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Can you really swim? Validation of self and parental reports of swim skill with an in-water swim-test among children attending community pools in Washington state

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Abstract

Background—Drowning is the second leading cause of unintentional injury death among U.S. children. Multiple studies describe decreased drowning risk among children possessing some

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Contributorship MCMC: Co-principal investigator. Conception, design, data collection, analysis, interpretation of findings, and manuscript writing. LQ: Co-principal investigator. Conception, background, design, data collection, interpretation of findings and manuscript review. EB/JG: Conception, design, data collection, interpretation of findings, and manuscript review. BAL: Data collection, analysis and manuscript review. CW/KW: Data collection and manuscript review. MAG: Project coordinator. Background, data collection, and manuscript review. MRS: Data analysis support and manuscript review. RL: Conception, design, analysis, interpretation of findings, and manuscript review.

swim skills. Current surveillance for this protective factor is self/proxy-reported swim skill rather than observed in-water performance; however, children's self-report or parents' proxy report of swim skill has not been validated.

This is the first U.S. study to evaluate whether children or parents can validly report a child's swim skill. It also explores which swim skill survey measure(s) correlate with children's in-water swim performance.

Methods—For this cross-sectional convenience-based sample, pilot study, child/parent dyads (N=482) were recruited at three outdoor public pools in Washington state. Agreement between measures of self- and parental-reports of children's swim skill was assessed via paired analyses, and validated by in-water swim-test results.

Results—Participants were representative of pool's patrons (i.e., non-Hispanic White, highly educated, high income). There was agreement in child/parent dyads' reports of the following child swim skill measures: "ever taken swim lessons", perceived "good swim skills", and "comfort in water over head". Correlation analyses suggest that reported "good swim skills" was the best survey measure to assess a child's swim skill – best if the parent was the informant (r=0.25–0.47). History of swim lessons was not significantly correlated with passing the swim test.

Conclusion—Reported "good swim skills" was most correlated with observed swim skill. Reporting "yes" to "ever taken swim lessons" did not correlate with swim skill. While non-generalizable, findings can help inform future studies.

Keywords

Drowning; Public Health; Surveillance; Child

INTRODUCTION

Drowning is the second leading cause of unintentional injury death among U.S. children 1–17 years old.[1] In Washington state (WA), the rate of drowning among children 1–19 years old occurring in natural water settings (including while boating) is more than two times the national average (1.04 vs. 0.49 per 100,000).[2]

Drowning injury is severe; more than 50% of victims treated in the emergency department for nonfatal drowning are admitted or transferred for further care.[3] Hypoxic insult may result in long-term memory problems, learning disabilities, and permanent loss of self-help skills.[4 5]

While there is no universally accepted measure of what constitutes water competency, research has shown that drowning risk is lower among children who possess some degree of swim skill, usually obtained through swim lessons.[6–8] UNICEF and the World Health Organization, the American Academy of Pediatrics, the Open Water Drowning Prevention International Task Force, and the International Lifesaving Federation support learning how to swim and acquiring water survival skills as an important drowning prevention strategy.[9–13]

While the gold standard method is to test a child's performance in water, data collected on swim skill have largely been based on child/self or family reports. In the United States, the validity of swim skill reports has not been assessed by correlation with a child's swimming performance. Survey data that correlate with children's actual swimming performance without in-water testing is needed for swim skill surveillance, as a mechanism to reduce drownings.

This study evaluated whether children (7–17 years) attending community pools in Washington State (WA) or their parents can validly report a child's swim skill. It explored which swim skill self/proxy-reported survey measure(s) (e.g., comfort in deep water, history of swim lessons, subjective assessment of skill, self-reported swim distance) correlate best with a child's in-water swimming performance. Specifically, this study:

1. Assessed children's self-perceptions of their swim skill.
2. Assessed parent's perceptions of their children's swim skill.
3. Compared responses to survey swim skill measures to children's in-water swimming performance.

METHODS

Study design

This convenience-based sample, pilot cross-sectional study was conducted at the three highest attendance, outdoor public pools associated with the Seattle and the Snohomish Departments of Parks and Recreation in WA. Participating pools were conveniently selected due to their location and schedule throughout the week. While they also offer lap swimming and learn to swim sessions, participation was restricted to those families visiting the pool to relax or have fun during the open swim sessions.

Parents with school-aged children attend the open/public swim sessions at these pools, which charged an entrance fee (≤$4.00 USD) and required children (≤17 years) to pass a life-guard administered in-water swim-test before entering the deep end. Open/public swim sessions allow patrons to freely enjoy swimming or playing in the water, different from lap swimming and learn to swim teaching sessions.

Sampling—Pool administrators estimated that 80–100 children take the swim test daily at these locations during the summertime. Power calculations estimated a minimum sample size of 436 child-parent dyads (alpha=0.05, estimated 50% in-water swim-test failure rate).

Participant inclusion and exclusion criteria—Children (7–17 years) who were accompanied by a parent or guardian, visited these pools during data collection days, did not belong to a swim team, and were fluent in English or Spanish were eligible to participate. Parental presence was required to give permission for their children's participation, and to serve as informants on their children's swim skills. Taking the in-water swim-test was not required; children who chose not to take the swim test were also eligible to participate. Verbal child assent, written parental permission and consent were obtained. The study protocol was approved by the authors' Institutional Review Boards.

Data collection

Between 3–8 trained interviewers collected data at 1–2 pool locations during July 8–30, 2014, coinciding with the beginning of school-children's summer vacation break. Interviewers approached potential participants (e.g., adults with children who appeared to be 7–17 years old) outside the pool, while waiting to buy tickets or for the open swim session to start. Adults were invited to participate, and screened for eligibility (i.e., inclusion and exclusion criteria).

Parents completed the parental consent and permission form. Subsequently, a second interviewer verbally explained the study to the child. If the child assented, parents and children were interviewed simultaneously during approximately 5 minutes, yet separately to avoid their influencing each other's responses. They were reunited once both finished answering the questions.

Survey instruments—Interviewer-administered child/self and parental report surveys were developed in English and Spanish, based on previously used measures and expert advice. These included 4 close-ended child swim skill measures: "knowing how to swim" (1=yes, 0=no/not sure), "ever taken swim lessons" (1=yes, 0=no/not sure), "perceived good swim skill" (1=good, 0=so-so/not good/can't swim), and "comfort in water over head" (1=comfortable/very comfortable, 0=uncomfortable/slightly uncomfortable). A unique identifying number was assigned to each child/parent dyad.

In-water swim-test—All participating pools required children to pass a basic in-water swim-test before they were allowed in the deep end of the pool during the open/public swim sessions. Children who chose not to be swim-tested were only allowed to be in the shallow end of the pool. While no specific strokes or technical skills were required, to pass the swim-test children had to propel themselves a specific distance (i.e., Pool A (83ft), Pool B (120 ft), Pool C (88 ft)), while not touching the bottom or sides of the pool, demonstrating breathing, front crawl stroke and/or arms above water. All pools required these minimum water competency requirements.

No child was required, invited or encouraged to take the in-water swim-test as part of this study. Swim-test results (pass/fail) were provided by the lifeguard administering the test, only for those participating children who were voluntarily swim-tested that day. Wearing a life-jacket during the swim-test was considered a test fail.

Statistical analyses

Child and parent survey responses, and child swim-test result data were linked and analyzed using Epi Info 7.1.1.14 and SAS v. 9.3. Cross-tabulations were used to describe the sample, and identify any differences (N, %, X^2) by 3 sub-groups of child/parent dyads:

Seeking to be swim-tested that day (i.e., swim-tested)—Dyads included the children who voluntarily chose to take the in-water swim-test that day. A child's willingness to voluntarily take the in-water swim-test could be a reflection of that child having a better self-perception of his/her ability to pass the swim-test.

Previously swim tested this season (i.e., previously swim-tested)—Dyads included children who may have a more accurate perception of his/her swim-skill, based on recent in-water swim-test experience.

Parents' comfort in water over their head—Dyads included the parents/guardians who did or did not feel comfortable in water over their head. Parents/guardians' comfort in water over their head may influence their decision on whether to expose their child or not to opportunities in which the child can be in the water and learn how to swim.

We paired the child/parent data, and calculated concurrence between child/parent responses to each swim-skill measure via cross-tabulations (N, %). McNemar's (S) statistic assessed if there were statistically significant differences between child/parent reports within dyads. When differences were significant, the swim-skill measure was excluded from the remaining analyses. When differences were not statistically significant, we calculated Kappa (k) statistics to describe the level of agreement between child/parent informants for those measures as low ($k<0.4$), moderate ($0.4 \geq k \geq 0.75$), or high ($k>0.75$).[14] For the dyads in which the child was seeking to be swim-tested (N=305), we assessed which paired child/self and parental reports of a child's swim skill measure correlated (Pearson's r) best with the child passing the in-water swim-test.

RESULTS

Sample description

In total, 775 families were approached. Of the 586 eligible families, 82% agreed to participate. The final sample size was 482 child/parent dyads. The majority of the dyads were swim-tested (63%, n=305); 85% of them passed.

Most children were 7–10 years old (median=9 years), non-Hispanic White (72.4%), and represented both genders equally (Table 1). Significantly more non-Hispanic White children (79.7%) had previously been swim-tested (X^2=11.40, p=0.003; Hispanic=5.7%; non-Hispanic Other=14.6%). Swim-tested children were slightly older (median=10 years) and of non-Hispanic White (87.1%) parents/guardians (non-Hispanic Other 9.6%; Hispanic 3.3%; X^2=9.79, p=.0008) (data not shown).

Parents/guardians' were on average 44 years old, mostly female (74.9%) and non-Hispanic White (83.2%). Most parents/guardians completed a bachelor's degree or higher (73.9%), and 47.9% of the dyads reported an annual household income of ≥$100,000 (Table 1). More swim-tested (51.5%) than non-swim-tested (41.8%) dyads reported ≥$100,000 annual household income (X^2=9.17, p=.01) (data not shown).

Reports on children's swim skills

Children's self-reported swim skills—Most children self-reported "knowing how to swim" (92.9%), "ever taken swim lessons" (88.5%), "good swim skills" (58.7%), and feeling "comfortable in water over head" (76.6%). All swim skill measures were significantly higher among those who had previously been swim-tested. Children seeking to

be swim-tested on the data collection day also reported significantly higher swim skill on all measures except “ever taken swim lessons” (Table 2).

Parental/guardian reports on children’s swim skills—Similarly, most parents/guardians said their children “know how to swim” (88.8%), had “ever taken swim lessons” (87.3%), had “good swim skills” (56.6%), and felt “comfortable in water over head” (73.2%). Parents/guardians’ reports were significantly higher among dyads where the child had previously been swim-tested, except for the “ever taken swim lessons” measure. Parents/guardians who reported feeling comfortable in water over head reported significantly more often that the child was also “comfortable in water over head” (Table 2).

Reports on parents’ swim skills

Most parents/guardians self-reported that they “know how to swim” (95%), had “ever taken swim lessons” (73.2%), and felt “comfortable in water over head” (87.5%). Females accounted for the majority of parents/guardians who did not feel comfortable in water over their heads (93.3%, X^2=12.45, p=.0004) (data not shown).

Agreement between child/self and parental reports on children’s swim skills

Total paired sample (N=482) data were analyzed to evaluate agreement between children and parents/guardians’ responses within each dyad (Table 3).

Knows how to swim—Most parents and children within dyads (85.9%) concurred in reporting the child “knows how to swim”. However, children were statistically (S=8.33, p=0.004) more likely to report knowing how to swim (92.9%) than their parents reporting their child knows how to swim (88.8%). Therefore, the “knows how to swim” measure was excluded from the remaining analyses.

Ever taken swim lessons—Most parents and children within dyads (84.5%) concurred in reporting the child had “ever taken swim lessons”. Differences between child/self (88.5%) and parent/guardian (87.2%) reports of that child ever taking swim lessons were non-significant. Agreement was high for dyads where the child was not seeking to be (k=0.76) or had not previously been (k=0.76) swim-tested, or when the parent/guardian was not comfortable in water over their head (k=0.84).

Perceived good swim skills—While 43.2% of parents and children concurred when reporting the child had “good swim skills”, only 28.1% concurred when reporting the child did not have “good swim skills”. Agreement in child and parent/guardian responses were moderate and low (k=0.32–0.41).

Comfort in water over head—Most dyads (62.4%) agreed in reporting whether the child was comfortable in water over his/her head. Discordant child and parent responses were not statistically significant. Agreement between child and parent/guardian responses was low (k=0.20–0.35).

Correlation between child/self and parental reports, and swim-test results

Among swim-tested dyads (N=305), passing the in-water swim-test positively correlated with child/self and parental reports of the child having “good swim skills” and feeling “comfortable in water over head”. Perceived “good swim skills” most strongly correlated with passing the in-water swim-test, especially if the parent/guardian was the informant (r=0.28) and the parent/guardian also reported not being comfortable in water over head (r=0.41). The “ever taken swim lessons” measure did not significantly correlate with the child passing the in-water test, regardless of the informant. Therefore, it was excluded from the remaining analyses (Table 4).

Paired child/self and parental reports, and swim-test results—Child/self and parental reports of a child having “good swim skills” or feeling “comfortable in water over head” were not significantly correlated among dyads where the child failed the swim-test. If the child passed the in-water swim-test, correlations were stronger for the “good swim skills” (r=0.25–0.47) measure than the “comfortable in water over head” (r=0.17–0.21) measure (Table 5).

DISCUSSION

Knowing how to swim is an important strategy to reduce unintentional drowning. Children could gain this skill from community-based learn to swim programs, private lessons, at some schools or other locations. Surveillance data on swim skill is necessary to monitor this protective factor and potentially guide efforts to reduce unintentional drowning. However, testing children’s swim skills in water is not always feasible.

This study examined the validity of four survey swim skill measures that are commonly used in surveillance, yet never validated. Findings indicate agreement within participating child/parent dyad’s reports on 3 of the 4 evaluated child swim skill measures (i.e., “ever taken swim lessons”, “perceived good swim skills”, and “comfortable in water over head”).

Most studies show that swim lessons result in improved swim skills, yet developing skills takes time and repetition.[9] While showing greatest agreement within dyads, neither child/self- or parental-reports of the “ever taken swim lessons” measure correlated with passing the in-water swim-test. The high concurrence in parental- and child-self reports of “ever taken swim lessons” could be a reflection of this study’s convenience sample of children whose parents were physically present at the pool, thus showing active engagement in their children’s water recreational activities. Contrary to the assumption that children who took swim lessons have learned to swim, our findings suggest that assessing a child’s history of ever taking swim lessons (i.e., “Have you/your child ever taken swim lessons?”) without assessing the length or results of such training is not a useful measure to assess a child’s ability to pass a swim test within this population.

Correlation analyses which simultaneously considered the three data sources for this study (i.e., child/self- and parental reports of a child’s swim skill, and the child’s in-water swim-test results), suggest that reports of feeling “comfortable in water over head” and perceived “good swim skills” are the best measures to assess a child’s swim skill among participants.

While correlations were overall low, it was highest when the parent is at least one of the informants for the perceived “good swim skills” measure, among dyads where the child passed the swim-test and the parent reported feeling uncomfortable in water over head. Among this population group (i.e., mostly non-Hispanic White, high income, highly educated families choosing to attend a public pool), parents feeling uncomfortable in water over head does not necessarily result in children not learning how to swim.

Study significance

Unlike previous studies, this non-generalizable, convenience sample study benefits from the collection of data on children’s swim skill via multiple methods: in-water swim-test results, child/self- and parental reports. Previous studies have found moderate or weak correlations between young adult’s self-perceived and in-water swim skills.[15 16] To our knowledge, this is the first study in the U.S. that compares children’s self/proxy-reported data with results from a basic in-water swim-test to validate swim skill surveillance measures. Valid population swim skill data could identify vulnerable populations, inform the development of drowning prevention and learn to swim policies and programs, and help organizations that promote swimming and learning to swim to evaluate their programs’ reach and effectiveness.

Swim-test criteria

Various skills have been suggested to establish water competency.[17] Based on an international survey of recreational aquatic organizations, the American Red Cross defined swim competency as having skills in entering, submersion and surfacing, propulsion, turning, floating/treading, and exiting from water.[18] Contrastingly, Dixon et al. identified 7 swim competency domains, based on young adults’ perceptions (i.e., not panicking; instinctive, basic, advanced, and rescue skills; covering a distance; ability to swim in multiple settings).[19] It is generally agreed that swimming involves propelling oneself some distance without aid, yet research has not yet defined what is the minimal distance and skills necessary to prevent drowning. Some validated programs outside of the U.S. suggest 25 meters and some specific skills to reduce the risk of drowning. [7 20]

Similarly, we observed variability in the pool’s minimum swim-test passing criteria. While all pools required children to traverse ≥25 meters (82 feet), the specific distance differed based on each pool’s dimensions. Parents and children advised that lifeguards’ enforcement of the pools’ objective swim-test passing criteria also varied, potentially affecting this study’s findings.

Establishing consistent criteria for day-to-day operations across different sites is challenging. Nonetheless, future studies could benefit from consistent swim-test criteria across water venues.

Limitations

Pool administrators confirmed that our study participants were representative of the patrons at these three specific pools (e.g., mostly non-Hispanic White, high income, highly educated). Yet, they were not representative of Washington’s diversity. Findings cannot be

generalized to all of WA, all population groups (especially racial/ethnic minorities, and non-English- or Spanish-speakers), the US, or other geographical or cultural contexts. Additionally, older children were under-represented, primarily because their parents/guardians were not present; the sample is skewed towards younger children (median: 9 years). Sampling limitations impeded reliable analyses by socio-demographic characteristics.

Participants were a convenience sample of pool-attending families, whose children likely learned how to swim at community pools (63% of those who had ever taken swim lessons) and whose parents were actively engaging with them in water recreational venues. Children who voluntarily chose to be swim-tested could have had more opportunities to obtain swim skills, knowledge, and confidence to pass the swim-test than the general population. In fact, the child's lack of swim skill or confidence, and/or fear of failing were frequently mentioned as reasons for not taking the test. This sample bias, and the fact that passing a swim-test does not confer total protection against drowning, [21] must be considered. Furthermore, passing an in-water swim test at a controlled environment (i.e., pool) does not necessarily imply the child possesses the water competency required in open water or other natural water venues (e.g., beach, rivers).

Conclusion

This convenience-based sample, pilot study serves as a first step in the validation of survey child swim skill measures commonly used in public health surveillance. Parent's perception of his/her child having "good swim skills" was the measure that most correlated with observed swim skill among participants.

Findings are limited to the population commonly served by the participating pool venues in this study – mostly non-Hispanic White, highly educated, high income families with active parental participation in children's swimming activities. Future studies need to evaluate the validity of swim skill measures among diverse populations, which could be reached at open water and free-admission venues. Additionally, strategic collaborations with after school programs, schools, and summer camps could increase the participation of older children and those who attend public water venues without a parent present. Findings can help pool operators develop consistency in swim-test criteria and administration, which is important for both safety and research purposes. Additionally, it is recommended that future studies incorporate verbal or pictographic descriptions of what it means to know how to swim to ensure respondents have a clear understanding on what it means to know how to swim prior to answering swim skill surveillance questions.

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Table 1

Socio-demographic characteristics of all participant child/parent dyads (N=482)

Participant	Socio-demographic Characteristics	N	%
Children (n=482)	Age, in years		
	Median (min, max)	9 (7, 17)	
	7–10 years	322	66.8
	11–14 years	141	29.3
	15–17 years	19	3.9
	Missing	0	0
	Sex		
	Male	240	49.8
	Female	240	49.8
	Missing	2	0.4
	Race and ethnicity		
	Non-Hispanic White	349	72.4
	Non-Hispanic Other	83	17.2
	Hispanic	43	8.9
	Missing	7	1.5
Parents or Legal Guardians (n=482)	Age, in years		
	Median (min, max)	44 (28, 64)	
	25–34 years	28	5.8
	35–44 years	265	55
	45–54 years	175	36.3
	55–64 years	11	2.3
	Missing	3	0.6
	Sex		
	Male	121	25.1
	Female	361	74.9
	Missing	0	0
	Race and ethnicity		
	Non-Hispanic White	401	83.2
	Non-Hispanic Other	51	10.6
	Hispanic	27	5.6
	Missing	3	0.6
	Highest education completed		
	Less than a bachelor’s degree	126	26.1
	Bachelor’s degree or higher	356	73.9
	Missing	0	0
	Annual household income		

Participant	Socio-demographic Characteristics	N	%
	< $100,000	203	42.1
	≥ $100,000	231	47.9
	Declined to answer	48	10

Table 2

Child/self and parental reports of child swim skills, overall and by children's swim-test status

Informant	N (%)	Total (N=482)	Children's Swim-Test Status					
			Seeking to be Swim-Tested*			Previously Swim-Tested*		
			Yes (n=305)	No (n=177)	X^2, df, p-value	Yes (n=251)	No or Unknown (n=231)	X^2, df, p-value
Child (Self)	Knows how to swim							
	No or not sure	34 (7.1)	5 (1.6)	29 (16.4)	37.14, 1, <.0001	9 (3.6)	25 (10.8)	9.61, 1, 0.002
	Yes	448 (92.9)	300 (98.4)	148 (83.6)		242 (96.4)	206 (89.2)	
	Ever taken swim lessons							
	No or not sure	55 (11.5)	29 (9.6)	26 (14.9)	NS	21 (8.5)	34 (14.9)	4.75, 1, 0.03
	Yes	422 (88.5)	273 (90.4)	149 (85.1)		227 (91.5)	195 (85.2)	
	Missing (excluded) †	5						
	Perceived good swim skill ‡							
	No	196 (41.3)	92 (30.6)	104 (59.8)	38.80, 1, <.0001	83 (33.6)	113 (49.6)	12.46, 1, 0.0004
	Yes	279 (58.7)	209 (69.4)	70 (40.2)		164 (66.4)	115 (50.4)	
	Missing (excluded) †	7						
	Comfort in water over head §							
	No	112 (23.4)	43 (14.1)	69 (39.4)	39.63, 1, <.0001	36 (14.3)	76 (33.3)	24.1, 1, <.0001
	Yes	367 (76.6)	261 (85.9)	106 (60.6)		215 (85.7)	152 (66.7)	
	Missing (excluded) †	3						
Parent or Legal Guardian	Knows how to swim							
	No or not sure	54 (11.2)	6 (2)	48 (27.1)	71.22, 1, <.0001	13 (5.2)	41 (17.8)	19.10, 1, <.0001
	Yes	428 (88.8)	299 (98)	129 (72.9)		238 (94.8)	190 (82.3)	
	Ever taken swim lessons							
	No or not sure	61 (12.7)	32 (10.5)	29 (16.4)	NS	27 (10.8)	34 (14.7)	NS
	Yes	421 (87.3)	273 (89.5)	148 (83.6)		224 (89.2)	197 (85.3)	

Informant	N (%)	Total (N=482)	Children's Swim-Test Status					
			Seeking to be Swim-Tested*			Previously Swim-Tested*		
			Yes (n=305)	No (n=177)	X^2, df, p-value	Yes (n=251)	No or Unknown (n=231)	X^2, df, p-value
	Perceived good swim skill ≠							
	No	209 (43.4)	83 (27.2)	126 (71.2)	88.18, 1, <.0001	79 (31.5)	130 (56.3)	30.13, 1, <.0001
	Yes	273 (56.6)	222 (72.8)	51 (28.8)		172 (68.5)	101 (43.7)	
	Comfort in water over head §							
	No	129 (26.8)	41 (13.4)	88 (49.7)	75.19, 1, <.0001	44 (17.5)	85 (36.8)	22.78, 1, <.0001
	Yes	353 (73.2)	264 (86.6)	89 (50.3)		207 (82.5)	146 (63.2)	

*"Seeking to be Swim-Tested" refers to dyads where the child voluntarily chose to take the swim-test on the data collection day and results were available for this study. "Previously Swim-Tested" refers to dyads where the child had been swim-tested previously during that same swim-season but prior to the study date.

†Records with missing data were excluded from the analyses.

≠No=Can't swim, not good, and so-so.

§No=Uncomfortable or slightly uncomfortable; Yes=Comfortable or very comfortable

NS=Not statistically significant

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Table 3

Agreement between child/self and parental reports of child swim skill measures

Knows How to Swim*																				
%		**Total (N=482)**			**Seeking to be Swim-Tested**						**Previously Swim Tested**						**Parent's Comfort in Water Over Head**					
					Yes (N=305)			**No (N=177)**			**Yes (N=251)**			**No** ** **(N=231)**			**Yes (N=421)**			**No (N=60)**		
Child Report		**Yes**	**No**		**Yes**	**No**		**Yes**	**No**		**Yes**	**No**		**Yes**	**No**		**Yes**	**No**		**Yes**	**No**	
	Yes	85.9	2.9	**88.8**	97.1	1	**98.1**	66.7	6.1	**72.8**	93.6	1.2	**94.8**	77.5	4.8	**82.3**	86.2	2.6	**88.8**	85	5	**90**
Parent Report	No	7	4.2	11.2	1.2	0.7	1.9	17	10.2	27.2	2.8	2.4	5.2	11.6	6.1	17.7	7.6	3.6	11.2	3.3	6.7	10
		92.9	7.1		**98.3**	1.7		**83.7**	16.3		**96.4**	3.6		**89.1**	10.9		**93.8**	6.2		**88.3**	11.7	
S, *p-val.*		8.33, 0.004			NS			8.81, 0.003			NS			6.74, 0.009			10.26, 0.001			NS		
k, 95%CI[§]		NA			0.35,−0.02–0.72			NA			0.53, 0.27–0.78			NA			NA			0.57, 0.23–0.91		
Ever Taken Swimming Lessons*																						
%		Total (N=477)			Seeking to be Swim-Tested						Previously Swim Tested						Parent's Comfort in Water Over Head					
					Yes (N=305)			No (N=175)			Yes (N=248)			No ** (N=229)			Yes (N=418)			No (N=58)		
Child Report		Yes	No		Yes	No		Yes	No		Yes	No		Yes	No		Yes	No		Yes	No	
	Yes	84.5	2.7	**87.2**	86.4	3	**89.4**	81.1	2.3	**83.4**	86.7	2.4	**89.1**	82.1	3.1	**85.2**	84.5	2.9	**87.3**	86.3	1.7	**88**
Parent Report	No	4	8.8	12.8	4	6.6	10.6	4	12.6	16.6	4.8	6.1	10.9	3.1	11.8	14.9	4.3	8.4	12.7	1.7	10.3	12
		88.5	11.5		**90.4**	9.6		**85.1**	14.9		**91.5**	8.5		**85.2**	14.9		**88.8**	11.3		**88**	12	
S, *p-val.*		NS			NS			NS			NS			NS			NS			NS		
k, 95%CI[§]		0.69, 0.58–0.79			0.62, 0.47–0.77			0.76, 0.63–0.90			0.59, 0.41–0.76			0.76, 0.64–0.88			0.66, 0.55–0.77			0.84, 0.62–1.0		
Perceived Good Swim Skills[†]																						
%		Total (N=475)			Seeking to be Swim-Tested						Previously Swim Tested						Parent's Comfort in Water Over Head					

Knows How to Swim*

%		Total (N=482)			Seeking to be Swim-Tested						Previously Swim Tested						Parent's Comfort in Water Over Head					
					Yes (N=305)			No (N=177)			Yes (N=251)			No** (N=231)			Yes (N=421)			No (N=60)		
Child Report		**Yes**	**No**		**Yes**	**No**		**Yes**	**No**		**Yes**	**No**		**Yes**	**No**		**Yes**	**No**		**Yes**	**No**	
					Yes (N=301)			No (N=174)			Yes (N=247)			No** (N=228)			Yes (N=414)			No (N=60)		
Child Report		Yes	No		Yes	No		Yes	No		Yes	No		Yes	No		Yes	No		Yes	No	
	Yes	43.2	13.1	**56.3**	56.8	15.6	**72.4**	19.5	8.6	**28.1**	53.4	14.6	**68**	32	11.4	**43.4**	44.4	13.5	**57.9**	35	10	**45**
Parent Report	No	15.6	28.1	43.7	12.6	15	27.6	20.7	51.2	71.9	13	19	32	18.4	38.2	56.6	15	27.1	42.1	20	35	55
		58.8	41.2		**69.4**	30.6		**40.2**	59.8		**66.4**	33.6		**50.4**	49.6		**59.4**	40.6		**55**	45	
S, *p-val.*		NS			NS			8.65, 0.003			NS			NS			NS			NS		
k, 95%CI§		0.41, 0.33–0.50			0.32, 0.20–0.43			NA			0.38, 0.25–0.50			0.40, 0.29–0.52			0.41, 0.32–0.50			0.41, 0.18–0.63		

Comfort in Water Over Head‡

%		Total (N=479)			Seeking to be Swim-Tested						Previously Swim Tested						Parent's Comfort in Water Over Head					
					Yes (N=304)			No (N=175)			Yes (N=251)			No** (N=228)			Yes (N=419)			No (N=59)		
Child Report		Yes	No		Yes	No		Yes	No		Yes	No		Yes	No		Yes	No		Yes	No	
	Yes	62.4	11.1	**73.5**	76.6	9.9	**86.5**	37.7	13.1	**50.8**	74.9	7.6	**82.5**	48.7	14.9	**63.6**	64	11.2	**75.2**	52.5	10.2	**62.7**
Parent Report	No	14.2	12.3	26.5	9.2	4.3	13.5	22.9	26.3	49.2	10.7	6.8	17.5	18	18.4	36.4	12.7	12.2	24.9	23.7	13.6	37.3
		76.6	23.4		**85.8**	14.2		**60.6**	39.4		**85.6**	14.4		**66.7**	33.3		**76.7**	23.4		**76.2**	23.8	
S, *p-val.*		NS			NS			4.59, 0.03			NS			NS			NS			NS		
k, 95%CI§		0.33, 0.23–0.42			0.20, 0.06–0.34			NA			0.32, 0.17–0.50			0.28, 0.15–0.41			0.35, 0.25–0.45			0.22, −0.03–0.47		

"Seeking to be Swim-Tested" refers to dyads where the child voluntarily chose to take the swim-test on the data collection day and results were available for this study. "Previously Swim-Tested" refers to dyads where the child had been swim-tested previously during that same swim-season but prior to the study date. "Parent's Comfort in Water Over Head" was self-reported by each parent, and serves as a proxy for parent's swim comfort. Sample sizes vary due to missing data.

NA= Not applicable, as McNemar's test (S) found statistical significance ($p<.05$) in differences in child/parent reports.

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NS= Not statistically significant.

[*] No= No/Not sure.

[†] No= So-so, Not Good, or Can't Swim.

[‡] Yes= Comfortable/Very Comfortable. No=Uncomfortable/Very Uncomfortable.

[§] Agreement levels: Low (k < 0.4); Moderate (0.4 >= k >= 0.75); High (k > 0.75).

[**] No= No/Unknown.

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Table 4

Correlation of child/self- and parental reports of child swim skill measures with the child passing the in-water swim-test, among the swim-tested dyads* (N=305)

Child Swim Skill Measure	Total Swim-Tested (N=305)			Children Seeking to be Swim-Tested, and…							
				Previously Swim-Tested				Parent's Comfort in Water Over Head			
				Yes (n=188)		No † (n=117)		Yes (n=268)		No (n=37)	
	Informant	Child	Parent	Child	Parent	Child	Parent	Child	Parent	Child	Parent
Ever Taken Swim Lessons	r										
	p-value	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	N										
Perceived Good Swim Skills	r	0.2	0.28	0.15	0.25	0.24	0.27	0.19	0.26	NS	0.41
	p-value	0.001	<.0001	0.04	0.001	0.01	0.004	0.002	<.0001		0.01
	N	301	305	184	188	117	117	264	268		37
Comfort in Water Over Head	r	0.17	0.13	NS	0.19	0.19	NS	0.16	0.15	NS	NS
	p-value	0.003	0.02		0.01	0.05		0.009	0.01		
	N	304	305		188	11		267	268		

*Excludes the "knows how to swim" measure, given significant discordance between child and parent responses (see Table 3). "Previously Swim-Tested" refers to dyads where the child had been swim-tested previously during that same swim-season but prior to the study date. "Parent's self-report of "Parent Comfort in Water Over Head" serves as a proxy for parent's swim comfort.

†No=No or unknown.

NS=Not statistically significant.

Table 5

Correlation of paired child/self and parental reports of child swim skill measures with swim-test results, among the swim-tested dyads* (N=305)

Child Swim Skill Measures		Total Swim-Tested (N=305)		Previously Swim-Tested				Parent's Comfort in WaterOver Head			
				Yes (n=188)		No† (n=117)		Yes (n=268)		No (n=37)	
	Swim-test result	Pass	Fail	Pass	Fail	Pass	Fail	Pass	Fail	Pass	Fail
Perceived Good Swim Skills	r	0.29		0.25		0.35		0.26		0.47	
	p-value	<.0001	NS	0.001	NS	0.0007	NS	<.0001	NS	0.008	NS
	N	255		165		90		224		31	
Comfort in Water Over Head	r	0.17		0.21				0.18			
	p-value	0.006	NS	0.006	NS	NS	NS	0.006	NS	NS	NS
	N	258		169				227			

*Excludes the "knows how to swim" measure (significant discordant in child and parent responses for the full sample and by sub-groups were found), and the "ever taken swim lessons" measure (independent child and parent reports were not significantly correlated with the child passing the in-water swim test). "Previously Swim-Tested" refers to dyads where the child had been swim-tested previously during that same swim-season but prior to the study date. Parents' self-report of "Parent's Comfort in Water Over Head" serves as a proxy for parent's swim comfort.

†No=No or Unknown.

NS=Not statistically significant.