Evaluation of a community-based drowning prevention programme in northern Islamic Republic of Iran

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تقييم برنامج مجتمعي المرتَكَز للوقاية من الغرق في شمال جمهورية إيران الإسلامية

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الخلاصة: تقيِّم هذه الدراسة جدوى حزمة من التدخلات للوقاية من الغرق في شمال جمهورية إيران الإسلامية. وقد استخدم الباحثون تصميماً شبه تجريبي قبل وبعد إجراء الملاحظات على القاطنين والسائحين في مناطق مجموعة التدخلات (الدراسة)، وهي مناطق ساحلية فيها مياه ترفيهية، وفي مناطق مجموعة الشواهد، وهي مناطق تقع بجوار بحر قزوين في منتجعات بجوار الخط الساحلي لبحر خزر. وقد هبط معدل الغرق المميت في المجموعة السكانية القاطنة في تلك الولايات من 4.24 لكل مئة ألف نسمة من السكان إلى 3.04 لكل مئة ألف نسمة من السكان كخط أساسيّ في نهاية المشوار. واتضح للباحثين أن خطر الموت بسبب الغرق في مناطق التدخل في مناطق المياه الترفيهية كان خلال الفترة السابقة للتدخل أكبر (معدل الأرجحية = 1.15، فاصلة الثقة 95٪، وتتراوح بين 0.66 و2.01). مما صار في فترة تنفيذ التدخل (معدل الأرجحية 0.24، فاصلة الثقة 95٪ وتتراوح بين 0.15 و0.37). وانتهى الباحثون إلى أن من الممكن تخفيض خطر الغرق من خلال زيادة درجة الإشراف والارتقاء بمستوى الوعي لدى المجتمع.

ABSTRACT This study evaluated the feasibility of a drowning intervention package in northern Islamic Republic of Iran. A quasi-experimental design used pre- and post-observations among residents and tourists in water-recreation beach areas of intervention and control regions by the Caspian Sea and in residents near the Caspian Sea coastline. The fatal drowning rate in the studied resident population in the provinces fell from 4.24 per 100 000 residents at baseline to 3.04 per 100 000 residents at endline. The risk of death from drowning in the intervention areas in the water-recreation area was greater during the pre-intervention (OR = 1.15, 95% CI: 0.66–2.01) than the implementation period (OR = 0.24, 95% CI: 0.15–0.37). The risk of drowning can be reduced by implementing increased supervision and raising community awareness.

Évaluation d'un programme communautaire de prévention de la noyade dans le nord de la République islamique d'Iran

RÉSUMÉ La présente étude a évalué la faisabilité d'un programme d'intervention contre la noyade dans le nord de la République islamique d'Iran. Un plan quasi-expérimental a été utilisé à partir des observations réalisées avant et après l'intervention auprès de résidents et de touristes dans des zones de plages pour les loisirs aquatiques et des régions témoins près de la mer Caspienne ainsi qu'auprès de résidents à proximité du littoral de la mer Caspienne. Le pourcentage de noyades mortelles au sein de la population résidente étudiée dans les provinces est passé de 4,24 pour 100 000 résidents au début de l'étude à 3,04 pour 100 000 résidents à la fin de l'étude. Le risque de décès par noyade dans les zones d'intervention de loisirs aquatiques était plus élevé avant l'intervention (OR = 1,15, IC 95 % : 0,66–2,01) que pendant la mise en œuvre (OR = 0,24, IC 95 % : 0,15–0,37). Le risque de noyade peut être réduit en renforçant la surveillance et en faisant de la sensibilisation auprès de la communauté.

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Introduction

Drowning is a serious public health problem. A recent global burden of disease study revealed that the global mortality rate from drowning was 7% of all injury-related deaths [1]. In the Islamic Republic of Iran, in 2001, the mortality rate due to drowning ranged between 0.9 and 4.1 per 100 000 population (average 2.6 per 100 000 population) with wide variations among the country's 30 provinces [2].

Various drowning prevention measures—pool fencing, parental education, close supervision by parents or lifeguards and cardiopulmonary resuscitation—have been implemented in high-income countries, and these may be applicable to low- and middle-income countries such as the Islamic Republic of Iran. Education is an important factor too. Rahman et al. stated that the risk of childhood drowning was 2.1 times greater for mothers who were illiterate compared with those who had a secondary or higher level of education [3]. This correlates with Fang et al.'s findings in China [4]. Parental education and close supervision by parents have already been examined in rural settings in some low- and middle-income countries including Bangladesh and China [3,4].

A community-based drowning prevention package was implemented in northern Islamic Republic of Iran in 2005, focusing on high-risk groups and selected high-risk areas. The study focused on the feasibility of a drowning prevention package, which was assessed by measurement of both the process and the short-term drowning fatality rate before and after implementation.

Methods

Study design

To evaluate the feasibility of the drowning intervention package a quasi-experimental community-based trial was performed in 2 separate areas in northern Islamic Republic of Iran. This comprised: (1) pre- and post-intervention observations in the resident population of areas near the Caspian Sea coastline, without a comparison community; and (2) pre- and post-intervention observations, in an intervention and a comparison region, at water-recreation beach areas at the Caspian Sea. Cross-sectional data were collected at pre-intervention and post-intervention in these areas (Figures 1 and 2). This study proposal was reviewed and approved by the medical ethics committee of the Guilan University of Medical Science.

Study areas and populations

Residential areas near the Caspian Sea coastline

This study area comprised residential areas along the Caspian Sea coastline of both Guilan and Mazandaran provinces, with data collection limited to natural open water regions, including the sea, rivers, lakes, canals and wells.

Water recreation areas at the Caspian Sea

This study area encompassed seaside beach areas, in both an intervention region (270 km of seaside beaches in Guilan province) and a control region (270 km of seaside beaches in Mazandaran province). From these sociodemographically similar areas, data were gathered in an area spanning 540 km of coastline during the summer seasons. Information was also supplied by Iranian Red Crescent beach lifeguards at Caspian Sea resorts, who provided first-aid and rescue services. The study included the resident and tourist populations in both provinces.

Planning and implementation

The baseline drowning prevention package was applied from March 2005 to March 2006 in order to identify epidemiological aspects of drowning throughout both the provinces. Using the findings from focus group discussions (FGD) and a literature review, and the data gathered from a cross-sectional survey at baseline, applicable drowning prevention measures were formulated.

During March to July 2006, the intervention package was implemented on a small scale in both study areas (in Anzali county) for 5 months to gauge community feedback. The local provincial government, the lifeguard service, the Guilan University of Medical Sciences and the Red Crescent Society jointly agreed to accept responsibility for the programme. FGD and brainstorming were used to assess the initial community response to the intervention package. The main programme was initiated in July 2006, with the aim of reducing drowning incidents and increasing public awareness in the study area.

The implementation phase evolved from a collaborative effort between the FGD and brainstorming committees, with objectives derived from experiences from the baseline cross-sectional study. This introductory phase of the programme was launched in June 2006 in the seaside region of Guilan province, and completed in March 2009, with application in a comparison community in Mazandaran province. The implementation phase in the resident population was effected simultaneously in both provinces by the Caspian Sea coastline. Public health and safety issues were addressed in accordance with the intervention during the years 2006 to 2009.

Interventions

Residential areas near the Caspian Sea coastline

Elements of the plan in the intervention strategies in rural settings by the Caspian Sea coastline included environment modifications:

- modification of environmental change through, for example, the elimination of certain water reservoirs);

and raising community awareness via:

- information programmes for health care workers (*behvarz*), who were

employed to educate clients about drowning risk factors, with a specific emphasis on training high-risk populations in basic resuscitation techniques; and

• integration of public health messages into local television and radio news, such as the *Darya* TV programme broadcast in Guilan province during the summer season (2 hours per day over the 3-month summer season).

Water-recreation areas at the Caspian Sea

The intervention strategies in the Caspian seaside region included 2 initiatives to increase supervision by:

• extension of lifeguard services throughout the beach regions of the Caspian Sea (1 lifeguard for every 1500 m of beach, equivalent to 180 lifeguards, compared with 15 lifeguards before the intervention); and

• expansion of the number and scale of rescue service stations in the beach areas where the intervention was to be established (1 rescue service station for every 4500 m of beach, equivalent to 60 rescue service stations, compared with 8 rescue service stations before the intervention).

In both study areas

In both study areas, intervention programmes designed to effect recreational behaviour changes were implemented through public health educational campaigns, utilizing posters, pamphlets and notices at the sites of previous drownings. Their purpose was to inform the local community about circumstances related to drowning incidents in the country, to educate people about various means of preventing drowning and to gather data to facilitate the determination of causes of drowning. In both study areas, active interventions were implemented during 2006.

Data sources

Drowning data can be obtained from 2 sources in Islamic Republic of Iran—the death registry system and
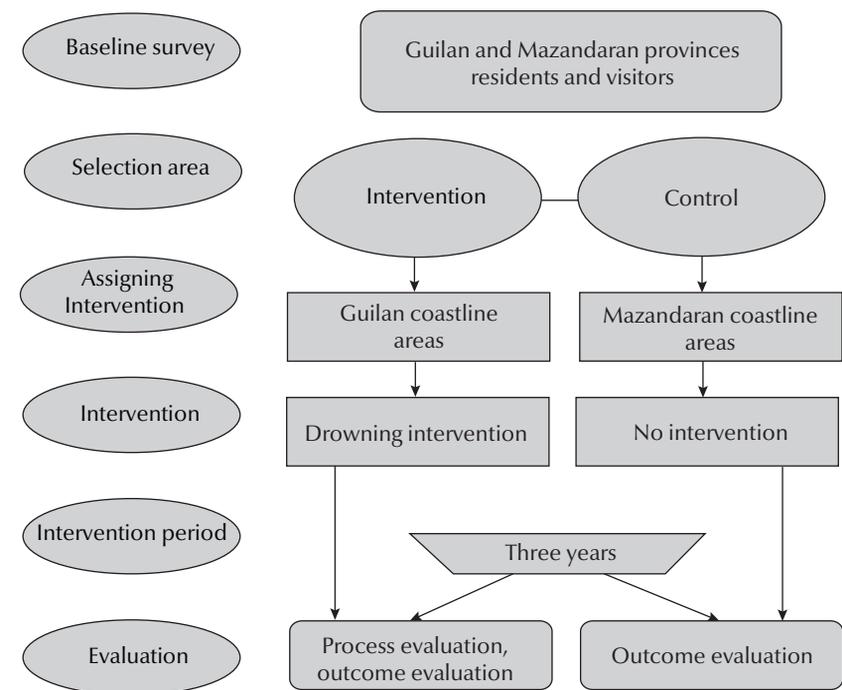

Figure 1 Model for implementation of a drowning prevention programme in the resident and visitor population in Guilan and Mazandaran provinces using a quasi-experimental study design

the forensic medicine system—both of which are based on death certificates. Also, weekly reports were used, which are based on case reports from ambulance excursions, thus including cases that are not usually registered in hospitals [5]. Drowning fatality data were extracted from the forensic
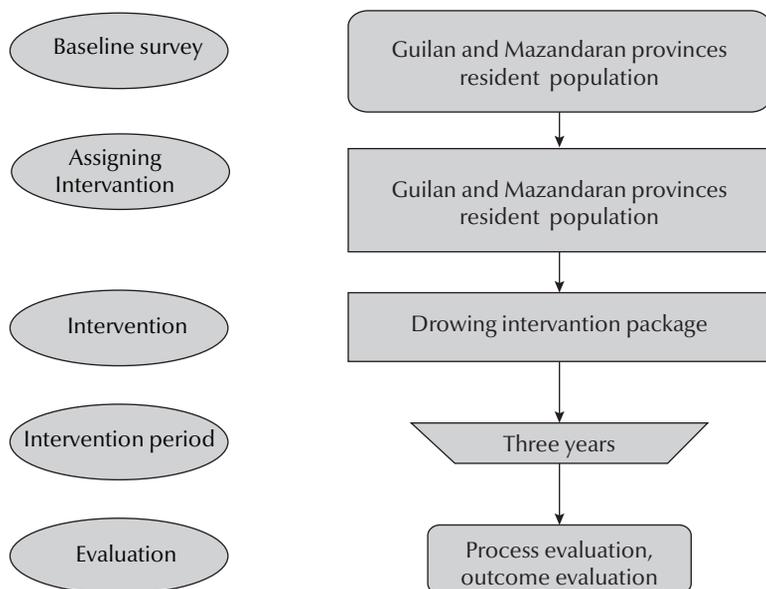

Figure 2 Model for understanding implementation of a drowning prevention programme in the resident population of Guilan and Mazandaran provinces, using a before and after study design

medicine system and the death registry, and near-drowning data were extracted only from the weekly reports. In calculating the denominators for the incidence of drowning, population statistics for 2005, for both before and after the implementation, were used. Both populations were obtained from Islamic Republic of Iran's official statistics registry [6], with exclusion of the tourist population due to a lack of reliable data for this group.

Additional data were obtained through household surveys of the family members of victims of unintentional drowning whose deaths occurred during the study period when the victims were residents in the study areas.

Health care workers (*behvarz*) were recruited to rural areas to work with health education staff on a programme of workshop training sessions related to drowning hazard identification. The programme entailed home visits by health personnel to the population in their service areas, and focused on enabling people to identify the risks related to drowning and on providing instructions about common, appropriate safety and prevention measures. These included ensuring adult supervision and the erection of fencing on the canal waterways and/or around open water reservoirs.

Definition of drowning

The World Congress of Drowning definition of drowning from 2002 was used: "Drowning is the process of experiencing respiratory impairment from submersion/immersion in liquid. Furthermore, drowning outcomes should be classified as: death, morbidity, and no morbidity" [7]. Immersion is the involuntary entry of a person into a body of water while submersion occurs if the person comes to lie under the water surface [8]. Near-drowning is when the person recovers after submersion in water [9].

Data analysis

We conducted our analysis using 2 approaches.

Residential areas near the Caspian Sea coastline

To assess any change in outcome in relation to unintentional cases of fatal drowning in the resident population, outcome measures were taken 3 years after implementation of the intervention package near the Caspian Sea coastline (March 2005–06 to March 2008–09). Population-based rates and relative risks (RR) were calculated using the most recent census data for Islamic Republic of Iran [6]. We examined the trend in the unintentional drowning rate in the area over time. Chi-squared tests for trend were used to test for differences over time in unintentional drowning rates between the sexes and between places of drowning.

Water-recreation areas at the Caspian Sea

Odds ratios (OR) were used to compare drowning risks between the 2 time periods in both the intervention and control areas along the beaches of the Caspian Sea. For individuals with more than 1 case of near-drowning, only the first episode was included in the data set. Unconditional logistic regression was used, and the interaction parameters for the population ORs within different seasons were compared using the Wald test. A 5% significance level was used to reject all null hypotheses. The method used to calculate confidence intervals (CI) for proportions was the Wilson score method without continuity correction. CI for the ORs were calculated using the methods described by Armitage and Berry. The method used to calculate CI for differences between 2 proportions was the Newcombe–Wilson method without continuity correction. The CI for a relative-risk reduction is 1 minus the CI for the relative risk [10].

Results

Programme process

Information about the drowning prevention programme was broadcast every day on local TV between 14.00 and 18.00 hours during the summer seasons. More than 100 000 pamphlets related to the drowning prevention programme were distributed in the study areas among the visitor and resident populations.

Drowning prevention package materials were incorporated into the Red Crescent Society's cardiopulmonary resuscitation courses and health workers' education planning. More than 360 community volunteers were trained in first response, including cardiopulmonary resuscitation, and about 2100 health workers were educated in accordance with the drowning prevention package.

The initial response of the community was gauged after piloting and implementing the intervention package in a small district within the study area. All the FGD groups were aware that drowning is a health problem. Most groups reported that, due to a lack of supervision by parents, most drowning cases among children happened during daylight hours. The participants suggested some prevention measures. For example, male children should be trained in basic swimming, and additional rescue stations were needed along the Caspian Sea coastline. Integrating public health messages into local TV, such as the *Darya* programme, and lake and canal/waterways fencing in rural settings would prevent drowning events.

In partnership with local government bodies, 31 protected areas for swimming on the beaches of the Caspian Sea were established, and more than 200 hazards were identified.

Overall programme outcomes

Overall, there were 1294 drowning deaths among the resident and visitor

Table 1 Number of cases of unintentional fatal drownings between 2005–06 and 2008–09, before and after the programme intervention, in the resident population around the Caspian Sea coastline of Islamic Republic of Iran

Variable	Baseline period						Intervention period					
	2005–06			2006–07			2007–08			2008–09		
	No.	%a	/100 000b	No.	%a	/100 000b	No.	%a	/100 000b	No.	%a	/100 000b
Total	191	100.0	4.24	154	100.0	3.07	204	100.0	4.04	160	100.0	3.04
Age (years)												
0–9	27	14.1	2.75	21	13.6	2.61	20	9.8	2.47	17	10.7	2.08
10–19	61	31.9	6.12	52	33.8	5.40	57	28.0	5.40	21	13.1	2.10
20–65	93	48.8	4.08	70	45.5	2.40	117	57.3	4.00	112	70.0	3.80
65+	10	5.2	3.90	11	7.1	3.07	10	4.9	2.82	10	6.2	2.80
Sex												
Male	164	85.8	–	139	90.2	–	159	77.9	–	147	91.8	–
Female	27	14.1	–	15	9.7	–	45	22.0	–	13	8.1	–
Location												
Sea, unprotected	89	46.5	–	90	58.0	–	96	47.0	–	55	34.5	–
Sea, protected	1	0.5	–	2	1.2	–	6	2.9	–	2	0.9	–
River	75	39.0	–	52	33.7	–	80	39.2	–	78	49.0	–
Lake	10	5.2	–	8	5.1	–	12	5.8	–	23	14.5	–
Canal	10	5.2	–	0	0.0	–	5	2.4	–	0	0.0	–
Other	6	3.1	–	2	1.2	–	5	2.4	–	2	0.9	–

aPercentage of cases; bRate per 100 000 resident population.

populations in northern Islamic Republic of Iran between March 2005 and March 2009. During the 4-year time period covered by the study, the average annual number of drowning deaths in Guilan province was 124, ranging from 91 cases during March 2008–09 to 193 cases during March 2007–08, while drowning deaths in Mazandaran province ranged from 176 cases during March 2007–08 to 232 cases during March 2005–06. Drowning death rates for tourists could not be computed since denominator data were incomplete [6].

Residential areas near the Caspian Sea coastline

Evaluation of the impact of the drowning prevention programme on the resident population around the Caspian Sea coastline showed favourable changes in the overall risk associated with drowning in the resident population of both study groups within the time frame of the study (Table 1). During the 4-year period (2005–06 to 2008–09), 709 fatal cases of unintentional drowning occurred in the resident population in the study area. The incidence fell from 4.24 per 100 000 residents at baseline in 2005–06 to 3.16 per 100 000 at endline in 2008–09, although no consistent trend was detectable in the intervening periods (Table 1).

On average, 86% of the victims were male and only 14% female, and more men than women drowned in every year of the study. The relative risk of drowning for males versus females in the resident population was highest in 2008–09 (RR = 10.9) but there was no consistent trend in other years (RR = 5.84 in 2005–06, RR = 8.96 in 2006–07, RR = 3.40 in 2007–08).

All the age groups identified within the study period showed consistently decreasing numbers of drowning fatalities, except for the 20–65 year age group, for whom the fatality rate

Table 2 Distributions of annual rates of unintentional fatal and non-fatal drownings between 2005/06 and 2008/09 in residents and tourists of water-recreation areas at the Caspian Sea in northern Islamic Republic of Iran: comparison of the intervention area (Guilan province) and control area (Mazandaran province)

Variable	Years			
	Baseline period		Intervention period	
	2005–06	2006–07	2007–08	2008–09
Total no. of cases				
Intervention area	76	126	218	161
Control area	183	207	206	290
No. of drownings (fatal)				
Intervention area	49	67	101	32
Control area	112	132	115	148
No. of near-drownings (non-fatal)				
Intervention area	27	59	117	129
Control area	71	75	91	142
Estimated population proportion fatal cases) (%) (95% CI)				
Intervention area	0.64 (0.53–0.74)	0.53 (0.49–0.62)	0.46 (0.40–0.53)	0.20 (0.14–0.27)
Control area	0.62 (0.54–0.68)	0.64 (0.57–0.70)	0.56 (0.49–0.62)	0.51 (0.45–0.57)
Estimated population OR (95% CI)				
Intervention area	1.81 (1.14–2.89)	1.14 (0.80–1.61)	0.86 (0.66–1.13)	0.25 (0.17–0.36)
Control area	1.58 (1.17–2.12)	1.76 (1.33–2.33)	1.26 (0.96–1.66)	1.04 (0.83–1.31)
Population OR (95% CI) comparing intervention and control areas				
Intervention area	1.15 (0.66–2.01)	0.65 (0.41–1.01)	0.68 (0.47–1.00)	0.24 (0.15–0.37)
Control area	ref	ref	ref	ref
RR (95% CI), comparing intervention and control areas				
Intervention area	1.05 (0.86–1.29)	0.83 (0.69–1.01)	0.88 (0.73–1.06)	0.39 (0.28–0.54)
Control area	ref	ref	ref	ref
RR (95% CI) reduction (%) comparing intervention and control areas				
Intervention area	–0.05 (–0.25–0.16)	0.17 (–0.00–0.33)	0.12 (–0.06–0.29)	0.61 (0.44–0.76)
Control area	ref	ref	ref	ref

OR = odds ratio; RR = relative risk; CI = confidence interval.

fluctuated. The highest annual rates were in the 10–19 year age group, which ranged from 6.12 per 100 000 at baseline to 2.08 per 100 000 at endline.

A chi-squared test for trend between the sexes found that the decline in the incidence of drowning was significantly greater in females when looking at age groups ($P = 0.001$); the highest rate was observed among 10–19-year-olds, with an annual rate of between 2.1 and 6.1 per 100 000 resident population during the period 2005–09.

The majority of drowning fatalities occurred in unprotected areas along the Caspian Sea coastline and in rural settings, where rivers were the most high-risk environment (Table 1).

Water-recreation areas at the Caspian Sea

In the evaluation of the interventions in the Caspian seaside region, 756 cases of drowning deaths and 711 cases of near-drowning were identified during the study period in the beach areas of the Caspian Sea in the resident and tourist populations.

In the intervention area, Guilan province, the risk of drowning decreased from baseline in 2005–06 (OR = 1.81, 95% CI: 1.14–2.89) to endline in 2008–09 (OR = 0.25, 95% CI: 0.17–0.36), and the probability of a case of death decreased from 64% to 20% (Table 2). In the control area, Mazandaran province the risk of drowning decreased only slightly from 2005–06 (OR = 1.58, 95% CI: 1.17–2.12) to 2008–09 (OR = 1.04, 95% CI: 0.83–1.31) and the probability of drowning decreased from 62% to 51% (Table 2).

Comparing risks in Guilan province and Mazandaran province showed a significant decrease over time from OR = 1.15 (95% CI: 0.66–2.01) at the beginning of the study to OR = 0.24 (95% CI: 0.15–0.37) at the end. Comparing the population probabilities for risk of drowning between the provinces, we can see that the decreasing trend over time was more pronounced in the intervention area (Guilan province) than in the control area (Mazandaran province). Also the comparison confirmed by the logistic regression showed a significant difference in ORs both within and between the groups over time. The observed results revealed significant effects of time and group, and also a time and group interaction. Furthermore, we can see that swimming in the intervention area showed a slightly greater relative risk of drowning than swimming in the intervention area at the beginning of the study (RR = 1.05), whereas by the end of the study this had fallen considerably (RR = 0.39) (Table 2, Figure 3).

Discussion

Drowning prevention programmes have not been consistently implemented in low- and middle-income countries. This is the first study to evaluate a drowning prevention programme in a contemporary environment in such countries. The study was designed to determine the feasibility of implementation of a drowning prevention programme in northern Islamic Republic of Iran. Our baseline study showed that the drowning rate in the area investigated was similar to those reported in known high-risk populations, such as in Alaska, lower- and middle-income countries in the Americas and other low- and middle-income countries in the eastern Mediterranean [11,12].

When looking at the unintentional drowning rates in the resident population by age, the highest annual rates were in the 10–19 year age group, which ranged from 6.12 per 100 000 at baseline to 2.08 per 100 000 at endline. A large number of studies have shown that more than half of all drowning deaths

are of children below the age of 15 years [13]; one reason for this is that older children (10–19 years old) overestimate their physical ability. Younger children (< 10 years old) are at risk due to immature skills in swimming and lack of parental supervision. All the age groups showed consistently decreasing numbers of drowning fatalities over the study period, except for the 20–65 year age group, for whom the fatality rate fluctuated.

With regard to place of occurrence in the resident population, our research found that standing bodies of water, such as lakes, were a potentially hazardous environment for young children [5], and unintentional falls into rivers and canals was a common cause of drowning in older children. These findings are consistent with those of previous studies [14].

The data revealed a male-to-female relative risk of 5.84 in the resident population during the first year of measurement, which rose to 10.9 during the final year of the study period. This means that, in every year, males drowned more frequently than females. Males in Islamic Republic of Iran are more likely to engage in various water activities during all seasons of the year and at any time of the day or night, but females are more likely to engage in recreational activities in or near their home in shallow water, and also while they are on holiday; cases of drowning among females tended to occur during daytime [5].

This study also identified a significantly greater decline (by the end-year of the intervention) in the frequency of drowning fatalities on the beaches of the Caspian Sea in the intervention area (Guilan province), where the prevention programme had been adopted, compared with the control area (Mazandaran province), which did not adopt the drowning prevention programme. This means that supervision by a lifeguard or lifesaver of the people who venture into the sea was a positive factor in the reduction of drowning

Predicted probabilities for case = event
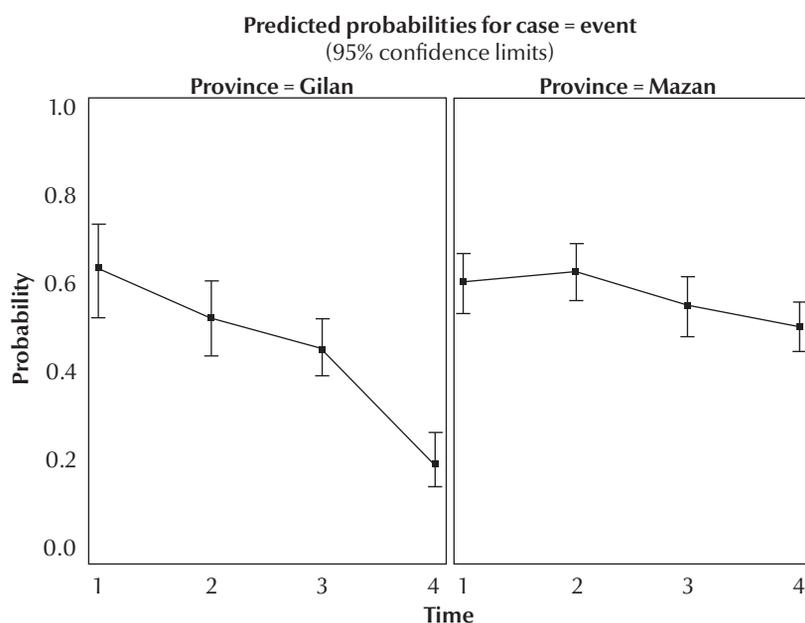(95% confidence limits)

Figure 3 Comparing the population probabilities of the risk of unintentional fatal and non-fatal drownings between the intervention area (Guilan province) and control area (Mazandaran province) after the intervention package in water-recreation areas by the Caspian Sea

along Caspian Sea beaches. This finding is consistent with the falls in the rate of drowning found in high-income countries [15]. A previous study found that the Caspian Sea Liefguard Service, supported by the government, accounted for more than 90% of the medical costs of drowning, where the drowning cost per person was over 17 times the country's gross domestic product per capital [16]. It is suggested that interventions to drowning prevention have been highly cost-effective during the study period.

The effectiveness of intervention programmes and educational campaigns regarding drowning prevention vary according to their design, intensity and objectives [17,18]. In this study, we utilized a comprehensive community-based quasi-experimental design to assess the feasibility of the intervention package. It was difficult to measure the effectiveness of the individual intervention components separately [19]. Therefore, the evaluation was performed with respect to the effect of the whole package. The results appear to suggest that, during the study period, the drowning fatality rate decreased more in the intervention area than in the control area. This could indicate a significant effect of the local intervention. However, it is possible that other factors might have affected the frequency of drowning in the study areas during the study period. Although the reduction in drowning fatality rates in the control area was not statistically significant, it suggested a generally decreasing temporal trend in injury rates. The findings showed that drowning prevention measures—comprising in this study lifeguard services and lake, pond and canal/waterway fencing—are effective, which is in accordance with the findings of other studies [20]. Interestingly, a systematic review of primary prevention strategies found that fencing, a strategy that specifically targets toddlers and young children, is the only effective intervention [21]. Fencing has been successfully

implemented in and around canals and other water bodies in rural areas in China and Bangladesh [8,22]. The Islamic Republic of Iran has not passed legislation in this respect, so the drowning prevention programme policy-makers did not make a specific effort in this regard during the programme phase.

Three main types of biases might have affected the validity of the study: selection bias, misclassification and confounding. To minimize selection bias, we included only unintentional drowning victims in our findings. Thus, the main potential sources of bias in our study are likely to be data misclassification and confounding. We have demonstrated some shortfalls in the reporting of drowning events, owing to the fact that information on drowning deaths in a number of cases was incomplete or lacking, perhaps at least partially due to misclassification of the cause of death [23]. Under-reporting may also have influenced reliability, despite the fact that data were gathered from multiple reporting systems. Additional studies involving the capture–recapture of data may prompt improvements in the injury registry systems for similar study populations [23]. Bias in selection effects refers to differences between intervention and comparison groups in before–after studies. Any 2 communities labelled as similar in our research are unlikely to be identical in all the respects that might have affected the impact of the intervention. The choice to conduct a before–after study is usually determined by whether resources for carrying out that study are an issue, and might involve confounding factors that are difficult to control for, whereas the use of quasi-experimental designs, which are easier to interpret, can facilitate the determination of at least a few potential confounding factors.

Regarding external validity, given that the study was population-based, its findings should be applicable to all

individuals in the catchment areas that meet the inclusion criteria. Since the results presented in this study were largely based on registry systems that essentially comprise all the regions of Islamic Republic of Iran, our results are likely to be applicable to the whole population. Also, the data collected for this study were used within a health system framework in a rural setting similar to those existing in more developed countries.

Like other population-based programme evaluations [24,25], our evaluation had a number of limitations. Inadequate budgets limit evaluation design and activities, but the most significant limitation here lies in a lack of comparison data [16], constraining conclusions about associations between the programme and the changes observed on the impact and outcome measures. Because of defects in estimating the tourist population, the rate of drowning was not calculated for this group. Finally, trend analysis was not possible since it was constrained by the number of observations.

Conclusions

The study shows that reducing the risk of drowning is possible by raising community awareness, in partnership with relevant organizations. Since the programme was designed to involve the community, it was expected to be feasible and accepted by that community. To determine the effectiveness of the intervention package, we need to increase efforts to develop its evidence base, e.g. by expanding the time intervals of analysis to evaluate long-term impacts and to consider seasonal variations. The lifeguard service provided by trained professionals (lifeguards) and community volunteers (lifesavers) was a vital tool in implementing the prevention programme and presumably a major influence on the drowning rate in the coastal areas of the Caspian Sea. The Islamic Republic of Iran health care

delivery system is ideally positioned to provide support for complementary drowning prevention strategies, employing education as an essential element in rural settings around the Caspian Sea.

Acknowledgements

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