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Can You Swim? An Exploration of Measuring Real and Perceived Water Competency

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Little is known about the relationship between real and perceived water competence among youth in the context of drowning prevention or of their perceptions of their risk of drowning. This study reports the findings of an international project entitled Can You Swim? Collegiate physical education students (n = 373) were assessed in a two-part study using an initial questionnaire survey to provide self-estimates of water competency and risk perception, followed by six practical tests in the water. Correlation coefficients between perceived and real swimming ($r_s = 0.369$) and floating ($r_s = 0.583$) skills were significant but only moderate in strength. No significant gender differences in real or perceived water competency were found. Significantly more males than females estimated lower risk of drowning associated with a series of aquatic scenarios ($p = 0.016$). The implications of these findings on drowning prevention and the need for further investigation are discussed.

While the role of swimming proficiency in drowning prevention may appear axiomatic, its protective capacity is not well understood. Brenner, Saluja, and Smith (2003) have argued that increased swimming competency is almost certain to be protective in a drowning situation and, if so, then differences in swimming competency may help explain why some are at greater risk of drowning than others. The relationship between swimming competency, swimming lessons, and the risk of drowning for young children has been the subject of some inquiry (Brenner, Moran, Stallman, Gilchrist, & McVan, 2006), but little is known about this relationship with respect to young adults, one of the most at-risk groups of drowning in most developed countries.

A systematic, large-scale review of childhood and youth drowning noted that even though studies have shown that swimming lessons improved the ability to dive,

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swim underwater, breathe correctly, and tread water, no study had examined the more important question of whether swimming lessons actually prevented drowning (Harborview Injury Prevention and Research Centre, 2001). All of these capacities have some association with survival in water, but determining their individual or collective protective capacity remains unclear. Recent studies have suggested a positive relationship between swimming instruction in children of preschool age. Brenner and colleagues (2009) reported that participation in formal swimming lessons was associated with an 88% reduction in the risk of drowning in 1–4-year-old children, although the estimates were imprecise and 95% confidence intervals (CIs) included risk reductions ranging from 3% to 99%. Successes have recently been reported in low and middle income countries (LMICs) among children in rural settings (Linnan, Rahman, Rahman, Scarr, & Cox, 2011; Rahman, Rahman, Mashreky, & Linnan, 2011).

Determining whether the swimming proficiency reported in many studies has an ameliorating effect on drowning risk is difficult to ascertain for two reasons. First, in the context of drowning prevention, there is no universally agreed definition among water safety experts as to what constitutes swimming competency. Hogg, Kilpatrick, and Ruddock (1983) highlight two essential aspects of swimming: flotation to permit breathing and propulsion to provide mobility. Swimming competency is often described in terms of distance swum, but even then, various distances have been used to assess competency. Many water safety initiatives establish arbitrary distances from 25 m to 200 m to identify "can swim" status. Langendorfer and Bruya (1995) have suggested that the term *water competence* is a more comprehensive term than swimming ability and better describes the raft of aquatic skills and knowledge associated with aquatic activity. In support of establishing more embracing terminology, Brenner and colleagues recommended that "the concept of swimming ability be replaced by the more encompassing notion of water competence with regards to drowning prevention" and that "swimming ability be promoted as a necessary component of water competence, but with the understanding that swimming ability alone is not sufficient to prevent drowning" (Brenner et al., 2006, p.116). Consequently, this study adopted the more comprehensive notion of water competency to describe a set of survival skills that may prevent drowning.

Second, much of the drowning prevention research has relied on self-estimates of water competence because of the difficulties associated with in-water testing of real competencies. The value of self-estimation in the reporting of health behaviors, quite appropriately, has been challenged (Mickalide, 1997; Nelson, 1996; Robertson, 1992; Watson, Kendrick, & Coupland, 2003), but nevertheless it has been widely used in drowning prevention studies. A major problem with the reliance on self-estimates of water competencies is the tendency for males to overestimate their ability and underestimate the risk of drowning. Howland, Hingson, Mangione, Bell, and Bak (1996) suggest that males probably overestimate their swimming ability and are thus more likely to place themselves at greater risk than females in aquatic settings. In a study of New Zealand youth, Moran (2006) found that significantly more young males than females aged 15–19 years estimated better swimming ability and lower estimates of risk of drowning. Similar results of higher self-estimated swimming competency among males have been reported in young adults (Gulliver & Begg, 2005) and in adults (Gilchrist, Sacks, & Branche, 2000; Howland et al., 1996; McCool, Moran, Ameratunga, & Robinson, 2008), but whether this competency is real or imagined is unknown.

Previous research has suggested that in addition to overestimating swimming proficiency, males and youth may underestimate the potential dangers inherent in aquatic activities (Baker, O'Neil, Ginsburg, & Li, 1992; Brenner et al., 2003; Howland et al., 1996; McCool et al., 2008; Moran, 2006). Moran (2006) found that male youth were more likely to report lower perceptions of drowning risk associated with a range of specific water safety-related scenarios. A study of adult beachgoers found that higher perceived swimming competency was associated with lower perception of risk, which raises the possibility that some individuals (especially young males) may be overly optimistic about their ability to manage risky situations (McCool et al., 2008).

The lack of consensus among experts as to what constitutes water competency in a drowning prevention context and the dependence on self-reported estimation rather than objective measurement in water safety research has meant that much of our understanding on the protective role of swimming in drowning prevention is speculative. Consequently, the purposes of this study were to

1. Obtain self-estimates of a range of water competencies that include swimming and survival skills among young adults;
2. Establish and administer a set of practical tests of the same water competencies;
3. Explore the relationship between real and perceived competencies and the implications of any over/underestimation of such skills among young adults; and
4. Identify perceptions of drowning risk among young adults and any relationship between risk estimation and actual water competencies.

Method

Following workshop discussions that focused on defining and measuring swimming competency in the context of drowning prevention at the World Water Safety Conference in Oporto, Portugal, 2007, a pilot study was initiated in New Zealand at the University of Auckland (KM) and in Norway at the Norwegian School of Sports Science (RS, DD, P-LK). The intention of the pilot study was to identify key components of swimming competency, establish protocols for their practical assessment, create a questionnaire that reported on self-perceptions of water competency, and provide personal estimates of the risk of drowning. These developments were underpinned by a conceptual model of water competencies based on the causes of drowning (Stallman, Junge, & Blixt, 2008). Further trials were undertaken at the University of Ballarat (JB, LP, KMcE) in Australia and at three institutions in Japan at Aichi, Naruto, and Chiba (TG, KT, AM, SS). Researchers at each of the participating institutions obtained ethics clearance from their institutional review boards before the commencement of the testing. All institutions had their own swimming pools that varied from 25m-50m in length, were heated (27–28 °C), and had deep water (2 m+) available for testing underwater activities.

Participants

University students newly enrolled in Physical Education programs were invited to voluntarily participate in a project entitled Can You Swim? Participants had undergone preliminary selection processes to enter their respective programs and in one case (Norway), minimal entry standards for swimming competency were required. The participants, their swimming skills, and aquatic experience were not known to the members of the research team. It was anticipated that because of their selection into a physical education-related degree program, all participants would be able to safely participate in the study. Participants whose safety was at risk were screened out of the study based on responses to the questionnaire before the practical testing.

Procedures

The study consisted of two phases of data gathering: an initial self-complete questionnaire followed by practical swimming assessment. To avoid possible learning effects from participation in aquatic-related courses, all data gathering took place before the commencement of course work. Participants were unaware when completing the questionnaire that the skills included in the practical tests paralleled those in the survey. Practical testing took place within a week of completing the written survey. Unique identification codes were allocated to enable survey responses to be matched with the practical test results. The data were manually entered into the database using Microsoft Excel 2007 and data entry errors identified and corrected before being exported to statistical software for analysis.

Research Instruments

The first phase of data collection consisted of a 20-question survey that sought self-estimates in six aspects of swimming and survival skills (i.e., distance swim, flotation, swim on back, dive entry, surface dive, and underwater swim) considered relevant to drowning prevention. Participants also rated their risk of drowning in five scenarios (such as “tipped upside down in a canoe 100 m from the shore of a lake”) using a four-point Likert scale ranging from *extreme risk* to *no risk*. The questionnaire also sought information on sociodemographic variables including gender, age, and ethnicity.

The second phase of data gathering consisted of practical testing of swimming and survival skills that matched the questionnaire items to enable the relationship between self-reported and actual swimming and survival competencies to be determined. The skills tested included

- distance swum nonstop in 15 min with no stroke or speed specified (distance achieved assessed on a 5-point scale ranging from < 50 m to > 300 m);
- stationary floating in deep water with minimal swimming motion (4-point scale ranging from < 2 min to > 15 min, and
- an underwater swim (5-point scale ranging from *did not complete* to *completed 25 m*).

For all other tests that included (a) 100 m swim on back with no speed or stroke specified, (b) dive into deep water, and (c) a deep water surface dive, a 4-point scale from *did not complete,* completed with poor form *(great difficulty, difficulty)*, with good form *(easily),* and with excellent form (*very easily)* was used.

Data Analysis

Data from the completed questionnaires were entered into SPSS Version 17 in Windows. Data were then analyzed to provide statistical information at a national level before being combined to provide an international database using the same coding and data entry procedures. Frequencies and percentages were calculated to describe student self-estimates and actual measures of their swimming and survival skill competencies and their perceived risk of drowning. Mann-Whitney *U* tests were used to ascertain significant differences between independent variables (such as gender) on dependent measures (such as estimated swimming or floating competency). Kruskall-Wallis *H* tests were used to analyze data (such as age group) that had multiple levels of comparison. Spearman rank correlation coefficients were obtained to determine significant associations between real and perceived skills.

Data Presentation

Regional results from each participating country have been reported previously at the World Drowning Prevention in Da Nang for New Zealand (Moran, 2011), Norway (Stallman, Dahl, Moran, & Kjendlie, 2011), Australia (Blitvich, Petrass, Moran, & McElroy, 2011), and Japan (Goya, Matsui, Teramoto, Shimongata & Moran, 2011). The results reported in this paper relate to the combined results of the six contributing institutions in four countries. While some regional variations in results were evident, they are not the focus of this paper and will be the subject of future investigation and publication. Analysis of real and perceived swimming and survival skills by ethnicity was not undertaken because of the homogeneity of most groups taking part in the study.

Results

Of the 373 first year university students who volunteered to take part in the study, slightly more than half (53%) were male, one half (50%) were between the ages 17–19 years, and the other half (50%) were between the ages 20–29 years. They were residents of New Zealand (n = 68; 18%), Norway (n = 81; 22%), Australia (n = 112; 30%), and Japan (n = 113; 30%).

Perceived Swimming and Survival Skills

More than half (53%) of students estimated that they could swim nonstop for a distance of more than 300 m, and one quarter (27%) estimated that they could swim 100 m or less (Table 1). More than one half (54%) considered that they could not float in deep water for more than 6 min. Most students estimated that they could swim 100 m on their back (82%), dive into the deep end of the pool (90%), swim 25 m underwater (62%), and surface dive to a depth of 2 m (74%). No significant differences were found in self-estimates of water competencies when analyzed by gender or age group as shown in Table 1.

Real Swimming and Survival Skills

Most students (76%) were able to swim more than 300 m nonstop, and two thirds (67%) were able to satisfactorily swim 100 m on their backs (Table 2).

Table 1 Student Self-Estimated Water Competencies by Gender

	Total		Male		Female		Mann-Whitney U	p
	n	%	*n*	%	*n*	%		
How many nonstop laps of a 25m pool can you swim?								
< 50 m	61	16.4	29	14.6	32	18.5		
51–100 m	38	10.2	25	12.6	13	7.5		
101–200 m	41	11.0	17	8.5	24	13.8	16624.50	0.548
201–300 m	34	9.1	20	10.1	14	8.1		
> 300m	198	53.2	108	54.3	90	52.0		
How long can you stay afloat?								
< 2 min	125	33.8	71	35.9	54	31.4		
2–6 min	74	20.0	37	18.7	37	21.5	16015.00	0.314
7–15 min	63	17.0	30	15.2	33	19.2		
> 15 min	108	29.2	60	30.3	48	27.9		
Can you swim 100m on your back?								
Yes, can swim 100 m nonstop back	306	82.3	159	80.3	147	84.7	16506.00	0.293
No, can't swim 100 m nonstop back	66	17.7	39	19.7	27	15.5		
Can you dive into deep end of pool?								
Yes, can dive headfirst into pool	335	89.8	183	92.0	152	87.4	16516.00	0.143
No, can't dive headfirst into pool	38	10.2	16	8.0	22	12.6		
Can you swim underwater?								
Yes, can swim underwater	232	62.2	125	62.8	107	61.5	17084.50	0.793
No, can't swim underwater	141	37.8	74	37.2	67	38.5		
Can you surface dive to a depth of 2 m?								
Yes, can surface dive to 2 m	274	73.5	151	78.2	123	74.5	15334.50	0.412
No, can't surface dive to 2 m	84	22.5	42	21.8	42	25.5		
Total	373#	100%	199	53.4%	174	46.6%		

#Missing data accounts for the variation in subtotals.

Table 2 Student Water Competencies by Gender

	Total		Male		Female		Mann-Whitney U	p
	n	%	*n*	%	*n*	%		
Swimming Ability								
< 50 m	21	5.7	12	6.1	9	5.2		
50–100 m	27	7.3	15	7.7	12	6.9		
101–200 m	19	5.1	16	8.2	3	1.7	10.066	0.185
201–300 m	20	5.4	10	5.1	10	5.8		
> 300 m	282	76.4	143	73.0	139	80.3		
Floating ability								
< 2 min	127	35.2	73	38.4	54	31.6		
2–6 min	47	13.0	28	14.7	19	11.1	9.124	0.244
7–15 min	43	11.9	21	11.1	22	12.9		
> 15 min	144	39.9	68	35.8	76	44.4		
100 m swim on back								
Did not complete	47	13.2	27	14.4	20	11.9		
Completed with poor form	72	20.2	47	25.0	25	14.9		
Completed with satisfactory form	101	28.4	56	29.8	45	26.8	11.234	0.024*
Completed with good/excellent form	136	38.2	58	30.8	78	46.3		
Dive into pool (2 m depth)								
Did not complete	20	5.6	10	5.3	10	6.1		
Completed with poor form	104	29.4	59	31.1	45	27.4		
Completed with satisfactory form	127	35.9	76	40.0	51	31.1	6.933	0.139
Completed with good/excellent form	103	29.1	45	23.7	58	35.4		
Underwater Swim								
Did not complete	28	7.8	13	6.8	15	8.8		
Completed 10 meters	70	19.4	35	18.3	35	20.6		
Completed 15 meters	70	19.4	37	19.4	33	19.4	1.590	0.811
Completed 20 meters	59	16.3	30	15.7	29	17.1		
Completed 25 meters	134	37.1	76	39.8	58	34.1		
Surface dive 2 m								
Did not complete	18	5.0	5	2.6	13	7.7		
Completed with poor form	48	13.4	29	15.2	19	11.3		
Completed with satisfactory form	166	46.2	94	49.2	72	42.9	7.549	0.110
Completed with good/excellent form	127	35.4	63	33.0	64	38.1		
Total	373[#]	100.0	199	100.0	174	100.0		

[#]Missing data accounts for the variation in subtotals

Proportionally fewer students (40%) could float for 15 min and more than one third could not stay afloat for more than 2 min (35%).

When analyzed by gender, no significant differences were found in distance swimming or floating skill, but significantly more females than males were able to swim on their backs with satisfactory or good/excellent form (females 73%; males 61%). Most students completed a dive entry (65%), a 15–25 m underwater swim (73%), and a surface dive (82%) with satisfactory or good/excellent form. Table 2 shows no significant differences in student performance of these items when analyzed by gender. Further analysis by age also found no significant differences in tested water competencies.

Real Versus Perceived Swimming and Survival Skills

To test the association between perceived and real competencies, data from the self-complete questionnaire and the practical tests were subjected to Spearman RHO correlation analyses (Table 3). The correlation coefficient between perceived and real swim distance was significant, but only moderate ($r_s = 0.369$; de Vaus, 2002). A more substantial correlation was found between real and perceived floating competency ($r_s = 0.583$). Differences between real and perceived competency for the 100 m on the back was significant but low ($r_s = 0.191$). All other comparisons were not significant at the 0.01 level (two-tailed).

When comparisons were analyzed by gender, males showed slightly greater association than females in their predictions of their swim distance competency (males, $r_s = 0.408$, females, $r_s = 0.315$) and floating ability (males, $r_s = 0.601$ females, $r_s = 0.569$), but no other comparisons were statistically significant.

Perceptions of the Risk of Drowning

Participants were asked to estimate their risk of drowning in relation to five scenarios depicting differing levels of risk. Table 4 shows that male and female responses to these scenarios were not significantly different for the low risk activity of deep

Table 3 Comparisons of Estimated and Actual Water Competencies Using Spearman Rank Correlations

	Swim Estimate	Float Estimate	Backstroke Estimate	Dive Entry Estimate	Under-Water Swim Estimate	Surface Dive Estimate
Swim	0.369*					
Float		0.583*				
Backstroke			–.191*			
Dive entry				–.092		
Underwater swim					–.134	
Surface dive						0.059

* Correlation is significant at the 0.01 level (2-tailed)

Table 4 Perceptions of Risk of Drowning by Gender

Risk Scenario	Extreme/High Risk		Slight/No Risk		Mann-Whitney U	P
	Male n(%)	Female n(%)	Male n(%)	Female n(%)		
Capsized canoe 100 meters offshore	47 (23.6%)	53 (30.8%)	152 (76.4%)	119 (69.2%)	15380.50	0.073
Caught in rip current at surf beach	102 (51.8%)	110 (63.6%)	95 (48.2%)	63 (36.4%)	14447.00	0.008*
Chased toy into deep end of swimming pool	7 (3.5%)	11 (6.4%)	191 (96.5%)	162 (93.6%)	15768.00	0.092
Fell into deep river when fully clothed	57 (28.6%)	74 (42.8%)	142 (71.4%)	99 (57.2%)	14897.50	0.016*
Swept off isolated rocks while fishing	159 (79.9%)	139 (80.4%)	40 (20.1%)	34 (19.6%)	16421.50	0.411
			Risk Total		14577.50	0.016*

water exposure in a swimming pool, the moderate risk activity of a canoe capsize 100 m offshore, and the high risk activity of being swept off isolated rocks when fishing. In all scenarios, females reported higher risk estimates than males and, when summated, the overall risk of drowning score was significantly different with female estimation of risk being greater than that of males (Mann-Whitney $U = 14577.50$, $p = 0.016$).

In the higher risk scenarios, significantly more females than males considered they would be at extreme/high risk if caught in a rip current at a surf beach (females, 64%; males, 52%) or through falling into a deep river fully clothed (females, 43%; males, 29%). No significant differences were found when individual risk scenarios and the total risk score were analyzed by age.

Discussion

This collaborative international study examined, among other factors associated with the role of swimming in drowning prevention, students' self-estimated and actual water competencies, together with their perceptions of the risk of drowning. It is the first study of its kind that attempts to compare perceived water competency with real water competency and does so among an age group recognized to be at high risk of drowning. Comparisons between the practical skills assessment and the paired self-estimation of practical skills demonstrated that these students had varied and somewhat inaccurate perceptions of their swimming and survival competencies.

As was to be expected from a cohort selected for a program where aquatic activities were an ongoing part of their professional development, most students had a sound aquatics skill base, though skill levels were not consistently high. Why the association between estimated and actual distance swimming appears to be uniformly high compared with other skills is hard to explain, but it may reflect the emphasis placed on swimming distances as opposed to performing other survival skills in the teaching of aquatics. Given the popularity for aquatic recreation in the countries taking part in the study, it is a concern that more than one third of students (35%) could not stay afloat for > 2 min and almost half (48%) could not stay afloat for more than 6 min, a duration not unlikely in the event of an aquatic emergency necessitating rescue or assistance.

Students tended to underestimate their distance swimming skills, floating competency, surface dive capacity, while overestimating their competency for swimming on the back, performing a dive entry, and underwater swimming. The lack of strong association between real and perceived swimming and floating competencies and a tendency to overestimate their ability to swim on their backs, suggests that many students could not accurately predict their performance in these fundamental water competencies. No other real versus perceived competencies reached statistically significant associations, which again suggests that students had difficulty in accurately predicting their likely performance outcome. Unlike other studies on drowning where self-estimates of swimming competency differed between males and females (Quan & Cummings, 2003), the current study found no significant gender differences in self-estimates or actual swimming ability, except for the ability to swim 100 m on the back, where females demonstrated higher proficiency than males (73% and 61% for females and males, respectively, $p = 0.024$).

While the swimming and survival skill levels of this selected cohort were high, not surprisingly, it is of interest that students of physical education did not predict their performance more accurately. Since physical performance is an area of professional inquiry for this cohort, it is not unreasonable to assume that they would possess a heightened awareness of their own physical skills and proficiencies. If so, their lack of accuracy in estimating swimming and survival competencies does not bode well for the exploration of swimming competency via self-estimation in more generalized populations. Further research is required to determine whether the lack of accurate prediction is unique to this population or whether a similar lack of accuracy in the self-estimation of aquatic skills is characteristic of other populations.

The widespread use of estimates of swimming capacity, either by self or significant others (such as instructors, teachers, or parents), in recent drowning prevention literature (for example, in children, Fife & Goldoft, 1994; in youth, Moran, 2006; in young adults, Gulliver & Begg, 2005; and in adults, Howland et al., 1996; Gilchrist et al., 2000; Mael, 1995) is understandable given the difficulties of assessing "real" water competencies along with the lack of a robust, accepted definition of what constitutes swimming competency. The lack of strong correlation between real and perceived water competencies in the context of drowning prevention found in the current study, however, suggests that caution should be exercised in any interventions based on estimated rather than actual competency.

The findings in relation to perception of the risk of drowning among youth offers support for previous research (Howland et al., 1996; McCool et al., 2008; Moran, 2006), which has argued that young male adults may underestimate the potential dangers inherent in aquatic activities. Males in the current study consistently reported lower perceptions of drowning risk even though their swimming and survival skills were not significantly better than their female counterparts. It may also be that the higher estimates of drowning risk among females reflect greater risk aversion than their male counterparts, providing them with greater protection in and around water. The findings of lower estimations of drowning risk among males in this study offer one possible explanation as to why more male youth drown than females. While the current study did not find evidence of male overestimation of water competency, similar studies of actual swimming, and survival competencies with other groups (such as male adolescents and adults) would be valuable in refuting or confirming previous speculation that higher male risk of drowning is predicated on a propensity to underestimate risk and overestimate ability to manage that risk (Howland et al., 1996; McCool et al., 2008; Moran, 2006).

Results from this study should be interpreted with some caution in light of several methodological limitations. First, the study confined its self-estimated and practical assessment of swimming and survival competencies to beginner students embarking on a professional degree in Physical Education. It is therefore likely that their estimates of swimming competency might be more accurate than the general youth population. It would also be anticipated, given their chosen career development, that their incoming swimming competency would be greater than that of other youth, and this greater competency might accurately reflect their ability to cope with the risk of drowning.

Second, the study was conducted in four countries and required translation of the written survey and practical test protocols into three languages; they consequently may have been subject to different local interpretations, thus reducing the validity of the survey and test protocols. Third, practical testing took place at six different pool locations that differed in pool length, depth of water, time availability, water temperature, and ambient conditions (both indoor and outdoor pools were used). These differences may have affected practical performance. Fourth, since different examiners were used to assess performance and no intertester objectivity tests were possible before commencing testing, it is possible that protocols were applied and evaluated differently at the various sites. Fifth, there is no universal definition or measurement of swimming and survival skill in the context of drowning prevention, further work is required on what being able to swim really means. Sixth, and finally, this was a first attempt at developing a universal measure of water competency. Certainly the tests require refinement and further reliability and objectivity testing with other groups and other testers to ensure their robustness. Notwithstanding these limitations, the results provide fresh evidence on the modest relationships observed between real and perceived water competencies.

Conclusion

This paper reports on the first phase of an international study, part of which attempted to identify the relationships between real and perceived water competency and perceptions of risk of drowning. The results suggest that participants in this study were unable to accurately predict their actual swimming and survival skills, and no significant differences were evident in perceived or actual competency by gender. Males were more likely to underestimate the risk associated with aquatic activities, reinforcing previous research findings. Further investigation using similar methodology is required to determine whether these findings would be replicated in other general youth populations to ascertain whether others can accurately assess their water competency. Until these relationships have been more clearly determined, caution is advised on the use of self-reported estimates of swimming and survival competency in the context of drowning prevention. In addition, further study on drowning risk estimation among other at-risk groups (especially males) may help explain current drowning statistics.

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