

Epidemiology of Drowning in Mazandaran, Iran: A Population Based Study

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Abstract: Drowning is a preventable, unintentional injury with a notable death rate. Mazandaran is a tourist destination in Iran with a long shoreline. The study aims to explore the epidemiological aspects of people who have drowned between 2007-2011. Using a cross sectional study, multi-source data of death due to drowning was used. Data were analyzed using χ^2 test. We also estimated the incidence rate. The incidence rate of drowning and death due to drowning were 1.3 and 0.95 per 100,000 population. Men (83.9 %) in the age group 15 -34 (72.9%) are at higher risk. Tourists are more likely to be drowned than local residents (82.4% vs. 17.6% p -value = <0.0001). Most drowned cases occurred in the Caspian Sea with a higher rate among tourists. Furthermore, most drowned cases (100% in rivers, 91.9% in Caspian sea and 55% in swimming pools) occurred in non-designated areas. In conclusion Despite the effectiveness of preventive policies, the incidence of drowning is still high and requires further intervention activities in Mazandaran.

Key words: Epidemiology • Drowning • Iran

INTRODUCTION

Unintentional injuries are health issues with both fatal and non-fatal consequences. Drowning is an unintentional injury with considerable fatal and non-fatal impacts. It is estimated that a quarter of drowning incidents require hospitalization [1]. It is also a leading cause of death in children. Epidemiological studies suggest that the pattern of mortality due to drowning is not consistent across the population. Males and children are at a higher risk of drowning. Furthermore, drowning statistics demonstrate a clear seasonal pattern, with the highest rates lying between May and Aug [1]. Despite the burden drowning has caused and the fact that it is preventable, drowning is described as a neglected preventable cause of death worldwide [2-4]. Based on a WHO report, there are 400,000 deaths annually due to drowning, which is ranked as the third non-intentional injury resulting in death [5]. In addition, 1.3 million Disability Adjusted Life Years (DALYS) were lost due to

premature death or disability from drowning [5]. In 1990 the death toll from drowning was higher than from war (504,000, vs. 502,000) [6-7].

Iran is a Middle Eastern country with a considerable percentage (60%) of arid or semi-arid land [8]. However, on its northern and southern borders, Iran is enclosed in the south by the Persian Gulf and in the north by the Caspian Sea, the largest landlocked lake in the world. A combination of forests, sea and a relatively moderate climate in summer has led the northern provinces of Iran to develop into major tourist destinations in the summer. Based on official reports from the province, Mazandaran is a major tourist destination due to its close proximity to Tehran, which is the most populated city in Iran [2]. In the city of Mazandaran many tourists and locals enjoy swimming in the Caspian Sea [2].

In Iran, road traffic accidents are the primary cause and burning the secondary cause of death due to non-intentional injuries. However, in the northern provinces of Iran, the second highest cause of death is drowning [9].

In 2001, the rate of death due to drowning as a specific cause in Iran was estimated to be 0.9 to 4.1 per 100,000 population, mean 2.6, with the highest level in the northern part of Iran [10]. Reports show that in 2009, the majority of drowning incidents occurred in Mazandaran [11].

In order to reduce the number of incidents due to drowning, different organizations including the Ministry of Health and Medical Education of Iran and the Red Cross organization, introduced a series of activities such as specified areas for swimming. These areas were equipped with life preservers and life rafts. Additionally, the number of lifeguards and emergency aids in these areas were increased. Furthermore, regulations to prevent swimming in windy and bad weather were introduced [2].

This study aims to explore the epidemiological aspects of cases of drowning, which resulted in death, in Mazandaran, Iran. It also aims to examine the effectiveness of preventive measures undertaken by the Iranian government to reduce incidents of drowning.

MATERIALS AND METHODS

This cross-sectional study was conducted using data on drowning which resulted in death in Mazandaran province from 2007 to 2011. Data was obtained from the drowning record system. This system collects data from different sources, such as forensic medicine, the national mortality record system and the Red Cross organization. The data were extracted via a checklist, which included required information on demographic characters, place of drowning, whether the victim was a local resident of Mazandaran and whether there was recovery before death (further details in Table 1). The data were checked for repetitions. Descriptive statistics such as mean, standard deviation and frequency were used to describe the data. Chi-square and independent sample t test was used to compare categorical and continuous variables across the two groups respectively. To estimate the incidence of risk of drowning, the number of locals who drowned was divided into the total population of Mazandaran province, based on information from the 2006 national census [12]. All analyses were carried out using SPSS software version 16. A P-value less than 0.05 was considered as statistically significant. We denoted a tourist as a person not living in Mazandaran, while locals those who live in a city within the province of Mazandaran. Designated areas

are defined as areas determined by the government as safe for swimming and equipped with special facilities to provide rescue in cases of drowning.

RESULT

A total number of 1,004 were drowned between 2007 - 2011 in Mazandaran, Iran. Of these cases, 64% resulted in death (Table 1). The incidence rate of drowning and death due to drowning were 1.3 and 0.95 per 100,000 respectively.

The results showed that the number of men who drowned was much higher than the number of women, (83.9% vs. 16.1%). Additionally, those aged 15-34 comprised the highest percentage of cases (72.9%). The mean age of women was 25.2 ± 2.6 and of men was 26.1 ± 11.8 with no statistical difference. The results found that the risk of drowning was not consistent across age group by sex ($p_value=0.03$); younger females were at higher risk than males, such that female cases at age 14 or less had a higher percentage than their male counterpart. However, females appear less frequently in the 15 -24age group (further details in Table 2).

The results found that tourists are more likely to drown than local residents (82.4% vs. 17.6% $p_value=<0.0001$). However, the percentage of cases resulting in death are higher among local people than tourists (76.3 % vs. 62.2% $p_value=<0.001$).

Most cases of drowning occurred in the Caspian Sea, with a higher rate among tourists (83.9% vs. 16.1% $p_value=<0.001$). However, local residents experienced drowning more often in rivers and swimming pools (56.9 vs. 43.1% $p_value=0.29$). Furthermore, the results highlighted the fact that the risk of death varied according to the location of drowning: in rivers 100%, in swimming pools 75% and in the Caspian Sea 65%, $P_value< 0.0001$).

Additionally, most cases of drowning (100% in river, 91.9% in the Caspian Sea and 55% in swimming pools $P_value= 0.0001$) occurred in non-designated areas. This is also the case with where drowning resulted in death (67.1% vs. 38.4% $p_value=0.0001$). This pattern was similar for tourists and local residents.

Regarding the seasonal pattern of drowning, there was drowning over 8 months with most occurring in summer, (89.4%). The pattern of drowning among tourists and local people and swimming in non-designated areas and the number of deaths due to drowning varied from month to month (further details in Table 3).

Table 1: The percentage of drowning by variable required informations

Parameter		N	%
Gender	Male	842	83.9
	Female	162	16.1
Age group	=14	101	10.1
	15-24	435	43.3
	25-34	297	29.6
	35-44	84	8.4
	=45	87	8.7
Location where drowning occurred	sea	946	94.2
	river	38	3.8
	pool	20	2
Residency status	native	177	17.6
	tourists	827	82.4
Protected swimming areas	protected	88	8.8
	unprotected	916	91.2
Outcome of drowning	dead	649	64.6
	revived	355	35.4

Table 2: Distribution of drowning according sex and gender (result of χ^2 test)

Parameter		Gender		P.V
		Male	Female	
Age group	=14	8.8	16.7	0.03
	15-24	44.7	36.4	
	25-34	29.6	29.6	
	35-44	8.3	8.6	
	=45	8.7	8.6	

Table 3: Distribution of drowning by month and selection variables (result of X^2 test)

Parameter		Residency status		Protected swimming areas		Outcome of drowning	
		Native	Tourists	Protected	Unprotected	Dead	Revived
Month	Apr	2.3	0.1	0	0.5	0.8	0
	May	4	0.4	3.5	0.8	1.1	0.8
	Jun	11.3	6.5	5.8	7.5	8.2	5.9
	Jul	37.9	25.3	40.7	26.3	25.6	31
	Aug	24.9	33.4	33.7	31.7	31.3	33
	Sep	18.1	32.6	16.3	31.4	31.6	27.3
	Oct	0.6	1.7	0	1.6	1.2	2
	Mar	1.1	0	0	0.2	0.3	0

DISCUSSION

This study has highlighted the role of certain factors in drowning resulting in death in the Caspian Sea, Iran. These factors include demographic factors, location of drowning and whether the victim is local or ot. It also indicates that the incidence of drowning and death caused by drowning have decreased over time.

The lower incidence and mortality rate of drowning in this study, compared to similar research conducted in Mazandaran [13] in 2002-2006, could be due to the different approaches of estimation of these indices; other

studies included tourists in their estimation of ratios, while we excluded them, or could be due to a real decrease in the occurrence of cases of drowning and drowning resulting in death.

A real reduction in cases of drowning could be explained as a result of the successful implementation of social safety policies and their effectiveness in Iran. As a whole, the rate of death in Iran is lower than global statistics of death due to drowning, which is reported as 68 per 100,000 and in developed countries as 1-1.3 per 100,000 [14-16].

Furthermore, men were more likely to drown than women. This is confirmed by other national and international research [11-16]. This difference could be due to gender differences in risk aversion; men seek more risky behaviours as part of masculine behaviour [12]. Furthermore, in Iran there are certain cultural and political restrictions in force for women with respect to swimming in non-designated area, which ultimately prevents them from swimming in high-risk areas [12].

Regarding age, the results found that the risk of drowning varies across different age groups. Those aged 15-34 are at higher risk. This is constant with other studies conducted in Iran[11-16]. However, worldwide, the risk of drowning is higher among the under 4s or teenagers and occurs in the bath tub [17-23]. This difference could be due to the fact that in Iran, including Mazandaran, bath tubs are rarely used[9]. Also, children are usually accompanied on trips by their families. This could provide them with extra parental protection [12].

A higher rate of drowning within this age group might be explained due to the pattern of drug and alcohol use at this age. Based on a cohort conducted in the United States, the age of 20 was found to be a critical age for commencing smoking, using marijuana and drinking alcohol [24]. In Iran age of drug usig estimated 18.8(± 5.67)[25]. Some drugs may cause confusion and lead the user to injuries such as drowning [26-28].

In comparison with local residents, tourists made up a higher percentage of victims. This was consistent with other studies [11-13,16,29-30]. It has been suggested, that in general, tourists may experience more health problems than local people. This could be due to exposure to changes in climate, food and other stresses. In tourist destinations located near the sea, drowning may be a leading cause of death. In research conducted in Istria, Croatia, drowning was the second highest cause of death [31-33]. For local residents, being familiar with the region and knowledge of risky areas may be the reason for the lower number of cases among this group. Whereas

tourists might be unaware of designated areas and also their limited number of days holiday could encourage them to swim in non-designated areas.

The results showed that most cases occurred in the Caspian Sea, with no reports of drowning in the bath tub. Although there are a number of actively used swimming pools in Mazandaran, there have been only a few cases of drowning in swimming pools. This could be due to the fact that tourists are less likely to use swimming pools.

Most cases occurred in non-designated areas, which could highlight the effectiveness of social safety programmes. It could also reflect however, the fact that the number of designated areas is inadequate and insufficient to meet the needs of the number of tourists visiting Mazandaran.

In terms of season, most cases of drowning occurred in the summer, which was expected, due to the popularity of summer for holidaying and for going swimming.

This study aimed to explore the death toll due to drowning in Mazandaran, which is a tourist destination in Iran. It also provided the opportunity to evaluate the effectiveness of the city's safety policy. However, we acknowledge there were certain limitations. We did not have access to information on other risk factors, which may have had a role to play in drowning, such as information on ischemic heart disease of the victims, use of alcohol or drugs and history of seizures. We also used data on cases that resulted in death, not all cases of drowning; therefore a study on all cases of drowning may provide a better overall view of the pattern of drowning.

CONCLUSION

The reduction in the number of drowning cases, may indicate the effectiveness of social safety policies and the usefulness of such preventive strategies. However, it should be borne in mind that the number of these preventable deaths is still high and we are in need to adopt further preventive policies and increase the knowledge of tourists with respect to swimming and its dangers.

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