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Predictors of Swimming Skill of Primary School Children in Rural Thailand

Orapin Laosee, Julie Gilchrist, Jiraporn Khiewyoo, Ratana Somrongthong, and Chitr Sitthi-amorn

Drowning is a leading cause of childhood deaths in Asian countries. Children in primary school have a high rate of fatal drowning. These fatal drownings commonly occur in natural water bodies near the child's residence. The 2004 Thai National Injury Survey reported a higher rate of drowning death in rural settings. While swimming skill is recommended to decrease drowning risk, there is a lack of information on factors contributing to a child's swimming skill. This study assesses guardians' perceptions of the swimming skill of rural primary school children and identifies associated risk and protective factors. A cross-sectional household survey was conducted during August-September 2009 in rural communities of Chiang Rai province, Thailand. We analyzed a total of 633 interview surveys completed with guardians of primary school children. Results revealed that less than one-fifth (19%) of the school children (age 6–12 years old) could swim. Multiple logistic regression showed that children who can swim are more likely to have attended swimming lessons (Odds Ratio [OR] = 23.95; 95% CI = 12.21–46.98); be 10–12 years of age (OR = 4.15; 95% CI = 2.35–7.30); be male (OR = 2.82; 95% CI = 1.67–4.77); have had self-reported life-threatening submersion experience (OR = 2.14; 95% CI = 1.10–4.12); or be the child of a guardian who can swim (OR = 2.10; 95% CI = 1.25–3.44). The results highlight the need to provide swimming lessons targeting all children beginning in the younger age groups. Local resources in natural water sites may provide a place for safe swimming lessons in rural areas.

Keywords: swimming skill, drowning, children, primary school, Thailand

Drowning is a leading cause of injury death among children aged less than 15 years worldwide (World Health Organization, 2008). The majority of drowning deaths (97%) occur in low and middle income countries (LMIC; Hyder, Borse et al., 2008; Linnan et al., 2007; Peden et al., 2008; Peden & McGee, 2003; World

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Health Organization, 2008). Drowning is one of the most common causes of death among young children in developing countries in Asia, including Thailand (Fang et al., 2007; Hyder, Wali, Fishman, & Schenk, 2008; Linnan et al., 2007; Rahman, Giashuddin, Svanstrom, & Rahman, 2006; Sitthi-amorn et al., 2006). In 1999, a study of unintentional injury death among children aged 2–16 years in Thailand showed that 35% of deaths were due to drowning (13.1/100,000; Kozik et al., 1999). A recent Thai National Injury Survey estimated 2,600 young Thai children drown each year. In children aged 1–17 years, fatal drowning rates are 17.2 per 100,000, which makes drowning the leading cause of injury death in Thailand (higher than motor vehicle related deaths; Sitthi-amorn et al., 2006). The survey indicated the majority of children who drowned were boys. Among school-aged children the mortality rate among those aged 5–9 years and 10–14 years were 15.5 per 100,000 and 9.0 per 100,000, respectively. For the younger age group (5–9 years), the Thai drowning rate is 2.2 times higher than the average of low-income countries and 1.3 times higher than middle-income countries (Sitthi-amorn et al., 2006; World Health Organization, 2008).

The majority of drowning deaths occur in rural settings, with rural toddlers drowning at a rate of 72.4 per 100,000 children. Rural children between 1 and 17 years are almost 5 times more likely to drown than their urban counterparts. This is generally attributed to higher exposure to aquatic environments in rural areas and higher risk aquatic environments along with lower rates of swimming skill (Ministry of Public Health, 2008; Sitthi-amorn et al., 2006).

Several strategies have been proposed to prevent child drowning in developed and developing countries: increasing supervision, limiting exposure to bodies of water, equipping boats with flotation devices, and providing swimming lessons (Brenner et al., 2009; Committee on Injury Violence and Poison Prevention, 2010b; Dyson, 2005; Hyder, Borse et al., 2008; Smith, 1995; Thompson & Rivara, 1998; Towner & Ward, 1998; Turner, 2004). Specific prevention strategies should be matched to the appropriate age groups. Teaching swimming to increase survival skills in water is recommended for preschool and school-aged children in high income countries (HIC; Committee on Injury Violence and Poison Prevention, 2010a, 2010b; Hyder, Borse et al., 2008). Research studies of preschool aged children in HIC revealed that participation in formal swimming lessons was associated with a reduction in the risk of drowning (Asher, Rivara, Felix, Vance, & Dunne, 1995; Brenner et al., 2009; Yang, Nong, Li, Feng, & Lo, 2007). It is not known if these results from studies in HIC are equally applicable to LMIC. In the injury survey among Thai children over the age of four who died of drowning, 85% did not know how to swim (Sitthi-amorn et al., 2006).

The World Health Organization has been promoting “learn to swim” programs for primary school children, especially in low and middle income countries, as one intervention to protect children from drowning. In Thailand, more information about what factors are related to gain sufficient skill in swimming is needed. This information could be useful to target and promote swimming lessons. Therefore, the study aims were to conduct household interview surveys in rural areas to assess perceived swimming skill among children and to identify associated risk and protective factors that may influence the acquisition of swimming skill.

Method

Study Area

A cross-sectional household interview survey was conducted in rural communities of Chiang Rai province, Thailand. This province is located in the northern most part of Thailand, 820 km from the capital city. Chiang Rai province has a population of 1.2 million people living in 431,763 households across 11 thousand square kilometers.

Procedures and Participants

A proportional method was used to determine the sample size needed to estimate the prevalence of perceived swimming skill among primary school children (Shieh, 2005). We estimated a prevalence of 25% of children being able to swim from a national survey (Sitthi-amorn et al., 2006) and 0.04 acceptance error. The sample size was determined to be 450, which was increased by 10% to allow for missing data, resulting in a sample size target of 495 as a minimum. Public primary schools in Chiang Rai province were used as a sampling frame and entry point. Schools in district 3 were chosen because most of the schools are located in rural settings. Villages in the area of 12 schools were used for the community survey. School personnel assisted by informing guardians that the survey would be conducted in their community. All households in the participating villages were approached; 675 households included children in grades 1 through 6. Of those, 651 guardians were available to respond to the household interview survey.

Interview survey respondents were guardians with at least one child in grades 1 through 6. A guardian in this study was defined as an adult 18 years or older who is the primary care taker of the child/children (e.g., father, mother, aunt, or other). If there was more than one child in the household, the oldest child still in primary school was selected to determine factors associated with their swimming skill because the oldest child is the most likely to be able to swim (Brenner, Saluja, & Smith, 2003; Irwin, Irwin, Ryan, & Drayer, 2009; Sitthi-amorn et al., 2006). To avoid language barriers, ten data collectors who were undergraduate students in the geographic study area were recruited and trained to administer the household survey. The data collection was done by face-to-face interview during the weekend between August and September 2009. Each interview took approximately 20 min. Researchers monitored and supervised field staff throughout the data collection period.

The study was approved by the Ethics Review Committee for Research Involving Human Research Subjects, Health Science Group, Chulalongkorn University. Written informed consent was received from each adult respondent.

Interview Survey

The primary purpose of the study was to assess perceived children's swimming skill and determine the feasibility of conducting swimming lessons using available resources in the community. The questionnaire was developed from material available in the literature and was subsequently assessed by five experts to ensure its

content and face validity. A section of the questionnaire aims to identify associated risk and protective factors. It consisted of two parts: first, demographic questions to ascertain respondents' characteristics such as sex, age, education, marital status, household income, self-reported swimming skill and a self-reported life-threatening submersion experience. The second part addressed the characteristics of the oldest primary school child (grades 1–6). It consisted of questions related to sex, age, child's health, previous participation in formal swimming lessons, availability of pool at school, child's primary caretaker, perceived swimming skill and a self-reported life-threatening submersion experience. Swimming skill in this study was defined as the physical skills necessary to traverse at least 25 m of open water and remove oneself from the water without assistance.

Data Analysis

Data were double entered by data entry operators in EPI-Info version 6.04. The analysis was performed using Statistical Packages for the Social Sciences (SPSS, version 17.0). Descriptive statistics were calculated to present the guardian and child characteristics. Bivariate analyses were computed through simple logistic regression to examine associations between reported children's swimming skill and both guardian's and child's characteristics. The magnitude of association was presented by Odds Ratios (OR) and 95% CI of OR. Then, multiple logistic regression with backward stepwise method was used to identify independent factors related to the child's swimming skill after adjusted for others independent variables. Variables that were likely to be associated with child's swimming skill ($p < .25$ on bivariate analyses) were considered for inclusion in the initial model (Hosmer & Lemeshow, 2000). Plausible interaction terms between independent variables were assessed after selection of the main effect model. The final model was tested for goodness of fit by using Pearson's chi-square statistics. After checking the goodness of fit of the model, adjusted ORs and their 95% CIs were used to interpret the model.

Results

We interviewed 651 guardians of primary school children and received 633 completed questionnaires for analysis. Eighteen interviews were incomplete due to unexpected interruptions. Three-quarters of the adult respondents were female and the mean age of the respondents was 44.10 years. About 53% of guardians had a primary school education. The majority of guardians (89%) were married and over half reported that they earn about 3,000–10,000 Baht/month (approximately 35 Baht: 1 USD). About one-third (36%) of responding guardians reported being able to swim at least 25 m and 12% had a self-reported life-threatening submersion experience (Table 1).

Guardians provided information on the oldest primary school child within their household; children were evenly distributed by gender and age group. The majority (90%) were reported in good health and over half (52%) were also taken care of by others (e.g., grandmother, father, aunt). A vast majority of children (94%) were studying in a school without a swimming pool, and a similar percentage of children had not attended formal swimming lessons (89%) and had a self-reported life-threatening submersion experience (89%). A high percentage (81%) of children could not swim (Table 2).

Without controlling other independent variables, in bivariate analysis, guardian characteristics associated with a child's greater swimming skill included being married, being able to swim, self-reported life-threatening submersion experience, and having greater household income. In addition, child characteristics significantly associated with greater swimming skill included attending swimming lessons, attending a school with a swimming pool, being in the older age group, self-reported life-threatening submersion experience, and being male (Table 3).

The final model of multiple logistic regression identified five variables: ever attending formal swimming lessons, being in the older age group, being male, self-reported life-threatening submersion experience, and being a child of guardian who can swim, which were significantly associated with swimming skill among primary school children. The Pearson goodness of fit test for final model was 12.33 ($\chi^2 = 12.33, p > .05$; Table 4).

Table 1 Selected Demographic Characteristics and Self-Reported Swimming Experiences of Guardians ($n = 633$)

Characteristics of Guardians	No.	(%)
Sex		
Female	478	(75.5)
Male	155	(24.5)
Age group (years)		
18–40	279	(44.1)
41–60	299	(47.2)
> 60	55	(8.7)
Mean(S.D.)	44.10 (11.45)	
Educational level		
No school	134	(21.2)
Primary school	340	(53.7)
Secondary school or higher	159	(25.1)
Marital status		
Married	565	(89.3)
Others	68	(10.7)
Household income		
£ 4,000	326	(51.5)
> 4,000	307	(48.5)
Median (Min.: Max.)	4,000 (500:80,000)	
Swimming skill		
No	410	(64.8)
Yes	223	(35.2)
Self-reported life-threatening submersion experience		
No	554	(87.5)
Yes	79	(12.5)

Table 2 Selected Demographic Characteristics and Swimming Experiences of Oldest Primary School Child as Reported by Guardians (n = 633)

Children's Characteristics	No.	(%)
Sex		
Girls	320	(50.6)
Boys	313	(49.4)
Age group (years)		
6–9	292	(46.1)
10–12	341	(53.9)
Mean (S.D.)	9.53 (1.76)	
Child's health		
Good	575	(90.8)
Poor	58	(9.2)
Primary caretaker		
Mother	300	(47.4)
Others	333	(52.6)
Attend school with swimming pool		
Yes	36	(5.7)
No	597	(94.3)
Previous formal swimming lessons		
Yes	72	(11.4)
No	561	(88.6)
Swimming skill		
Yes	119	(18.8)
No	514	(81.2)
Self-reported life-threatening submersion experience		
Yes	72	(11.4)
No	561	(88.6)

Table 3 Bivariate Analysis of Factors Associated With Reported Swimming Skill of Primary School Children, Crude Odds Ratios, and 95% Confidence Intervals

Variables	Swimming Ability of Children				OR	95%CI
	No (n = 514)		Yes (n = 119)			
	No.	(%)	No.	(%)		
Guardian's characteristics	514	(81.2)	119	(18.8)		
Sex						
Female	387	(75.3)	91	(76.5)	1.07	0.67 - 1.70
Male	127	(24.7)	28	(23.5)	Referent	-
Age						
18-40 yrs	221	(43.0)	58	(48.7)	1.54	0.69 - 3.44
41-60 yrs	246	(47.9)	53	(44.5)	1.27	0.57 - 2.84
> 60 yrs	47	(9.1)	8	(6.7)	Referent	-
Educational level						
No school	108	(21.0)	26	(21.9)	Referent	-
Primary school	282	(54.9)	58	(48.7)	0.85	0.51 - 1.43
Secondary school or above	124	(24.1)	35	(29.4)	1.17	0.66 - 2.07
Marital status						
Married	452	(87.9)	113	(95.0)	2.58	1.09 - 6.12
Others	62	(12.1)	6	(5.0)	Referent	-
Household income (Baht/month)						
≤ 4,000	275	(53.5)	51	(42.9)	Referent	-
> 4,000	239	(46.4)	68	(57.1)	1.53	1.03 - 2.29
Swimming skill						
No	349	(67.9)	61	(51.3)	Referent	-
Yes	165	(32.1)	58	(48.7)	2.01	1.34 - 3.01

(continued)

Table 3 (continued)

Variables	Swimming Ability of Children				
	No (n = 514)		Yes (n = 119)		95%CI
	No.	(%)	No.	(%)	
Self-reported life-threatening submerston experience					
No	457	(88.9)	97	(81.5)	-
Yes	57	(11.1)	22	(18.5)	1.82
Children's characteristics					
Sex					
Girls	275	(53.5)	45	(37.8)	-
Boys	239	(46.5)	74	(62.2)	1.89
Age group					
6-9 yrs	268	(52.1)	24	(20.2)	-
10-12 yrs	246	(47.9)	95	(79.8)	4.31
Child's health					
Good	468	(91.0)	107	(89.9)	-
Poor	46	(9.0)	12	(10.1)	0.89
Primary caretaker					
Mother	238	(46.3)	62	(52.1)	-
Others	276	(53.7)	57	(47.9)	1.26
Attend a school with swimming pool					
No	497	(96.7)	100	(84.0)	-
Yes	17	(3.3)	19	(16.0)	5.56
Previous formal swimming lessons					
No	495	(96.3)	66	(55.5)	-
Yes	19	(3.7)	53	(44.5)	20.92
Self-reported life-threatening submerston experience					
No	468	(91.1)	93	(78.2)	-
Yes	46	(8.9)	26	(21.8)	2.84

Note. Bolded numbers indicate significant variables.

Table 4 The Multiple Logistic Regression Model of Factors Associated With the Reported Swimming Skill of Primary School Children

Variables	Adjusted		
	OR	95% CI	
Children's characteristics			
Previous formal swimming lessons	23.95	12.21	- 46.98
Age group 10–12 years	4.15	2.35	- 7.30
Boys	2.82	1.67	- 4.77
Self-reported life-threatening submersion experience	2.14	1.10	- 4.12
Guardian's characteristic			
Be able to swim at least 25 meters	2.10	1.25	- 3.44

Discussion

Drowning rates are highest among children and in rural areas (Fang et al., 2007; Quan & Cummings, 2003; Rahman et al., 2006; Sitthi-amorn et al., 2006). Providing swimming lessons is an important strategy to prevent childhood drowning (Brenner et al., 2009; Hyder, Borse et al., 2008; McIntosh, 2009; Rahman et al., 2010; World Health Organization, 2008). This is the first study that has attempted to estimate the swimming skill of rural children in a developing country and factors associated with swimming skill. Results highlight substantial deficiencies in reported swimming skill among primary school children (age 6–12 years) in rural settings of Thailand. In our study, 81% of rural children were reported by their guardians as being unable to swim. This is similar to the Thai National Injury Survey, which indicated that 84% of children who had a self-reported life-threatening submersion experience were unable to swim (Sitthi-amorn et al., 2006). The American Academy of Pediatrics (AAP) has recommended swimming lessons for most children 4 years and older and some children at younger ages depending on exposure risk and developmental readiness (Committee on Injury Violence and Poison Prevention, 2010a). Our study results emphasize the need to prioritize swimming lessons for primary school children in rural areas where most drowning occurs.

Some demographic characteristics of guardians were significantly associated with children's swimming skill. This study found that guardians' swimming skill, marital status, and household income were significantly associated with children's reported swimming skill. Previous studies have reported that socioeconomic status (e.g., household income) is one of the key indicators strongly associated with children's swimming skill (Irwin et al., 2009; Rahman et al., 2006). While socioeconomic status was related, this study and another from Bangladesh found that guardians' educational levels were not associated with children's reported swimming skill (Ahmed, Rahman, & Ginneken, 1999). This could be explained because there was lack of infrastructure such as swimming pools, swimming instructors, or swim programs in rural areas; therefore, children could not access swimming lessons.

This is the first study in a LMIC to report a significant association between guardians' swimming skill and their children's reported swimming skill. Our findings were similar to a study of urban youth in the United States that reported that parental swimming skill was related to their child's skill (Irwin et al., 2009). Guardians who can swim may have a more positive attitude toward swimming and may be more likely to support or even assist their children in learning to swim. Education should be provided for those guardians who don't swim to understand the importance of their children learning to swim. In addition, all guardians should learn safe rescue techniques and emergency response skills (such as CPR) as recommended by the International Task Force on Open Water Drowning Prevention (International Task Force on Open Water Drowning Prevention, 2009).

Our analysis confirmed previously identified factors related to reported swimming skill such as sex, age, and participating in swimming lessons (Fang et al., 2007; Howland, Hingson, Mangione, Bell, & Bak, 1996; Irwin et al., 2009; Peden & McGee, 2003; Quan & Cummings, 2003; Rahman et al., 2006; Sitthi-amorn et al., 2006). In addition, we identified new factors, such as attending a school with a pool and having a self-reported life-threatening submersion experience. While we found that guardians estimated that boys had higher swimming skill compared with girls, previous studies have indicated that boys also experience higher rates of drowning (Ahmed et al., 1999; Fang et al., 2007; Peden & McGee, 2003; Quan & Cummings, 2003; Rahman et al., 2006; Sitthi-amorn et al., 2006). One explanation for these finding is that males may have a greater exposure to aquatic activities or participate in higher risk aquatic situations (Gilchrist, Sacks, & Branche, 2000; Howland et al., 1996). In addition, children who attend a school with a swimming pool may be more likely to be able to swim because swimming lessons are part of their school curriculum. Not surprisingly, having had a self-reported life-threatening submersion experience was found to be associated with greater swimming skill. Presumably these children or their families were motivated to improve swimming skills to avoid a future fatal drowning. Since fatal and nonfatal drowning incidents are common in rural areas, this suggests that without the availability of formal lessons in the rural areas, children may attempt to learn by themselves or in an unsafe manner.

Currently, swimming lessons in Thailand are often provided through the schools. Unfortunately, we found that almost all children in rural areas (94%) attend schools without a swimming pool. As a result, 88% of rural school children do not participate in formal swimming lessons, which put them at higher drowning risk. Lack of infrastructure is one of the barriers to ensuring swimming skills among school children; however, natural water environments are plentiful and are the common location of childhood drowning in Thailand (Sitthi-amorn et al., 2006). These natural water environments can become the needed infrastructure to provide rural children with the opportunity to learn to swim. Modification and use of rivers and ponds for swimming lessons has been successful in Australia, Bangladesh, Thailand, and China (Beattie, Shaw, & Larson, 2008; Centre for Injury Prevention & Research, 2006; Laosee et al., 2008; Yang et al., 2007). Swimming programs that are tailored to and run by the local community are important for long term success (Beattie et al., 2008). School teachers can still take a lead in providing swimming instruction using the natural sites with involvement of the community members and local organizations.

Further research should explore the strategies that encourage schools and community organizations to work together to offer regular “swimming lessons and survival skill” and information on water safety to children and their families. This study did not survey other survival skills (such as floating). Further work is required to identify those skills that prevent drowning in young children in rural areas of developing countries. Finally, strategies that promote swim program sustainability through community ownership should be explored.

This study has certain limitations. First, a guardian’s report of their child’s skill and self-reported life threatening submersion experience may have been underestimates because some rural children may swim with their peers without the knowledge of their guardians. Second, this community-based survey aimed to capture swimming skill of rural children; however, some of these children lived in rural areas but attended school in urban settings. Finally, we were limited in our ability to generalize present findings from guardians of rural children in Thailand to elsewhere. Urban children or those from other countries might have different predictors of swimming skill.

Conclusion

This study highlights that most school children in rural communities of Thailand are reported by guardians as being unable to swim. In addition, children’s swimming skill is related to their guardians’ skill. Providing swimming lessons is a crucial strategy to reduce the high drowning rates in Thailand in this and future generations. The lack of swimming pools in most rural schools is a barrier to providing lessons; however, local resources in natural water sites can provide a place for safe swimming lessons in rural areas. Swimming lessons should be provided for all children to raise swimming proficiency along with other related survival skills and water safety knowledge. Collaboration between the schools and the community in delivering swimming lessons is key to enhancing sustainability of programs.

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