Retention of survival swimming skills among SwimSafe graduates in rural communities of Bangladesh: Results from a cross-sectional study

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ABSTRACT

Background Drowning is the leading cause of death among children in rural Bangladesh. While survival swimming for children ages 6 years and above is recommended in low-income and middle-income countries, research into the long-term retention of survival swimming skills is absent.

Methods The retention of four survival swimming skills, including swimming for 25 m, floating/treading for 30 s, reach rescue skills and throw rescue skills, was observed among those trained under the SwimSafe programme more than 10 years ago. Information about the practice of survival swimming skills among SwimSafe graduates and whether they recommended such lessons for others was also collected through surveys. A multistage sampling strategy was used. Descriptive statistics on the retention of survival swimming skills and other variables and ORs from logistic regression analysis were reported.

Results A total of 3603 SwimSafe graduates were observed. The retention of swimming and floating/treading skills was 88.4% and 89.7%, respectively, and that of swimming and floating/treading skills combined was 84.2%. While 87.7% of the graduates retained reach rescue skills, the retention of throw rescue skills was lower (71.9%). Approximately 60.6% of the graduates retained all four survival swimming skills. The majority of the graduates (70.3%) rarely practised swimming following graduation. Overall, 61.7% of the graduates recommended other children to learn survival swimming skills.

Conclusion The majority of the SwimSafe graduates retained swimming and floating/treading skills for over 10 years despite minimal practice. Retention of throw rescue skills was lower. Therefore, refresher training and awareness campaigns focused on survival swimming skills are recommended.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Drowning was the leading cause of death of children 5–9 years (26.2/100 000/year).
⇒ Survival swimming lessons for children aged 4–10 years were found to be effective in preventing drowning.
⇒ Survival swimming lessons are widely recommended for children 6 years of age or older as a drowning prevention strategy.

WHAT THIS STUDY ADDS

⇒ This study assessed the retention of survival swimming skills in the long term among those trained as children since there is limited evidence on this topic.
⇒ To the best of our knowledge, this study is the first of its kind to assess the retention of survival swimming skills among participants who were trained as children more than 10 years ago.
⇒ This study found retention of all four survival swimming skills—ability to swim for 25 m, float/tread for 30 s and competence in land-based reach and throw rescue, to be high among the participants, with slightly lower rates of retention for throw rescue skills.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The findings of this study can be used to advocate for the scale-up of survival swimming lessons as a drowning prevention strategy in Bangladesh and similar settings.
⇒ This study recommends the use of refresher trainings and awareness campaigns to ensure the retention of survival swimming skills.

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INTRODUCTION

Globally, drowning is one of the leading causes of unintentional injury deaths adversely affecting children aged 1–4 years, followed by those 5–9 years.[1] Unintentional drowning claimed over 70 000 lives in the South-East Asia Region in 2019, of which over 33% were children under 15 years.[2] Similarly, the 2005 and 2016 Bangladesh Health and Injury Survey identified that drowning was the leading cause of death among children ages 1–17 years.[3 4]

The Centre for Injury Prevention and Research, Bangladesh introduced a survival swimming training programme called 'SwimSafe' in 2006, focusing on children ages 4–10 years, considering the American Academy of Pediatrics guideline.[5] The SwimSafe was one of the interventions of a community-based quasi-experimental study titled Prevention of Child Injuries through Social-intervention and Education (PRECISE). PRECISE was implemented in three subdistricts—Raiganj, Sherpur Sadar, and Manohardi. The project was evaluated in 2010 and it was identified that SwimSafe was 96% protective in

preventing drowning.[6] Later, the programme was expanded to 37 subdistricts in 10 districts of the country.

WHO, in its 2021 guideline, recommended swimming, water safety and safe rescue skills training for older children above 6 years in low-income and middle-income countries (LMICs), like Bangladesh, where accessible water bodies are abundant and often seasonal.[7 8]

The SwimSafe curricula were developed in collaboration with drowning prevention researchers and programme personnel in Bangladesh, swimming coaches of the Bangladesh Swimming Federation, and survival swimming experts of the Royal Life Saving Society Australia. The training manual comprised 21 steps including water familiarisation, acquisition of breathing skills, floating/treading skills, skills related to survival swimming, such as push, glide, arm pull and kick, and land-based reach and throw rescue techniques. Children were required to demonstrate four survival swimming skills—their ability to swim for 25 m, float/tread for 30 s and be competent in land-based reach and throw rescue techniques to graduate.

Local ponds that were not being used for fish farming and were within the vicinity of children's homes were selected for swimming training. These ponds were modified to ensure safety and suitability for survival swimming lessons using a bamboo structure to create a stair or safe path from the ground to water, set the boundaries for a shallow water platform and a deep-water area, and form a perimeter fence. Children were trained in the basic skills of swimming like push, glide, arm pull and kick in the shallow water platform and were allowed to swim in the deep-water area inside the perimeter fence once they adopted these basic skills.

To ensure community involvement and ownership of the programme, local youths who volunteered were selected as community swimming instructors (CSIs). CSIs underwent a 7-day training—5 days on how to teach children survival swimming skills and safety standards during lessons, and 2 days on first response training including cardiopulmonary resuscitation (CPR).

A group of 15 children learnt survival swimming in a session. The CSIs took five children in the water at a time for 30 min each day. On average, each child took 14 days to become a SwimSafe graduate. About 700 000 children learnt survival swimming through the SwimSafe program between 2006 and 2019.

Studies exploring the retention of survival swimming skills among children several years after graduating from training programmes are lacking. Thus, this study is the first of its kind to assess the retention of four survival swimming skills by directly observing graduates who were trained 10 or more years ago and obtain information about the practice of survival swimming skills and whether SwimSafe graduates recommended survival swimming lessons for others.

METHODS

A cross-sectional study was conducted to assess retention of survival swimming skills among a subsample of the 77 000 SwimSafe graduates living in the three subdistricts of Bangladesh where the SwimSafe programme was in operation from 2006 to 2012. Graduates who were between 4 and 10 years of age at the time of training were selected.

Graduates who had communicable diseases (any febrile illness, ear or eye infection, tuberculosis, etc), non-communicable diseases (eg, epilepsy), physical disabilities (eg, loss of a limb), mental disorders and those who were pregnant or menstruating at the time of data collection were excluded from the study. To achieve the desired absolute precision of 5% and enable disaggregated analyses for three age categories (<6 years, 6–9 years and ≥10 years) and two sex categories (male and female), the required total sample size was estimated to be 2298. Assuming a response rate of 70%, the adjusted sample size was 3283 (2298/0.7), which was rounded to 3300. A relatively conservative response rate was assumed given the gap of more than 10 years between graduation and follow-up. A total of 3603 SwimSafe graduates were selected for the study from three subdistricts who met the eligibility criteria.

A multistage sampling strategy was adopted to select the target number of SwimSafe graduates for the study. A total of 331 ponds were identified where children received survival swimming lessons of which 156 ponds were randomly selected, with 52 ponds per subdistrict. Following pond selection, data collectors visited 59 057 households around the 156 ponds (about 400 households around each pond) and identified 9363 SwimSafe graduates. Among them, 6908 were currently living in the study areas while the remaining had migrated to different districts. Among the graduates who were living in the study areas, 4240 consented to participate in the study, and among them, 3603 SwimSafe graduates were randomly selected for the study (figure 1).

Data collection was conducted between August and October 2022. A pretested, structured questionnaire was used to collect (a) sociodemographic information such as the graduates' age, sex, level of education, and occupation, (b) information about engagement in swimming-related activities, such as frequency of and type of water body used for practising survival swimming and the number of unintentional falls in water and (c) the frequency of recommendations provided about learning survival swimming.

Following this, observational data on SwimSafe graduates' retention of survival swimming skills were collected. This included swimming for 25 m, floating/treading for 30 s and demonstrating land-based reach and throw rescue skills in a pond. It is worth mentioning that no bamboo structure was created in the pond during observation of swimming skills considering that the SwimSafe graduates were old enough and had the skills of swimming. However, for any emergency, throw-and-reach rescue materials were made available at the pond sites and those who collected observational data were trained rescuers. The distance covered by each graduate was measured using a measuring tape starting from the bank of the ponds. A stopwatch was used to observe the duration of floating/treading.

Descriptive statistical analysis was conducted to report numbers and percentages of SwimSafe graduates disaggregated by the retention of survival swimming skills and the variables in the structured questionnaire. In addition, regression analysis was done to test for associations between sociodemographic characteristics of SwimSafe graduates and retention of survival swimming skills. The SwimSafe graduates' sex, ability to swim for 25 m, float/tread for 30 s and demonstration of reach and throw rescue skills were coded as binary variables for descriptive analysis. For the regression analysis, a nominal categorical variable for survival swimming was created with categories ranging from no skills, varying combinations of the four survival swimming skills and all four skills. All other variables in the structured questionnaire were coded as nominal categorical variables. Statistical analyses were conducted by using Stata/MP V.16.1 package.[9] Patients or the public were not involved in the design, conduct, reporting or dissemination plans of our research.

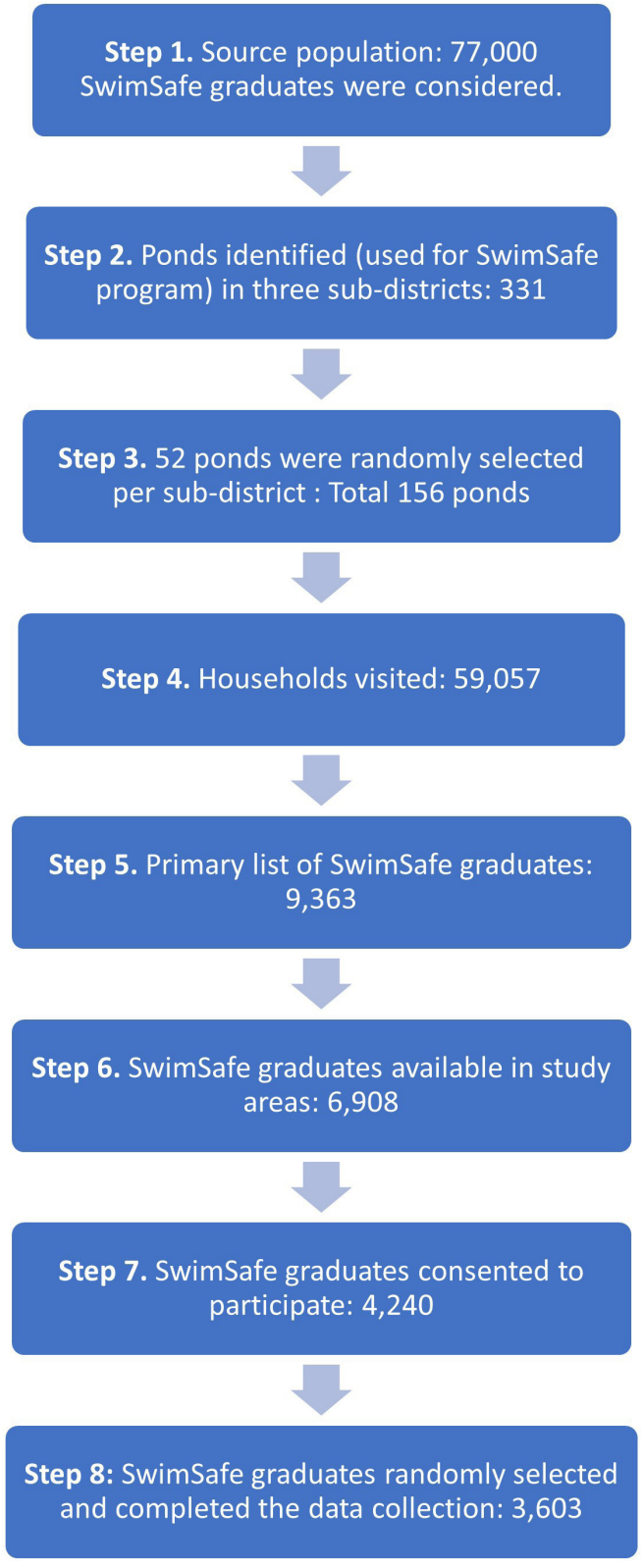

Figure 1 Sampling strategy.

RESULTS

The proportions of male and female SwimSafe graduates who participated in the study were almost equal, 50.4% (n=1815) and 49.6% (n=1788), respectively. More than half (55.6%; n=2005) of the respondents were between 18 and 20 years old, and over one-third (34.0%; n=1225) of participants were more than 20 years old. About three-quarters (76.1%; n=2742) of the SwimSafe graduates had secondary level education, and slightly more than one-fifth (21.3%; n=768) of the graduates had higher secondary education and above. More than half 66.7% (n=2404) of the graduates were involved in sedentary work, 21.0% (n=757) were housewives and 12.3% (n=442) were labourers (table 1).

Table 1 Sociodemographic characteristics of SwimSafe graduates (N=3603) in Bangladesh during data collection in 2022

	Numbers and percentages of SwimSafe graduates	
Categories	**n**	**%**
Sex		
Male	1815	50.4
Female	1788	49.6
Total	3603	100.0
Age groups in years		
<18	373	10.4
18–20	2005	55.6
>20	1225	34.0
Total	3603	100.0
Year of graduation		
2006–2008	1142	31.7
2009–2010	2009	55.8
2011–2012	452	12.6
Total	3603	100.0
Level of education		
Primary	93	2.6
Secondary	2742	76.1
Higher secondary and above	768	21.3
Total	3603	100.0
Occupation		
Sedentary work	2404	66.7
Labourers	442	12.3
Housewife	757	21.0
Total	3603	100.0

Retention of survival swimming skills

Overall, 88.4% of the SwimSafe graduates retained their ability to swim 25 m. Among those who did not retain this skill (n=418), 86.1% (n=360) were able to swim for 11–20 m, indicating some retention of swimming skill. The majority (89.7%; n=3231) of the graduates retained their ability to float/tread for 30 s. Among those who were unable to float/tread for 30 s (n=372), 57.0% (n=212) floated/treaded for 11–20 s. Most of the graduates were able to demonstrate reach rescue skills (87.7%; n=3159), while retention of throw rescue skills was lower (71.9%; n=2589) (table 2). In addition, we also found that among the graduates participating in this study, only 66 individuals (<2%) reported falling into the water unintentionally, indicating alertness around water.

When segregated by sex, the individual proportions of male graduates who retained the ability to swim 25 m, float/tread for 30 s and demonstrate rescue techniques were more than that of females. Similarly, female graduates were less likely to retain all four survival swimming skills compared with males (OR 0.4, 95% CI 0.2 to 0.7).

Approximately 61.0% (n=2182) of the SwimSafe graduates retained all four survival swimming skills. The majority

Table 2 Survival swimming skills of SwimSafe graduates (N=3603) (including swimming, floating/treading, and reach and throw rescue abilities) in Bangladesh in 2022

	Male		Female		Both	
Categories	**N**	**%**	**N**	**%**	**N**	**%**
Ability to swim 25 m						
Able to swim	1713	94.4	1472	82.3	3185	88.4
Unable to swim*	102	5.6	316	17.7	418	11.6
Total	1815	100	1788	100	3603	100
Length covered by the participants who were not able to swim 25 m						
10 m or below	8	7.8	36	11.4	44	10.5
11–20 m	92	90.2	268	84.8	360	86.1
>20 m	2	2	12	3.8	14	3.3
Total	102	100	316	100	418	100
Ability to float/tread for 30 s						
Able to float/tread water	1733	95.5	1498	83.8	3231	89.7
Unable to float/tread water†	82	4.5	290	16.2	372	10.3
Total	1815	100	1788	100	3603	100
Time of floating/treading by SwimSafe graduates who were unable to float/tread for 30 s						
10 s or below	9	11	73	25.2	82	22
11–20 s	47	57.3	165	56.9	212	57
>20 s	26	31.7	52	17.9	78	21
Total	82	100	290	100	372	100
Ability to demonstrate reach rescue						
Able to demonstrate	1603	88.3	1556	87	3159	87.7
Unable to demonstrate‡	212	11.7	232	13	444	12.3
Total	1815	100	1788	100	3603	100
Ability to demonstrate throw rescue						
Able to demonstrate	1338	73.7	1251	70	2589	71.9
Unable to demonstrate‡	477	26.3	537	30	1014	28.1
Total	1815	100	1788	100	3603	100

*'Unable to swim' includes graduates who swam less than 25 meters.
†'Unable to float/tread water' includes graduates who floated/treaded for less than 30 seconds.
‡'Unable to demonstrate' indicates inability to demonstrate rescue skills or incorrect demonstration of these skills.

of the graduates (75.9%; n=2735) retained 25 m swimming, 30 s floating/treading and reach rescue skills. More than half (61.7%; n=2222) of the graduates demonstrated 25 m swimming, floating/treading and throw rescue skills. Over 84.0% (n=3033) of the respondents had 25 m swimming and 30 s floating/treading skills. The highest (88.4%; n=3185) number of the graduates had only 25 m swimming skills. In all categories, the proportion of skill retention was higher among males than females (table 3).

Survival swimming practice

Most of the SwimSafe graduates (86.5%; n=3040) reported that they practised swimming in a pond, and 8.3% (n=293) of them mentioned that they went to a river to practice swimming. Smaller percentages of graduates practised swimming in canals (3.7%; n=133) and other water bodies (1.5%; n=54).

When asked about practising swimming following graduation, 70.3% (n=2534) of the SwimSafe graduates stated that they rarely (not even once a month) practised swimming while 2.4% (n=88) of the graduate never swam again. However, 15.6% (n=563) of the graduates reported swimming for 15 days or less in a month, and 11.6% (n=418) reported swimming for 16–30 days a month. Among the 563 graduates who swam for 15 days or less in a month, 66.1% (n=372) were males and 33.9% (n=191) were females. A total of 12.5% (n=451) of SwimSafe graduates reported participating in swimming events since graduation.

Since graduating from the SwimSafe programme, 13.2% (n=475) of the graduates reported having rescued others from the water while 86.8% did not take part in any rescue-related activities.

Recommendations from SwimSafe graduates

Approximately, 61.7% (n=2222) of the SwimSafe graduates recommended children to learn survival swimming skills. The majority of respondents (84.7%, n=1883) suggested survival swimming lessons for children ages 6–10 years, with 67.0% (n=1488) and 20.1% (n=447) recommending the same for children ages 4–5 and 11–15 years, respectively (table 4).

More than 38.0% (n=1382) of SwimSafe graduates recommended that parents enrol their children in survival swimming lessons and among them, 82.8% (n=1144) of the graduates suggested that parents should enrol their children in a survival swimming programme when children are 6–10 years, and 61.8% (n=854) suggested the same for children aged 4–5 years (table 4).

DISCUSSION

This study uses a large sample of SwimSafe graduates to assess the retention of survival swimming skills, after 10 or more years of graduating from the SwimSafe programme. The majority (88.4%) of the SwimSafe graduates were able to swim for 25 m and 84.2% of the graduates could demonstrate both swimming and floating/treading skills. A lower percentage of graduates demonstrated all four skills, that is, swimming for 25 m, floating for 30 s, reach rescue and throw rescue (60.6%). The lowest retention rate was seen for throw rescue skills (71.9%). More than 70% of the graduates rarely practised swimming and over

Table 3 Distribution of varying combinations of survival swimming skills (including swimming, floating/treading and rescue ability) of the SwimSafe graduates (N=3603) in Bangladesh in 2022

	Male		Female		Both	
Combinations of survival swimming skills	**n**	**%**	**n**	**%**	**n**	**%**
25 m swimming, 30 s floating/treading, and reach rescue and throw rescue	1219	67.2	963	53.9	2182	60.6
25 m swimming, 30 s floating/treading and throw rescue	1245	68.6	977	54.6	2222	61.7
25 m swimming, 30 s floating/treading and reach rescue	1508	83.1	1227	68.6	2735	75.9
25 m swimming and 30 s floating/treading	1677	92.4	1356	75.8	3033	84.2
25 m swimming only	1713	94.4	1472	82.3	3185	88.4

Table 4 Information about recommendations from SwimSafe graduates (N=3603) about enrolling in survival swimming lessons in Bangladesh in 2022

Recommendations from SwimSafe graduates	n	%
Distribution of SwimSafe graduates who suggested children to learn survival swimming		
Suggested	2222	61.7
Did not suggest	1381	38.3
Distribution of estimated age of children for whom SwimSafe graduates recommended learning survival swimming*		
4–5 years	1488	67
6–10 years	1883	84.7
11–15 years	447	20.1
16+ years	139	6.3
Distribution of SwimSafe graduates who suggested parents to teach survival swimming skills to their children		
Suggested	1382	38.4
Did not suggest	2221	61.6
Distribution of estimated age of children at which SwimSafe graduates recommended parents to provide survival swimming lessons*		
4–5 years	854	61.8
6–10 years	1144	82.8
11–15 years	300	21.7
16+ years	89	6.4

*Multiple responses allowed.

86% did not take part in rescue-related activities following graduation. The retention of all four survival swimming skills and the practice of such skills were lower among female graduates compared with males. A small percentage (38.4%) of graduates recommended parents to enrol their children in survival swimming programmes.

Past studies have assessed the immediate and short-term impact of educational interventions on water safety knowledge and skills including pull rescue, throw rescue, safe entry, safe exit, floating up to a maximum 2 min, among young adults[10] and the retention of floating and rescue skills among primary school children shortly after training.[11] A similar study in the USA assessed parents' perception about whether their children retained swimming and water safety skills following a 2-week long swimming curriculum.[12] This study is the first to conduct direct observations of retention of survival swimming skills among adolescents and young adults who were trained as children.

A study in New Zealand that assessed water safety knowledge, buoyancy, submersion, simulated rescue, negotiating obstacles and propulsion skills among primary school-aged children, found the ability to remain buoyant to improve significantly, both immediately and ten weeks after training, which is consistent with the findings of the current study. The same study saw no significant improvements in rescue skills.[11] However, in contrast, over 87% of the SwimSafe graduates retained reach rescue skills and over 70% retained throw rescue skills even after 10 years or more.

Recent advancements in the field of drowning prevention saw WHO and United Nations recommend the need for survival swimming lessons for older children ages 6–10 years since the proportion of swimming ability has been found to increase with increasing age.[3 7 13 14] This recommendation is supported by the findings of this study that found more than 84% of the older children trained in the SwimSafe programme to retain both swimming and floating/treading skills as young adults.

The current study found declines in rescue skills since graduating from the SwimSafe programme. A similar study among young adults and adolescents found no significant effect of previous school-based swimming and water safety lessons on water safety knowledge, skills or attitudes.[15] However, frequent refresher training on survival swimming through school-based programmes or community-based swimming competitions is likely to improve these skills in addition to ensuring regular practice and spreading awareness about its importance.[14] In addition, these programmes should encourage those enrolled to motivate others to join and create an inclusive environment to enable more participation from females.

There is limited research on the long-term retention of survival swimming skills following such programmes in the literature. Future studies should focus on implementation research studies evaluating the processes and outcomes of such programmes. The long-term impact of these programmes, including refresher training sessions, on skills retention, and fatal and non-fatal drowning rates, should also be studied. In the current study, the term 'survival swimming' encompasses swimming, floating/treading, reach rescue and throw rescue skills. However, survival swimming is described in varying ways in the literature, using terminologies ranging from 'basic swimming, water safety and rescue skills'[6] to 'swimming and water safety skills'.[15 16] Research groups should work on standardising the definition and components of survival swimming and implementing context-specific survival swimming programmes for children older than 6 years globally.

Observing survival swimming skills among SwimSafe graduates was a major strength of this study. However, there are a few limitations of this study. Although initially it was planned that random sampling technique would be used to select the required sample from a sampling frame of 77 000 SwimSafe graduates, many graduates could not be reached since they had migrated out of their original districts. Thus, a simple random sampling method was used to select SwimSafe ponds first, followed by the selection of graduates near each pond. In addition, although 6908 SwimSafe graduates were available in study areas, 61.4% of these graduates consented to participate.

The respondents who consented to participate in this study may have had inherently different characteristics, in terms of survival swimming skills, compared with those who declined to participate. However, difference in survival swimming skills among participants and non-participants is less likely since frequently cited reasons for not agreeing to participate were due to reasons unrelated to survival swimming, such as the time of observations not aligning with their bathing time, being sick at the time of observations or not wanting to participate in a research study. Nevertheless, to reduce the selection bias, SwimSafe graduates were selected for the study randomly from a pool of graduates who consented to participate.

The sample may also suffer from survivorship bias since only SwimSafe graduates alive at the time of the study were eligible to participate. Those who have lost the survival swimming skills might have been exposed to a higher rate of drowning death. That may lead to an overestimation of the survival swimming skill retention rate, though the overall low drowning death rate suggests the overestimation should be only marginal.

CONCLUSION

SwimSafe graduates trained as children retained survival swimming skills for 10 years or more. However, their throw rescue skills declined over time. This decline may be attributed to the lack of practice and refresher training. The lack of practice and infrequent recommendations for survival swimming lessons seen in this study can be tackled through awareness building programmes aimed at community sensitisation. Survival swimming programmes should be implemented for children older than 6 years of age, particularly in LMICs. The visibility of these programmes could be enhanced through embedment in the school curricula. Further studies are required to explore the impact of refresher training to assess if reinforcement plays a role in skill retention. This empirical study is the first of its kind to directly observe retention of survival swimming skills. The success of the SwimSafe programme is reflected in the high rate of retention of survival swimming skills observed in this study which has important implications in scaling up the programme throughout the country and in similar settings.

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