the modern way of life in order to prevent non-essential outcomes when in the water. The more pronounced and highly adopted competence of swimming plays a protective role in the case of drowning, and therefore differences in swimming competency in the aquatic surface can explain why the risk of drowning in some individuals is much more pronounced than in the rest of the population (Brenner et al., 2006; Kjendlie et al., 2013; Stallman et al., 2017). The aim of most research papers on this topic is to present, describe and provide the population with scientifically substantiated facts about how much physical, cognitive and affective competences can contribute to the ability to move in an aquatic surface in the most efficient way. Taking all the risks and benefits that characterize swimming, experts seek to highlight the scientifically proven facts and figures obtained by research not only on young people, but also on people of middle and older age, and to raise

awareness of the importance of introducing swimming programs not only in primary education and high school but also beyond.

The foundations of water safety education are based on a clear definition of the water competencies that a person must possess. Today, it is recommended to replace expressions such as swimming ability with the term swimming competence (Moran et al., 2012; Brenner et al., 2006; Kjendlie et al., 2013; Stallman et al., 2017). Swimming ability exceeds both ability and skill, as skills can be modified or learned, while ability is resistant to change (Langendorfer, 2011). Research shows that swimming ability alone is often not enough to prevent drowning, highlighting the importance of awareness of water competencies (Stallman et al., 2008; Olstad et al., 2021; Peden & McGee, 2003; Stanley & Moran, 2017; Moran & Stanley, 2006; Junge et al., 2010; Brenner et al., 2003; Brenner et al., 2009). According to a report by the World Health Organization (WHO) about 360.000 people drown every year, more than half of them are as young as 25 years old (World Health Organization [WHO], 2014). Drowning is one of the leading causes of mortality among children and adolescents worldwide. The WHO states that it is the most common cause of death for children aged 5 to 14 years. In the European Union and the United States, it is the second most common cause of death for children aged 0 to 19 years (Bierens, 2006; Ferenčič et al., 2018). Assessing swimming skills is crucial for drowning prevention, the development of motor skills in water, increasing self-confidence in water, and raising awareness about safety. Swimming competencies should include self-rescue skills and the ability to save others. Research shows that many individuals believe they possess swimming skills, while they are unable to swim safely (Moran et al., 2012). This highlights the need for an objective assessment of swimming skills to identify at-risk individuals in a timely manner and provide appropriate education. Developing water skills can significantly impact self-confidence and the tendency to participate in water activities, contributing to a positive attitude toward physical activity (Sporiš et al., 2011). Swimming skill assessment also plays a key role in water safety education (Stallman et al., 2017). Most research relies on self-assessment due to difficulties in measuring actual competencies (Mickalide, 1997; Nelson, 1996; Robertson, 1992; Watson et al., 2003; Morgan et al., 2012).

Swimming education is thought to be one of the most important interventions to prevent the consequences of drowning. Among young population that lost their lives in the water, approximately 10% lived in high-income countries where learning to swim through various schools or organizations offering swimming lessons (Rejman et al., 2020). Children who have undergone training at an early age will not have a fear of water, and will adopt other swimming

skills much sooner than other children, will learn quickly about certain motor skills, will have greater self-confidence when moving in the water media, better ability to concentrate, quick reaction times and will become independent more quickly. When children overcome their fears of water through various games and methods in a very short time, they will achieve significant progress compared to other children (Amelia, 2012). The aim of this research was to construct and validate the questionnaire for the assessment movement competences in the water.

METHODS

Participants

The participants were 684 students of University of Zagreb. This research involved 346 male participants and 340 female subjects. All the participants voluntarily agreed to complete the questionnaire, and were guaranteed anonymity of the answer, as well as being thanked for participating in the same. Moreover, the number of the ethical approval from the Faculty of Kinesiology, Zagreb, Croatia, was XXIa-8501.

Measuring procedure

The data collection protocol entailed group surveying, i.e. surveying a larger number of participants. All participants answered questions relating to facts with which they were previously informed. Before completing the questionnaire, the participants were introduced with the aims of the research, and accordingly they were further encouraged to cooperate and give honest answers. In the first part of the questionnaire, the purpose of the research and reasons for conducting the research was clear to the subjects.

Design of the questionnaire

For the purposes of this research questionnaire a measuring instrument was used, specifically a questionnaire on the importance of water movement competences. The procedure of the survey method of the participants collected information, data, attitudes, and thoughts on the subject matter of the research itself. The questionnaire included the written collection of data and information on attitudes and opinions in a representative sample of participants. The questionnaire consisted of 22 statements obtained by mapping the research regarding the competences of movement in the water. The opinion of the subjects was assessed by using the Likert's scale of agreement or disagreement. The potential answers for each question was

evaluated as follows: Score 5 (I fully agree), Score 4 (I generally agree), Score 3 (I neither agree nor disagree), Score 2 (I generally disagree), Score 1 (I completely disagree).

Statistical analysis

The measuring data was processed using the STATISTICA 13.0 statistic package (StatSoft, Inc., Tulsa, OK, USA). In all variables the basic descriptive parameters were calculated, and the normality of the distribution was assessed through the Kolmogorov-Smirnov test. In order to determine the exact object of measurement to be tested by a specific measuring instrument, to the extent to which each of its factors conditions the variability of the results obtained, it was necessary to carry out an exploratory and contemplative factor analysis. The exploratory (EKS) and confirmatory (KON) factor analysis was carried out with the help of psych packages, in the RStudio software (version 2022.07.0.548, Spotted Wakerobin, Boston, MA) and was used for the extraction of factors in a constructed questionnaire examining subjects' opinion on the importance of movement competencies in water. First, the data was analyzed in order to meet multivariate assumptions (normality, linearity, homogeneity and homoskedasticity). The internal consistency method established the reliability of each questionnaire question. The internal consistency was measured through the Pearson correlation coefficient.

RESULTS

Descriptive parameters from the 22 questions were presented in Table 1. It can be seen that Q16 and Q18 have the lowest values. Also, the statement Q12 (breathing, shortness of breath, and breathing control are important components of the competences of movement in the water and the statement) showed the highest values. To examine the internal consistency of the water movement competence questionnaire, all subjects were tested together by calculating the average inter-item correlations and Cronbach's alpha coefficients. The results show acceptable internal consistency $\alpha \geq 0.7$. The Cronbach's alpha coefficient, calculated based on standardized results, is 0.757, while the basic value is 0.726. The questionnaire consists of a total of 22 items.

Table 1. Descriptive indicators of each survey questionnaire question.

QUESTIONS	N	Mean	SD
Q1. The concept of water movement competence is more comprehensive than swimming competence.	684	3.80	0.966
Q2. Moving in the water as a basic movement like walking is something that is not taught but is a part of the development.	684	3.14	1.180
Q3. From the perspective of the competence of movement in the water, all aspects of movement should be covered (forward, backward, sideways, below the surface of the water).	684	4.44	0.681
Q4. The concept of being able to move in the water or master movements in the water is more important than just the correct performance of the swimming movement.	684	3.60	1.003
Q5. Water movement competences are only part of water safety and must be part of the knowledge and attitudes of all programs (courses).	684	4.04	0.811
Q6. Moving underwater should be as pleasant and efficient as moving on the surface.	684	3.80	1.088
Q7. Movement on the back should be as comfortable and effective as movement on the chest.	684	3.85	1.085
Q8. It does not matter "how far you can swim, it is how you swim".	684	3.79	1.059
Q9. Water movement competences are of great importance in the modern way of life.	684	3.67	0.971
Q10. A range of movements should be developed in all directions and in all ways.	684	3.99	0.864
Q11. Learning movement in all it's forms (along the sagittal, transverse and longitudinal axis of the body) can save a life in a situation of drowning.	684	4.42	0.749
Q12. Breathing, breath retention and breathing control are important components of water movement competences.	684	4.63	0.642
Q13. Eye-opening (looking on the water) is of great importance for navigating the space medium of water.	684	4.13	0.939
Q14. A swimmer is a person who has well developed competences of movement in the water, i.e. in the water. That is capable of coping with unexpected and involuntary submerging.	684	4.28	0.834
Q15. Knowing how to move in water means to perform a set of competences of movement in the water.	684	4.11	0.783
Q16. Swimming is considered only a matter of performing the swimming movement "correctly".	684	2.81	1.044
Q17. From a perspective of competences of movement in water, swimming should not be a shift from position A to position B.	684	3.14	0.920
Q18. For knowledge of swimming, it is not necessary to swim a certain meter (25m, 50m..).	684	2.65	1.295
Q19. For swimming knowledge, it is necessary to have well-developed competences of movement in the water.	684	4.08	0.808
Q20. Education for water safety must strive to make teaching as realistic and authentic as possible.	684	4.14	0.753
Q21. It is of great importance that during primary education the competences of movement in the water are checked in all students of primary schools in the Republic of Croatia.	684	4.35	0.782
Q22. In the modern way of life, it is essential to give each person the opportunity to learn how to move in the water.	684	4.48	0.768

Legend: Q-question; N-number of participants; SD-standard deviation.

After the collected data presented in the previous table and statistical analysis of the questionnaire on the competences of movement in the water, the internal consistency of all the above claims was observed in the study. It is also important to state that the higher correlation value represents both greater and stronger consistency. All claims were divided into three subgroups depending on the values of the new Pearson correlation coefficient.

Questions Q2, Q16, Q17 and Q19 show very little internal consistency given that their Pearson correlation coefficient range from 0,187 to 0,285. Statistical analysis showed that all these coefficients are statistically significant with the value of $p \leq 0,01$. Moreover, questions Q1, Q4,

Q6, Q8, Q10 show a small internal consistency because there the Pearson correlation coefficient ranges from 0,33 to 0,446. Also, statistical analysis found all these coefficients are statistically significant with the value of $p \leq 0,01$. The rest of the statements showed medium internal consistency because their Pearson correlation coefficient range from 0,454 to 0,498.

An exploratory and affirmative factor analysis was further made with the aim of verifying the validity of the assumed theoretical model of the conducted questionnaire, and it was found that all the multivariate assumptions were satisfied, by the axis of homoskedasticity. Twelve participants were excluded from the analysis based on the assumed criterion, which implied an unaffected response to five or more claims. With Mahalanbis distance, 29 multivariate outliers were identified, which were removed from further analysis. The Bartlett test showed correlation adequacy, $X^2(300) = 2483.55$ $p < .001$ and the Kaiser-Meyer-Olkinov (KMO) sampling adequacy test, measure of sampling adequacy (MSA) = 0.83.

Table 2. Results for the internal consistency.

Questions	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Q 1.	81.55	57.024	0.214	0.722
Q 2.	82.21	57.559	0.119	0.733
Q 3.	80.91	56.705	0.381	0.711
Q 4.	81.75	56.843	0.213	0.722
Q 5.	81.31	55.829	0.378	0.709
Q 6.	81.55	54.796	0.316	0.713
Q 7.	81.50	54.031	0.377	0.707
Q 8.	81.56	55.357	0.292	0.715
Q 9.	81.68	56.129	0.275	0.716
Q 10.	81.36	55.961	0.338	0.712
Q 11.	80.93	56.218	0.382	0.710
Q 12.	80.72	57.010	0.377	0.712
Q 13.	81.22	55.854	0.309	0.714
Q 14.	81.07	55.745	0.372	0.709
Q 15.	81.24	55.654	0.412	0.707
Q 16.	82.54	58.665	0.083	0.733
Q 17.	82.20	57.823	0.172	0.724
Q 18.	82.70	58.970	0.021	0.746
Q 19.	81.27	55.973	0.369	0.710
Q 20.	81.21	56.141	0.387	0.709
Q 21.	81.00	55.606	0.417	0.707
Q 22.	80.87	56.357	0.358	0.711

Parallel analysis and scree plot suggested two factors, which corroborates the original theoretical model. The maximum probability estimate was tested by direct round rotation due to the expected correlation of factors. After testing all the questions, 2, 16, 17 and 18 were

omitted from the analysis, due to very low factor saturations. After that, another 2-factor model was tested, and factor loads are presented in the following table (Table 3).

Table 3. Representation of factor loads.

Questions	Factor 1	Factor 2
1	0.38	-0.13
3	0.46	0.03
4	0.28	-0.05
5	0.55	-0.06
2	0.37	0.13
10	0.62	0
11	0.58	-0.03
12	0.38	-0.01
13	0.42	0.06
14	0.53	-0.02
15	0.49	0
19	0.47	0.06
20	0.54	0.07
21	0.49	0.03
22	0.55	-0.06
6	-0.04	0.71
7	0.06	0.69
8	0.09	0.28
9	0.13	0.26
16	0.38	-0.13
17	0.46	0.03
18	0.28	-0.05

This model has achieved a simple structure with the load on each statement solely on one factor. Also, the model had a good fit: the value of the root mean square error of approximation (RMSEA) indicated a great fit at .06, 90% collective intelligence - CI [.05-.06]. Also, the value of root mean square of residuals (RMSR) indicated a great fit (.05), while comparative fit index - CFI (.87) and Tucker–Lewis index - TLI (.83) values indicated that this model could be further improved.

The multiple R² between the factor and the estimated values of the result factor, which can be viewed as a regression model predicting the estimated factor result, was 0.82 and 0.72, for factors 1 and 2. The average results for each factor were as follows: Factor 1, M=4.19 (SD=0.40) and Factor 2, M=3.79 (SD=0.68).

The internal consistency (reliability) of the scale was satisfactory. Also, the average correlation between statements was 0.19, indicating that there is a satisfactory correlation between the items, but not too high, as this could indicate the simultaneous construct of certain issues. The internal consistency of the sub scale (factor) was .79 and .58 for factors 1 and 2. The relatively low reliability of the second sub-scale is expected, due to the relatively small number of items (four items).

DISCUSSION

The aim of this study was to construct and validate a questionnaire for assessing motor competencies in water by collecting important information from previous research. In the current study, an attempt was made to construct and validate a measuring instrument-survey questionnaire for assessing the attitude of competences of movement in water through twenty-two statements obtained by mapping scientific research in this field. After analyzing the obtained results, the statements were divided into three subgroups depending on the values of their Pearson correlation coefficients. The obtained value for Cronbach's α was 0.7, from which we conclude that the internal consistency of statements in the questionnaire is acceptable. A high value of Cronbach's Alpha indicates that the items in the test are likely highly related. However, this value is also sensitive to the number of items in the test: a larger number of items generally results in a higher Cronbach's Alpha, while a smaller number of items may lead to a lower value. Additionally, a very high Cronbach's Alpha may suggest that some items are redundant. The results of this research provide new insights into the key factors influencing the perception of water movement competencies and comfort during water movement. Two factors identified in this study – the importance of water movement competencies (Factor 1) and comfort during water movement (Factor 2) – highlight different aspects of the development of water competencies, and the new findings from these factors significantly contribute to the understanding of how to develop safety and efficiency in the water.

Factor 1, which includes thirteen statements related to the perception of the importance of water movement competencies, reveals a high level of awareness among respondents about the necessity of developing water competencies for water safety. The participants recognized that water movement competencies are not only crucial for swimming but also play a key role in accident prevention, such as drowning. Statements such as "competencies for water movement are just a part of 'water safety'" and "learning to move in all its forms can save a life in a drowning situation" confirm that water movement competencies must be an integral part of the educational curriculum, starting from the earliest age (Wiesner, 2008; Moran et al., 2012). These results also support previous recommendations that self-awareness about one's own skills and the assessment of water safety play a key role in preventing accidents, especially among youth (Moran et al., 2012). Considering that many people consider themselves good swimmers, despite the inability to swim even 25 meters, the study shows that self-assessment of competencies is not always aligned with actual abilities, which can lead to unjustified confidence in risky conditions (Stanley & Moran, 2017). These findings suggest that

educational programs should focus on developing a realistic assessment of one's own skills, highlighting the importance of water safety and preventive measures (Stallman et al., 2017).

Factor 2 refers to the perception of comfort during movement in water, which includes the respondents' sensitivity to the difference between moving on the surface and underwater. Statements such as "movement underwater should be just as comfortable and efficient as movement on the surface" and "backstroke should be just as comfortable and efficient as breaststroke" indicate an increasing awareness of the importance of physical comfort in aquatic activities. Since comfort is linked to lower levels of stress and greater confidence in one's abilities (Olstad et al., 2021), this study suggests that educational programs should consider how subjective experiences of comfort can affect long-term outcomes in swimming education and water safety. As highlighted in earlier studies, changes in swimming conditions, such as transitioning from calm to choppy water, swimming in water of different temperatures, or even swimming in clothing instead of swimwear, can significantly reduce swimming efficiency and cause insecurity among swimmers (Tipton et al., 1999; Kjendlie et al., 2013). Therefore, it is important to emphasize that comfort is not only physical but also psychological – participants who feel comfortable in the water are more likely to develop correct swimming techniques, reduce fear, and increase their safety in aquatic conditions (Sporiš et al., 2011). These results support the importance of developing competencies that encompass all aspects – cognitive, affective, and psychomotor – to achieve long-term water safety (Stallman et al., 2017; Rejman et al., 2020). Recent studies show that the use of goggles and snorkels improves the skills of young non-swimmers with a fear of water, such as water entry, back gliding, and front swimming (Misimi et al., 2022). On the other hand, a study on non-swimmers without a fear of water did not show a significant difference in most skills, except for the bubble-blowing skill, where participants with goggles showed smaller improvements (Misimi et al., 2023).

Water competencies, according to the research, involve both cognitive and psychomotor skills that enable effective coping with challenges in the water. These competencies relate to the ability to recognize risks, manage emotions, control physical stress, and react to changing conditions, such as water temperature, waves, clothing, or even dangers like electrical currents (Rejman et al., 2020). In this context, it is important that educational curricula emphasize the development of these competencies to reduce the risk of drowning, as even good swimmers may not always be able to save themselves in unfamiliar conditions (Moran et al., 2012; Tipton et al., 1999). Additionally, it is crucial that the assessment of one's abilities is based on actual skills and experience, not subjective evaluation. To achieve effective education, it is necessary

to promote the development of realistic self-assessment in terms of one's skills in the water, which is essential for reducing the risk of accidents (Rejman et al., 2020). Using exploratory and confirmatory factor analysis, the study confirmed the validity of the theoretical model of the questionnaire. Although all multivariate conditions were met, except for homoscedasticity, the results indicate that the respondents' answers were largely shaped by their previous experiences and attitudes toward water safety. Respondents who had personal experiences with drowning or had witnessed such situations showed a greater awareness of the importance of water movement competencies, supporting the findings of other studies (Stallman et al., 2008).

Additionally, it is important to note that all participants in this study were students from the University of Zagreb, who had not undergone systematic water safety education within their educational curricula. This fact suggests the need for the implementation of programs that would educate students on the importance of water competencies and water safety. In light of this, the results of the research support the recommendation that water safety education should be included in educational programs from an early age to reduce the risk of accidents and increase overall safety (Moran & Stanley, 2006; Brenner et al., 2009). The findings of this study underline the importance of integrating water safety education into curricula across all stages of education, starting at a young age, to ensure that individuals develop the necessary competencies to function safely in aquatic environments. This research contributes to the growing body of evidence that highlights the need for comprehensive water safety education and the development of water competencies as a critical element in drowning prevention (Sporiš et al., 2011; Wiesner, 2008).

CONCLUSION

Based on the results obtained, the main findings indicate that the questionnaire can be presented as a valuable tool for assessing motor competencies in water, showing acceptable validity and reliability, and providing a valid examination that reflects self-rescue skills. This is based on the content analysis of water skills deemed important for drowning prevention, as well as the proper selection of program content in teaching non-swimmers. A high level of awareness of the importance of swimming competencies enables safe movement in the environment of the water, but also to enjoy the activities that the aquatic medium provides. Therefore, such information should be part of the school program and various educational programs. This, as well as the influence of the public media, would certainly contribute to greater awareness of the

population and thus to greater prevention of undesirable outcomes when doing activities in the water.

Declaration of Competing Interest

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