Risk assessment of hazard factors on drowning incidents in Turkey

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Abstract

Drowning, mainly originating from natural factors, is a significant source of hazards worldwide. In this study, the effects and risk assessment of natural and other hazard factors on unintentional drowning cases (UDI) between 2010 and 2020 in Turkey were investigated for the first time. An average of 935 UDIs recorded each year during the study period. 66.1% of UDIs resulted in a fatality, corresponding to a fatality rate of 0.79 per 100,000 population. The highest UDIs rate, with an average of 30.13 per 100,000 population, was recorded in Bartın province, located on the south coast of the Black Sea. The analysis and previous studies show that rip current is a lead cause of natural hazard in drowning incidents on the south coast of the Black Sea. Another significant natural factor in drowning incidents is temporal distribution by months and seasons. The study identified warm seasons as a risk-increasing factor because the number of UDIs was at record levels. According to the number of incidents, almost 80% of victims suffer from drowning during swimming and recreating activities in the surf zone and natural or artificial coastal structures. The study revealed that different natural factors of the incident location, such as meteorological, oceanographic, and surf zone characteristics of beaches, significantly affect the cause of drowning.

1. Introduction

Drowning is a significant cause of unintentional injuries and injury-related deaths and can result in survival, disappearance, or fatality (ILS 2017). It is the process of experiencing respiratory distress due to immersion/immersion in liquid and is considered a substantial hazard worldwide. Drowning reports indicate that thousands of people worldwide die from unintentional drowning yearly due to natural factors such as meteorological, oceanographical, hydrological, and environmental (WHO 2014). Risk assessments and prevention efforts against drowning have gained importance in recent years (Penning-Rowsell et al. 2005; Gensini and Ashley 2010; Arun Kumar and Prasad 2014; Van Leeuwen et al. 2016; Castelle et al. 2018; Kamstra et al. 2018; Carvalho et al. 2019; Mohammed Isa et al. 2021; Segura et al. 2022). The most comprehensive global effort to avoid water-related drowning is the declaration of July 25 of each year as "World Drowning Prevention Day" by a resolution taken by the United Nations (UN) General Assembly in April 2021 (A/RES/75/273). This decision is crucial in terms of serving UN sustainable development goals.

Examining the natural factors of drowning resulting in deaths and injuries is essential for proactive prevention (Nicholls 2001; Arun Kumar and Prasad 2014; Shabanikiya et al. 2014; Strom et al. 2017; Doelp et al. 2019). However, a reliable and inter-institutional coordinated incident registration system is needed to achieve this aim. Governmental and non-governmental authorities can prevent many drowning incidents with simple precautions by registering and well-analyzing. Drowning incidents are analyzed mainly according to different categories, such as age group, the incident of location, and activity information with some natural factors (RLS 2020). Drowning incidents can occur while swimming on a beach (Castelle et al. 2018; Segura et al. 2022), swept in a river (Strom et al. 2017), fishing on a rocky shore, or on a boat (Kamstra et al. 2018, 2020; Carvalho et al. 2019; Willcox-Pidgeon et al. 2019), during a flood or tsunami (Penning-Rowsell et al. 2005; Di Mauro et al. 2012; Vinet et al. 2012; Shabanikiya et al. 2014), or recreational/commercial diving facilities (Ramnefjell et al. 2012; Peden et al. 2016) in different liquid environments. The analyzing methods are essential for determining precautions and must be evaluated from different angles of view from a broad perspective due to the variety of incident characteristics. There are several methods for identifying and counting drowning incidents in the literature. For example, while WHO uses the International Classification of Diseases [ICD]-10 coding system by analyzing causes of death using the national register of drowning deaths (WHO 2019), ILS employs Minimum Data Set on Fatal Drowning: Coding and Definitions

Manual (ILS 2017)." In addition, the Utstein Style (Recommended Guidelines for Uniform Reporting of Data from Drowning) was published in 2003 (Idris et al. 2003) and revised recently (Idris et al. 2017).

The studies on drowning have increased in recent years, and governments have shown more interest in prevention policies (Warner et al. 2010; Nakamura and Llasat 2017). The significance of unintentional drownings has been extensively reported in several documents (WHO 2014; RLS 2020) and research (Kiakalayeh et al. 2008; McCarroll et al. 2014; Creach et al. 2015; Puleo et al. 2016; Hanes 2016; Castelle et al. 2018; Pointer et al. 2018; Doelp et al. 2019; Mohammed Isa et al. 2021; Mucerino et al. 2021; Endo et al. 2022). Although it is stated that drowning occurs in different locations, most incidents occur during recreational activities on the coastal (Creach et al. 2015; Castelle et al. 2018; Fitton et al. 2018; Orton et al. 2020; Mucerino et al. 2021; Yanes Luque et al. 2021; Huang et al. 2022; Leroy et al. 2022; Segura et al. 2022). A significant part of these studies stated that rip currents cause drownings on the shore (Gensini and Ashley 2010; Houser et al. 2011; Arun Kumar and Prasad 2014; Arozarena et al. 2015; Barlas and Beji 2016; Castelle et al. 2018; Mucerino et al. 2021). In addition, the effect of different factors on drowning near shores, such as age, gender, ethnicity, geographical region, incident location, type of activity, bottom structure, alcohol use, and warning signs, have been investigated (Altinok and Ersoy 2000; Penning-Rowsell et al. 2005; Houser et al. 2015; Hanes 2016; Puleo et al. 2016; Kamstra et al. 2018; Endo et al. 2022). Moreover, studies also show that, contrary to what is known, severe drowning incidents can occur in inland waters, such as drowning in a bathtub or irrigation ditch, lake, river, or creek (Novelo-Casanova and Suárez 2010; Glas et al. 2017; Strom et al. 2017; Orton et al. 2020). However, the importance of education and lifeguards in creating a sustainable safety culture has been emphasized in different studies (Caldwell et al. 2013; Castelle et al. 2018; Mucerino et al. 2021)

Drowning-related studies in Turkey have represented a very local or small sample to date (Turgut 2012; Turgut and Turgut 2012, 2014; Dirlik and Bostancıoğlu 2015; Taskesen et al. 2015; Barlas and Beji 2016; Turgut et al. 2016; Işın et al. 2020). No country-wide study for Turkey has been evaluated based on long-term national data. This study examines the long-term change and causes of drowning incidents in Turkey, especially considering natural factors, using public records by classifying them according to the ILS coding system. Hence, the present study stands out with valuable printouts and fills the gap in the literature. The study also evaluates any tendencies that may aid the prevention of drowning incidents in Turkey.

2. Methodology

The data presented in this study was collated from the official records obtained from the Coast Guard Command and Gendarmerie General Command under the Ministry of Interior of the Republic of Türkiye. Each official incident file consists of an intervention report, ship log (for coast guard), crime scene report, rescue report (for coast guard), personal data (of persons exposed to drowning), and an administrative report. These data were used for the first time and were not evaluated in national reports or scientific studies. This study focuses on the following information compiled from these reports: gender and age of casualty, date and time of incidents, geographical area of incidents, details of the drowning location, and type of activity undertaken immediately before drowning. After the drowning incident, the victim may live or die, but regardless of the outcome, they are involved in the drowning event (Idris et al. 2003). The results of the incidents after drowning were categorized as follows:

UDIs - Unintentional drowning incidents

FDIs - Drowning incidents resulting in a fatality

SDIs - Drowning incidents resulting in survival

DDIs - Drowning incidents resulting in disappearance

The data set was extracted and coded according to the coding list based on the Minimum Data Set on Fatal Drowning: Coding and Definitions Manual developed by the ILS (2017) to enable a systematic description of detailed analyses of drowning occur. The coding framework for each variable and definitions of each relevant code was described in Online Resource 1. Drowning rates were calculated using census statistics from the Turkish Statistical Institute (TurkStat 2022) and standardized the direct method per 100,000 population to the total Turkey population according to each variable. Percentages were presented up to one decimal place, while rates were presented to two decimal places and rounded accordingly. The statistical analyses were performed by using SPSS software version 26.0.

3. Data Analysis And Findings

Turkey had a total of 9350 reported UDIs from 2010 to 2020. The highest number of UDIs in the whole group occurred in 2012 (N = 915), and the lowest was in 2020 (N = 721). The number of annual UDIs varied from 681 (in 2010) to 447 (in 2020) over the years, with an average of 562 incidents (Fig. 1). In the study period, 66.1% of UDIs (N = 6183) resulted in a fatality, corresponding to a long-term fatality rate of 0.79 per 100,000 population in Turkey.

3.1. Geographical location of incidents

Almost two-thirds of the UDIs (N = 6,294; 67.3%; 1.58 per 100,000 population yearly) recorded in coastal cities, with the others occurred inland cities far from the coast (N = 3,056; 32.7%; 1.03 per 100,000 population yearly) (Online Resource 2). The number of UDIs showed significant differences among cities on and far from the coast (Mann-Whitney U test, U = 234.0; Z = − 5.045; P < 0.001). The highest rate of UDIs was recorded in the Black Sea coasts (14.6%, 2.45 per 100,000 population yearly), followed by the Mediterranean coasts (22.6%, 2.33 per 100,000 population yearly) and the Eastern Anatolian region (1.51 per 100,000 population yearly). Although the drowning rate is low (1.13 per 100,000 population yearly), the highest number of UDIs (N = 2,599; 27.8%) was recorded in the Marmara region, the most populated region of Turkey. The mean number of UDIs was significantly different across regions in Turkey (Kruskal-Wallis test, H = 19.851; df = 6; P = 0.003). The highest UDIs rate in Turkey was recorded in Bartın, a province of the Black Sea region, with a huge rate of 30.13 per 100,000 yearly. Bartın was followed by Kırklareli (7.98 per 100,000 population yearly), Sinop (6.43 per 100,000 population yearly), and Antalya (5.48 per 100,000 population yearly). The lowest UDIs rate was recorded in Ankara, Turkey's capital city, with 0.18 per 100,000 population yearly (Fig. 2).

3.2. Temporal features of incidents

The majority (84.3%) of drowning-related incidents in Turkey occurred during the warmer months, from May to September. Most drownings occurred in July (25.0 incidents per month; 26.7%), followed by August (22.8 incidents per month; 24.4%) and June (15.1 incidents per month; 16.2%). These are summer months, which collectively accounted for 67.3% of UDIs (209.7 incidents per month), while 15.2% of incidents occurred in the autumn (47.4 incidents per month), 13.1% in the spring (40.9 incidents per month), and 4.4% of the winter (13.6 incidents per month) incidents (Fig. 3). Figure 4a indicates variations in UDIs over the day of the week and time of day. The incident rate is generally average from Monday to Friday. UDIs are significantly higher than other weekdays since Saturdays and Sundays are public holidays. The peak time period for UDIs occurred at daytime (5 am – 5:59 pm) with 75.3% (N = 7,042) recorded, followed by the evening (6 pm – 9:59 pm) with 19.9% (N = 1,862) and the night (10 pm – 4:59 am) with 4.1% (N = 381) (Fig. 4b). The time of day was unknown in 65 incidents (0.7%).

More than half of UDIs recorded at most locations occurred during the summer season: beach (81.5%), lake/dam/lagoon/pond (67.6%), river/creek/stream (63.6%), irrigation ditch (61.4%), public swimming pool (58.1%), and well/bucket (52.9%). Similarly, 73.2% of deaths while swimming and recreating activities occurred during the summer months, followed by surfing/windsurfing/watercraft with 62.5% and diving activities with 52.2%. There was no statistically significant seasonal variation in the distribution of UDIs during fishing (Chi-square test, ^{2} = 1.86; df = 3; P = 0.395), non-aquatic transport (Chi-square test, ^{2} = 4.13; df = 3; P = 0.248) and surfing/windsurfing/watercraft (Chi-square test, ^{2} = 3.25; df = 3; P = 0.197) activities. One possible explanation for the close distribution is that fishing and non-aquatic transport activities occur in all seasons. While UDIs due to swept-in did not vary between seasons (Chi-square test, ^{2} = 6.29; df = 3; P = 0.098), it was the only location variable that exhibited a high rate outside of summer. While UDIs in the flood waters (Chi-square test, ^{2} = 2.38; df = 3; P = 0.305) and well/bucket (Chi-square test, ^{2} = 7.71; df = 3; P = 0.052) not differed statistically between seasons, the rates among seasons were close to each other. As a result, the highest UDIs due to swept-in were also observed (N = 8; 47.1%) in the winter season.

3.3. Gender and age details

The total number of UDIs, 81.6% (N = 7626) were male, 17.9% (N = 1672) female and in 0.5% (N = 52) gender was not reported. The proportion of male fatalities (6.69 per 100,000 population) was far greater than that of females (2.12 per 100,000 population). Among the UDIs, the median age at death was 23 years (21 years for females and 23 years for males), ranging from 1 to 96. The age groups most represented in UDIs were 15–19 (N = 1682; 18.0%), 20–24 (N = 1032; 11.0%), and 10–14 (N = 882; 9.4%). The age data was unavailable for 1.7% (N = 156) of the incidents (Fig. 5). The highest rate of FDIs was found among 15 to 19 years of age (1.49 per 100,000 population), while the lowest rates were among 85 years old and older (0.05 per 100,000 population). The FDIs rate was high in all age groups under 30 (> 0.5 per 100,000 population). Figure 5 demonstrates the FDIs rates (per 100,000 population) stratified by gender and age groups.

Teenagers 15–19 years old had the highest UDIs during swimming and recreating activities. The drowning rate due to falls was relatively high in children aged 0–4. Infants under 0–4 comprised 7.2% of drowning incidents. 23.4 percent (N = 2,187) of long-term drownings in Turkey of UDIs involved children under the age of 15, and 69.7% of incidents (N = 1,525) resulted in death. Of these UDIs, 53% occurred as a result of falls, and 46.9% occurred during swimming and recreating activities (the majority of whom had occurred on beaches with 37.7% and river/creek/streams with 28.1%). UDIs are also common among adults above the age of 65 years (793 of 8115 incidents; 9.8%) and mainly occur in swimming and recreating activities (736 of 793 incidents; 92.8%).

3.4. Location and type of activity

Over half (52.6%) of drowning incidents in Turkey occurred at beaches (N = 2,600) followed by inland waters such as rivers, creeks and streams (N = 828; 16.8%), lakes, dams, lagoons and ponds (N = 751; 15.2%), and at other categorized locations (N = 762; 15.4%). Information about the location of most drowning incidents (N = 4,409; 47.2%) was unavailable in the dataset. Of the 8,270 drowning incidents, the majority were associated with swimming activities (N = 6,617; 80%) followed by falling from anywhere (N = 1,492; 18%), and other recreational or commercial activities (N = 161; 2%) (Table 1). All drowning incidents associated with rocks or rocky foreshore locations resulted in fatalities (N = 5; 100%). Over 80% of drownings in lake/dam/lagoon/pond, irrigation ditch, and river/creek/stream resulted in a fatality, where the survival rate was quite low. Most drowning incidents resulting in the loss were recorded in flood waters (4 out of 16 incidents; 25%) and ocean/offshore (81 of 368 incidents; 22%). Teenagers 15–19 years old had the highest proportion of drowning incidents on beaches, river/creek/stream, lake/dam/lagoon/ponds, irrigation ditch, harbor/marina/jetty, and flood waters. Almost all the drownings in the

well/buckets, with a rate of 82 percent, were children in the 0–4 age group. Adults in the 30–34 age group were most exposed to drowning accidents in the ocean/offshore.

Table 1
Characteristics of unintentional drowning incidents in Turkey by location of incidents and type of activity.

Variables	FDIs		SDIs		DDIs		UDIs	
	N	%	N	%	N	%	N	%
Location of incidents								
Beach	1,424	28.8	1,085	22.0	91	1.8	2,600	52.6
River/Creek/Stream	670	13.6	131	2.7	27	0.5	828	16.8
Lake/Dam/Lagoon/Pond	637	12.9	103	2.1	11	0.2	751	15.2
Ocean/Offshore	156	3.2	131	2.7	81	1.6	368	7.4
Irrigation ditch	125	2.5	25	0.5	3	0.1	153	3.1
Public swimming pool	33	0.7	71	1.4	1	0.0	105	2.1
Harbor/Marina/Jetty	45	0.9	44	0.9	9	0.2	98	2.0
Well/Bucket	11	0.2	6	0.1	-	-	17	0.3
Flood waters	9	0.2	3	0.1	4	0.1	16	0.3
Rocks/Rocky foreshore	5	0.1	-	-	-	-	5	0.1
Unknown	3,068		1,322		19		4,409	
Average	6,183	66.1	2,921	31.2	246	2.6	9,350	100.0
Type of activity								
Swimming and recreating	4,365	52.8	2,121	25.6	131	1.6	6,617	80.0
Fall	958	11.6	453	5.5	81	1.0	1,492	18.0
Diving	47	0.6	13	0.2	7	0.1	67	0.8
Non-aquatic transport	28	0.3	23	0.3	4	0.0	55	0.7
Swept in	10	0.1	3	0.0	4	0.0	17	0.2
Fishing	4	0.0	2	0.0	8	0.1	14	0.2
Surfing/windsurfing/watercraft	2	0.0	5	0.1	1	0.0	8	0.1
Unknown	769		301		10		1,080	
Average	6,183	65.5	2,921	31.7	246	2.9	9,350	100.0

FDIs: Drowning incidents resulting in fatality; SDIs: Drowning incidents resulting in survival; DDIs: Drowning incidents resulting in disappearance; UDIs: Total unintentional drowning incident

4. Discussion

4.1. Long-term trend of drowning incidents in Turkey

The data set in this study shows that an average of 562 people die due to drowning every year in Turkey (ranging between 447 and 681) — an average of two drowning deaths per day. A noticeable decreasing trend was observed in the number of UDIs and FDIs, while there was an increase in the number of SDIs throughout the study period. No evident trend was observed in the number of those who disappeared due to drowning (Fig. 1). Compared to previous years, UDIs in Turkey are down substantially; there has been a 20.9% decrease in the last years (from 2010 to 2020). Unfortunately, this decrease was not stable. The change of UDIs was erratic for years. The lowest UDIs rate in the study period was seen in 2020. FDIs were reported as 5.2 worldwide and 2.3 in high-income countries between 2010 and 2020 (WHO 2014). Despite outstanding efforts and prevention strategies, a high FDIs of 3.77 occurred in Australia in a similar period (RLS 2020). Based on the 2019 data, the average fatality rate caused by drowning was 1.35 among EU members (Eurostat 2022). With a long-term average (0.79 per 100,000 population), FDIs in Turkey are represented at much lower rates (ranging between 0.54 and 0.92 per 100,000 population) (Fig. 1) than in the world, the EU, and high-income countries.

Such low death rates are primarily attributable to increased employment of lifeguards on beaches. Barlas and Beji (2016) reported that individuals refuse to follow any safety advice and, in some cases, even go so far as to harass lifeguards in Turkey. As a result of efforts to prevent drowning in Turkey, the obligation to employ lifeguards at specific standards in all kinds of pools, water parks, beaches, and coastal enterprises was implemented for the first time in 2006 (No 26063 dated January 28, 2006, in Official Gazette). Since then, lifeguards have been trained at ILS standards in training centers under the auspices of the Turkish Underwater Sports Federation. Following the regulation, it is obligatory to have at least one lifeguard for each pool, regardless of the depth, and at least two lifeguards per 500 m^2 in large pools. According to the law, beaches must have at least two lifeguards and a lifeguard tower per 200 m in the swimmable shoreline. Responsibility areas of lifeguards are defined as controlled swimming areas where a safety strip has been created at a distance they can reach within three minutes by swimming. Especially after the 2000s, the investments made in the tourism sector in Turkey and the state support showed their effects. Turkey ranks third in the world with its 486 blue flag beaches. Investments in Eco-Friendly Touristic Places and marine tourism gained momentum (Republic of Türkiye Ministry of Culture and Tourism 2022). All these investments undoubtedly contribute indirectly to preventing drowning in swimming areas and recreational activities.

4.2. Geographical location of incidents

According to the geographical location of the incidents (detailed in Fig. 2 and Online Resource 2), the highest rate of UDIs was recorded in the Black Sea region, with 2.45 per 100,000 population. In the cities on the Black Sea south coast (Bartın, Kırklareli, Sinop, Istanbul), more than 80% of UDIs occurred on beaches. Such a high drowning rate should be attributed to the Black Sea being characterized by rip currents. Beji and Barlas (2016) have suggested that hundreds of people drown due to rip currents each year on the Black Sea coasts of Istanbul. While rip currents are more typical for the coast of oceans (Gensini and Ashley 2010; Houser et al. 2011; Mucerino et al. 2021), the southern parts of the Black Sea stand as an exception. The nearshore bathymetry is responsible for forming rip currents in the Black Sea (Barlas and Beji 2016). Brander et al. (2011) described rip currents as a significant hazard to swimmers on many beaches worldwide. Safety signs and effective information strategies to warn visitors of the hazards of rip currents have yielded positive results (Beji and Barlas 2017). More efforts are needed to increase public awareness about rip currents in Turkey. We underline the lack of information, prevention, and control strategies to prevent drowning incidents related to rip currents in Turkey.

Antalya (Mediterranean) and Muğla (Aegean) were recorded as other geographic locations where drowning incidents were seen at a high rate. Contrary to the Black Sea, these regions' high drowning rates were mainly attributed to marine activities such as swimming, sailing, boating, snorkeling, and scuba diving. Antalya is one of the world's top tourism destinations and attracts 30% of foreign tourists visiting Turkey. Antalya (N = 206) and Muğla (N = 105) are the tourism centers with the highest number of Blue Flag beaches in Turkey (The Republic of Türkiye, Ministry of Culture and Tourism 2022). Although lifeguards are employed at these beaches, drowning incidents can be high during such high dense beach activities.

Şanlıurfa, which does not have a coast and is located in the Southeastern Anatolia Region of Turkey, stands out in the list of geographical locations. This region is one of the provinces with the highest maximum temperature in Turkey (up to 46.8°C). Residents and agricultural laborers living in the entire Eastern Anatolia Region, including Şanlıurfa, prefer irrigation ditches, natural and artificial lakes, and streams to cool off. Drowning incidents can frequently occur in Şanlıurfa due to uncontrolled inland waters and insufficient swimming ability.

4.3. Temporal features of incidents

RLS (2020) report has shown an increased risk of drowning during public and school holidays. Public school holidays in Turkey usually coincide with the summer period from mid-June to the beginning of September. During this period, recreating such as diving, fishing, boating, and swimming are increasing, especially in coastal areas. Similar studies confirmed a significant increase in UDIs at the beaches and swimming pools during the summer (Barlas and Beji 2016). It is known that hot weather increases the risk of drowning due to swimming and recreational activities. The significant difference between incidents on Saturday and Sunday (Fig. 4a) is that most people in the private sector in Turkey also work half a day on Saturday. The 15–19 age group accounted for an essential proportion of UDIs that occurred in summer (20.6%) and daytime (19.8%). The highest rate of UDIs (~ 75%) was recorded during daytime in both males and females. According to the dataset, temporal variables (months, seasons, weeks, and time of day) created significant differences in the incidence of UDIs (Fig. 3, Fig. 4). The awareness of the drowning risk may encourage more effective use of prevention strategies known to save lives.

4.4. Gender and age variables of incidents

Males have been determined to be a high-risk group for drowning fatality in Turkey (Fig. 5). In previous studies, most of the victims were male and more prone to drowning (WHO 2014). Riskier behavior such as swimming alone, fishing and boating, alcohol or drug use before swimming, and being more reluctant to wear life jackets are responsible for higher rates of drowning among males (RLS 2020; WHO 2014). Males may also exaggerate their swimming abilities by putting themselves in dangerous situations. According to the global report on drowning, age is a significant risk factor for drowning (WHO 2014), and half of drowning incidents worldwide occur among people under 30. UDIs varied significantly among different age groups in Turkey, and incidents were common among those younger than 30, with a high percentage (60.4%) (Fig. 5). Drowning fatalities in children is a universal concern and a preventable cause of death with simple precautions and education (Peden et al. 2008; Solomon et al. 2013; Terzidis et al. 2007; Turgut et al. 2016; White et al. 2018). Drowning in children under five years accounted for 7% of all incidents (Fig. 5), more than 90% of which were fall-related incidents. This striking statistic from the analysis (high ratio of UDIs among children under five) suggests that adult supervision was neglected. Active adult supervision is essential for preventing UDIs among children under five, and lapses in supervision contribute to fatalities (RLS 2020). There is no national initiative about swimming, lifesaving, or water safety education/training in local schools in Turkey. Attempts to help children acquire minimum swimming skills before leaving primary school will undoubtedly contribute to reducing child UDIs. More than 10% of the victims were over 65, and almost all (~ 93%) drowned during swimming and recreational activities. There are several causes of adult drowning, such as alcohol

drinking, inexperience, and non-use of a personal flotation device (Peden et al. 2018). Preexisting medical conditions such as cardiac conditions can influence the drowning risk of adults (Cobbett et al. 2014). The dataset in this study does not contain information about the victim's disease history.

4.5. Location of incidents and type of activities

Beach environments, where more than half of all fatal drownings occur due to recreational and swimming activities, should be considered first in drowning prevention interventions (detailed in Table 1 and Fig. 6). Despite the existence of beaches with lifeguards in Turkey, uncontrolled and unattended beaches pose a significant risk depending on the length of the coastal structure. Swimming activities on uncontrolled beaches, especially for non-swimmers, can result in drowning. Although drownings in swimming pools have resulted in most survival, the number of UDIs is too high to be neglected. The frequency of UDIs in swimming pools can be attributed to the lack of active adult supervision, while the high SDIs rate reflects success in lifeguard interventions. It is necessary to raise awareness of non-swimmers about not entering the water outside the responsibility areas of lifeguards. Even basic water safety training will undoubtedly significantly contribute to reducing drowning incidents. We believe water safety information/training should be accessible to the public. In this way, individuals can recognize the hazards of aquatic environments and learn about crucial survival and essential rescue skills. Cardiopulmonary Resuscitation (CPR) training may increase survival rates at a more advanced stage. Most of the UDIs (~ 56%) in flood waters result in fatality (Fig. 6a). Flooding has become more frequent and severe in recent years, and this tendency is expected to continue as part of climate change (Warner et al. 2010). Flood disasters are becoming more frequent and powerful, and this trend will likely continue as part of climate change (Akay 2019; Thomas 2017). Individuals, especially adults, should avoid going alone around flood waters. All incidents recorded on the rocks and rocky foreshore resulted in a fatality.

The results highlighted the significant number of fatal drowning incidents in inland waters (Fig. 6a). Individuals who live near inland water sources, such as dams, lakes, ponds, rivers, or irrigation ditch, are especially at risk. Inner waters carry specific risks due to their geomorphological features and coastal structure (Taylor et al. 2020). Risk factors that cause drowning in inland waters are identified as lack of swimming ability (Fang et al. 2007), underestimating the risk that water conditions can pose (Willcox-Pidgeon et al. 2018), residents and farm workers (Kiakalayeh et al. 2008) and rurality of location (Peden et al. 2016). Unsupervised irrigation ditches are seen as a playground for children (Rolloque et al. 2012). Children should be taught how to call for help and respond safely in the event of an accident. This is especially important in remote, rural, and work-related settings where help may be far away. Inland waters are often beyond public control, and unlike beaches, efforts to prevent drowning are inadequate in these locations (Peden et al. 2016). The willingness to swim of migrants, refugees, and tourists unfamiliar with local water risks and features is also an essential factor related to an increased risk of drowning. Currently, the number of refugees from Syria, Afghanistan, and Pakistan is relatively high in Turkey, and this population is increasing. The drowning incidents of these people due to their swimming activities are frequently also reflected in the media and national statistics (Turkish Coast Guard Command 2022). In addition, although drowning incidents due to illegal refugee migration have an important place in the sea, this group is not included in the data set. Further efforts are needed to increase understanding of the risks of drowning and raise awareness among the communities concerned.

A relatively high rate of fall-related UDIs was recorded (Fig. 6b) and determined to be most related to non-aquatic transport, diving, and fishing activities. Incidents occur more commonly among individuals employed in water-related professions, such as fishing communities (Brooks 2005). Turkey is a maritime country, having a long coastline and a massive Exclusive Economic Zone (EEZ), and therefore offers ample opportunities for the marine

sector. Although commercial fishing activities in Turkey are technologically advanced, it is thought that fishers do not have sufficient awareness in terms of sea and navigational safety (Ulukan 2016). People often refuse to wear a life jacket during fishing and aquatic sports activities in Turkey (Barlas and Beji 2016). Life jackets increase buoyancy and support the swimming ability (WHO 2014), thereby increasing the chances and duration of survival (Pitman et al. 2019; Stempski et al. 2014). It is clear that these measures also prevent drowning by boating (Cummings et al. 2011; Webber et al. 2020).

The highest number of fatal incidents were recorded during diving activities (70% of the incidents resulted in a fatality and 10% in disappearance) (Fig. 6b). Diving activities involve high risks, and the incidence of drowning fatalities is very high during commercial or sportive dives (Lippmann et al. 2017; Ramnefjell et al. 2012; Vinkel et al. 2016). More than half of the diving incidents were seen in the summer, suggesting that more recreational diving activities were carried out during this period. Although Turkey is at an advanced level for certified diving education and tourism, the number of uncertified amateur divers is relatively high. Recreational diving activities involve a drowning risk, especially for beginners, and these activities are not recommended for those who do not have fundamental diving training. Karadurmuş (2021) also reported that boat and hookah systems in Turkey pose a risk in terms of diving health and work safety. Turkish divers make risky dives due to economic concerns and a lack of safety awareness. Physical and mental fitness, equipment used, dive plan, and implementation of decompression procedures play a critical role in preventing fatal diving accidents (Karadurmuş 2021; Ramnefjell et al. 2012). Strategies to prevent drowning due to diving in Turkey should cover both sportive and commercial divers.

5. Concluding Remarks

This study analyzed long-term of drowning incidents in Turkey in line with the national Coast Guard and Gendarmerie General Command data. This paper is the most extensive case series of its kind to describe drowning incidents in the marine and inland water in Turkey. Consequently, our study provides in-depth data on current trends of drowning incidents and demonstrates the impact of natural and other factors on drowning, along with risk assessments in Turkey. The authors particularly highlight the following key points on drowning incidents in Turkey:

i. The high incidence of drowning was associated with rip currents in the Black Sea and intense tourism and marine activities in the Mediterranean Sea. It is necessary to identify rip currents and encourage early warning systems and the use of personal flotation devices. Official authorities should expand the controlled areas under the auspices of lifeguards. Individuals should avoid water activities, mainly when the meteorological services issue a weather warning which affects water safety.
ii. More effective drowning prevention strategies should be developed to target peak drowning events' seasons, days, and hours.
iii. The survival rate was relatively low in inland waters compared to pools, beaches, and offshore. High fatalities were attributed to a lack of water safety education and supervision/oversight in rural areas. Safe places away from water (playgrounds and public swimming pools) for children should be provided in rural areas with inland waterways, and safety barriers should be installed to control access to water.
iv. Drowning incidents are most common amongst males, with victims under 30 years representing a high percentage of incidents. National efforts should be initiated to teach risk groups swimming, water safety, and safe rescue skills. The use of personal flotation devices and lifesaving appliances should be encouraged. Above all, the causes of drowning in the identified risk group (males and under 30) should be investigated in depth.

v. Incidents in the rocky area and diving activities resulted in a high fatality rate. Illegal and unregulated diving can be responsible for high deaths. Most fatal diving incidents can be prevented by following adequate diving safety procedures. Awareness of diving safety and decompression is required, especially for beginners and recreational divers.

vi. Turkey should develop further water safety perspectives to reach long-term targets, such as marine spatial planning and drowning prevention strategies concerning natural and other factors.

vii. There is a need to develop and validate category definitions for location and activity variables that are consistently applied to allow for managing drowning strategies. We underline the need for a "National Minimum Dataset, Coding, and Definitions on Fatal Drowning" and a "Digitized National Common Database for Drowning" in Turkey.

This study serves the importance of the recently declared United Nations resolution on drowning that advises aggregating all drowning fatality data into national estimates (No A/RES/75/273 dated July 25, 2021, in UN General Assembly). Our findings provide a basis for further work and policies about unintentional drowning, including interventions for high-risk groups to serve UN sustainable development goals.

Declarations

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Data availability: Data are, however, available from the authors upon reasonable request and with permission of Coast Guard Command and Gendarmerie General Command under the Ministry of Interior of the Republic of Turkey.

Supplementary material: Online access to Online Resource 1 and Online Resource 2 is possible

References

1. Akay A (2019) The Effects of Natural Disasters Caused by Climate Change. Enhancing Required Joint Efforts on Climate Action Project Module 15. https://www.iklimin.org/wp-content/uploads/2020/02/modul_15_en.pdf (June 29, 2022)
2. Altinok Y, Ersoy S (2000) Tsunamis observed on and near the Turkish Coast. Nat Hazards 21:185–205. https://doi.org/10.1023/a:1008155117243
3. Arozarena I, Houser C, Echeverria AG, Brannstrom C (2015) The rip current hazard in Costa Rica. Nat Hazards 77:753–768. https://doi.org/10.1007/s11069-015-1626-9

4. Arun Kumar SVV, Prasad KVSR (2014) Rip current-related fatalities in India: A new predictive risk scale for forecasting rip currents. Nat Hazards 70:313–335. https://doi.org/10.1007/s11069-013-0812-x
5. Barlas B, Beji S (2016) Rip current fatalities on the Black Sea beaches of Istanbul and effects of cultural aspects in shaping the incidents. Nat Hazards 80:811–821. https://doi.org/10.1007/s11069-015-1998-x
6. Beji S, Barlas B (2017) Rip currents across the shores of the Black Sea. In: Sezgin M, Bat L, Urkmez D, Arici E, Ozturk B (eds) Black Sea Marine Environment:The Turkish Shelf. Turkish Marine Research Foundation (TUDAV), pp 114–131
7. Brander RW, Bradstreet A, Sherker S, MacMahan J (2011) Responses of swimmers caught in rip currents: perspectives on mitigating the global rip current hazard. Int J Aquat Res Educ 5:11. https://doi.org/10.25035/ijare.05.04.11
8. Brooks B (2005) Not drowning, waving!: Safety management and occupational culture in an Australian commercial fishing port. Saf Sci 43:795–814. https://doi.org/10.1016/j.ssci.2005.02.007
9. Caldwell N, Houser C, Meyer-Arendt K (2013) Ability of beach users to identify rip currents at Pensacola Beach, Florida. Nat Hazards 68:1041–1056. https://doi.org/10.1007/s11069-013-0673-3
10. Carvalho RC, Kennedy DM, Woodroffe CD (2019) A morphology-based drowning risk index for rock platform fishing: a case study from southeastern Australia. Nat Hazards 96:837–856. https://doi.org/10.1007/s11069-019-03572-w
11. Castelle B, Brander R, Tellier E et al (2018) Surf zone hazards and injuries on beaches in SW France. Nat Hazards 93:1317–1335. https://doi.org/10.1007/s11069-018-3354-4
12. Cobbett H, Morrow P, Stables SR (2014) Sink or swim: the advantages of full postmortem examination in cases of drowning. Acad Forensic Pathol 4:214–219. https://doi.org/10.23907/2014.033
13. Creach A, Pardo S, Guillotreau P, Mercier D (2015) The use of a micro-scale index to identify potential death risk areas due to coastal flood surges: lessons from Storm Xynthia on the French Atlantic coast. Nat Hazards 77:1679–1710. https://doi.org/10.1007/s11069-015-1669-y
14. Cummings P, Mueller BA, Quan L (2011) Association between wearing a personal floatation device and death by drowning among recreational boaters: a matched cohort analysis of United States Coast Guard data. Inj Prev 17:156–159. http://dx.doi.org/10.1136/ip.2010.028688
15. Di Mauro M, De Bruijn KM, Meloni M (2012) Quantitative methods for estimating flood fatalities: Towards the introduction of loss-of-life estimation in the assessment of flood risk. Nat Hazards 63:1083–1113. https://doi.org/10.1007/s11069-012-0207-4
16. Dirlik M, Bostancıoğlu B (2015) Child drowning deaths in Aydin province, western Turkey, 2002–2012. Eur J Trauma Emerg Surg 41:683–688. https://doi.org/10.1007/s00068-015-0493-0
17. Doelp MB, Puleo JA, Plant NG (2019) Predicting surf zone injuries along the Delaware coast using a Bayesian network. Nat Hazards 98:379–401. https://doi.org/10.1007/s11069-019-03697-y
18. Endo S, Shimada R, Ishikawa T, Komine T (2022) Can the visualization of rip currents prevent drowning accidents? Consideration of the effect of optimism bias. Nat Hazards 110:2017–2033. https://doi.org/10.1007/s11069-021-05023-x
19. Eurostat (2022) Causes of death - standardised death rate by NUTS 2 region of residence. https://appsso.eurostat.ec.europa.eu/ (May 22, 2022)
20. Fang Y, Dai L, Jaung MS, Chen X, Yu S, Xianget H (2007) Child drowning deaths in Xiamen city and suburbs, People's Republic of China, 2001–5. Inj Prev 13:339–343. https://doi.org/10.1136/ip.2007.016683

21. Fitton JM, Hansom JD, Rennie AF (2018) A method for modelling coastal erosion risk: the example of Scotland. Nat Hazards 91:931–961. https://doi.org/10.1007/s11069-017-3164-0
22. Gensini VA, Ashley WS (2010) An examination of rip current fatalities in the United States. Nat Hazards 54:159–175. https://doi.org/10.1007/s11069-009-9458-0
23. Glas H, Jonckheere M, Mandal A et al (2017) A GIS-based tool for flood damage assessment and delineation of a methodology for future risk assessment: case study for Annotto Bay, Jamaica. Nat Hazards 88:1867–1891. https://doi.org/10.1007/s11069-017-2920-5
24. Hanes DM (2016) Human instability related to drowning risk in surf zones for novice beachgoers or weak swimmers. Nat Hazards 83:761–766. https://doi.org/10.1007/s11069-016-2337-6
25. Houser C, Barrett G, Labude D (2011) Alongshore variation in the rip current hazard at Pensacola Beach, Florida. Nat Hazards 57:501–523. https://doi.org/10.1007/s11069-010-9636-0
26. Houser C, Murphy T, Labude D (2015) Alongshore correspondence of beach users and rip channels at Pensacola Beach, Florida. Nat Hazards 78:2175–2183. https://doi.org/10.1007/s11069-015-1804-9
27. Huang C, Anderson E, Liu Y et al (2022) Evaluating essential processes and forecast requirements for meteotsunami-induced coastal flooding. Nat Hazards 110:1693–1718. https://doi.org/10.1007/s11069-021-05007-x
28. Idris AH, Berg RA, Bierens J et al (2003) Recommended guidelines for uniform reporting of data from drowning: the "Utstein style". Circulation 108:2565–2574. https://doi.org/10.1161/01.CIR.0000099581.70012.68
29. Idris AH, Bierens JJLM, Perkins GD et al (2017) 2015 revised Utstein-style recommended guidelines for uniform reporting of data from drowning-related resuscitation: An ILCOR advisory statement. Resuscitation 118:147–158. https://doi.org/10.1016/j.resuscitation.2017.05.028
30. ILS (2017) Minimum Data Set on Fatal Drowning: Coding and Definitions Manual. International Life Saving
31. Işın A, Akdağ E, Turgut A (2020) The epidemiology of fatal drowning in children: a 13-year retrospective study in Turkey. Int J Inj Contr Saf Promot 27:465–471. https://doi.org/10.1080/17457300.2020.1810075
32. Kamstra P, Cook B, Kennedy D et al (2020) Drowning 'Truths': Contrasting experiential-experts' perceptions with official-experts drowning reports on Australia's hazardous coasts. Int J Disaster Risk Reduct 47:101558. https://doi.org/10.1016/j.ijdrr.2020.101558
33. Kamstra P, Cook B, Kennedy DM, Brighton B (2018) Treating risk as relational on shore platforms and implications for public safety on microtidal rocky coasts. Nat Hazards 91:1299–1316. https://doi.org/10.1007/s11069-018-3184-4
34. Karadurmuş U (2021) Individual seafood diver in Turkey – case of Balikesir province. International Symposium of Scientific Research and Innovative Studies (22–25 Feb. 2021). Balıkesir, Turkey
35. Kiakalayeh AD, Mohammadi R, Ekman DS, Chabok SY, Janson B (2008) Unintentional drowning in northern Iran: A population-based study. Accid Anal Prev 40:1977–1981. https://doi.org/10.1016/j.aap.2008.08.008
36. Leroy SAG, Gracheva R, Medvedev A (2022) Natural hazards and disasters around the Caspian Sea. Springer Netherlands
37. Lippmann J, Stevenson C, McD Taylor D, Williams J, Mohebbi M (2017) Chain of events analysis for a scuba diving fatality. Diving and Hyperbaric Medicine 47:144–154. https://doi.org/10.28920/dhm47.3.144-154
38. McCarroll RJ, Brander RW, MacMahan JH et al (2014) Evaluation of swimmer-based rip current escape strategies. Nat Hazards 71:1821–1846. https://doi.org/10.1007/s11069-013-0979-1

39. Mohammed Isa NA, Ramli MZ, Che Othman SF, Yusof MZ (2021) A preliminary studies to assess public knowledge of beach safety in east coast Malaysia. Nat Hazards 107:873–887. https://doi.org/10.1007/s11069-021-04613-z
40. Mucerino L, Carpi L, Schiaffino CF et al (2021) Rip current hazard assessment on a sandy beach in Liguria, NW Mediterranean. Nat Hazards 105:137–156. https://doi.org/10.1007/s11069-020-04299-9
41. Nakamura I, Llasat MC (2017) Policy and systems of flood risk management: a comparative study between Japan and Spain. Nat Hazards 87:919–943. https://doi.org/10.1007/s11069-017-2802-x
42. Nicholls N (2001) Atmospheric and climatic hazards: Improved monitoring and prediction for disaster mitigation. Nat Hazards 23:137–155. https://doi.org/10.1023/A:1011130223164
43. Novelo-Casanova DA, Suárez G (2010) Natural and man-made hazards in the Cayman Islands. Nat Hazards 55:441–466. https://doi.org/10.1007/s11069-010-9539-0
44. Orton PM, Conticello FR, Cioffi F et al (2020) Flood hazard assessment from storm tides, rain and sea level rise for a tidal river estuary. Nat Hazards 102:729–757. https://doi.org/10.1007/s11069-018-3251-x
45. Peden M, Oyegbite K, Ozanne-Smith J et al (2008) World report on child injury prevention. Geneva, WHO and UNICEF
46. Peden AE, Franklin RC, Leggat PA (2016) Fatal river drowning: the identification of research gaps through a systematic literature review. Inj Prev 22:202–209. http://dx.doi.org/10.1136/injuryprev-2015-041750
47. Peden AE, Franklin RC, Queiroga AC (2018) Epidemiology, risk factors and strategies for the prevention of global unintentional fatal drowning in people aged 50 years and older: a systematic review. Inj Prev 24:240–247. https://doi.org/10.1136/injuryprev-2017-042351
48. Penning-Rowsell E, Floyd P, Ramsbottom D, Surendran S (2005) Estimating injury and loss of life in floods: A deterministic framework. Nat Hazards 36:43–64. https://doi.org/10.1007/s11069-004-4538-7
49. Pitman SJ, Wrightd M, Hockena R (2019) An analysis of lifejacket wear, environmental factors, and casualty activity on marine accident fatality rates. Saf Sci 111:234–242. https://doi.org/10.1016/j.ssci.2018.07.016
50. Pointer K, Milligan GS, Garratt KL, Clark SP, Tipton MJ (2018) A 10-year descriptive analysis of UK Maritime and Coastguard data on lifejacket use and drowning prevention. Saf Sci 109:195–200. https://doi.org/10.1016/j.ssci.2018.06.003
51. Puleo JA, Hutschenreuter K, Cowan P et al (2016) Delaware surf zone injuries and associated environmental conditions. Nat Hazards 81:845–867. https://doi.org/10.1007/s11069-015-2108-9
52. Ramnefjell MP, Morild I, Mørk SJ, Lilleng PK (2012) Fatal diving accidents in western Norway 1983–2007. Forensic Sci Int 223:e22–e26. https://doi.org/10.1016/j.forsciint.2012.08.042
53. Republic of Türkiye Ministry of Culture and Tourism (2022) Tourism Statistics. https://www.ktb.gov.tr/EN-249283/tourism-statistics.html (June 26, 2022)
54. RLS (2020) Royal life saving national drowning report 2020 – Australia. Royal Life Saving Society – Australia, Sydney. https://www.royallifesaving.com.au/__data/assets/pdf_file/0003/33861/RLS_NationalDrowningReport2020LR-FINAL.pdf (May. 26, 2022)
55. Rolloque A, Consunji R, Perez MT, Alcantra M, Azas PD (2012) Cutcut project: a response to the prevention of child drowning in the Philippines. Inj Prev 18:A132. https://doi.org/10.1136/injuryprev-2012-040590h.2
56. Segura LE, Arozarena I, Koon W, Gutiérrez A (2022) Coastal drowning in Costa Rica: incident analysis and comparisons between Costa Rican nationals and foreigners. Nat Hazards 110:1083–1095.

https://doi.org/10.1007/s11069-021-04980-7

57. Shabanikiya H, Seyedin H, Haghani H, Ebrahimian A (2014) Behavior of crossing flood on foot, associated risk factors and estimating a predictive model. Nat Hazards 73:1119–1126. https://doi.org/10.1007/s11069-014-1124-5
58. Solomon R, Giganti MJ, Weiner A, Akpinar-Elci M (2013) Water safety education among primary school children in Grenada. Int J Inj Contr Saf Promot 20:266–270. https://doi.org/10.1080/17457300.2012.717083
59. Stempski S, Schiff M, Bennett E, Quan L (2014) A case-control study of boat-related injuries and fatalities in Washington State. Inj Prev 20:232–237. https://doi.org/10.1136/injuryprev-2013-041022
60. Strom MA, Pasternack GB, Burman SG et al (2017) Hydraulic hazard exposure of humans swept away in a whitewater river. Nat Hazards 88:473–502. https://doi.org/10.1007/s11069-017-2875-6
61. Taşkesen M, Pirinççioğlu AG, Yaramiş A (2015) Drowning and near-drowning in children in the southeast of Turkey. J Acad Emerg Med 14:16–18. https://doi.org/10.5152/jaem.2015.92499
62. Taylor DH, Pidgeon S, Peden AE (2020) A ten year national review of lake, dam and lagoon drowning deaths: 2008/2009 to 2017/2018. Royal Life Saving Society – Australia, Sydney
63. Terzidis A, Koutroumpa A, Skalkidis I et al (2007) Water safety: age-specific changes in knowledge and attitudes following a school-based intervention. Inj Prev 13:120–124. https://doi.org/10.1136/ip.2006.014316
64. Republic of Türkiye Ministry of Culture and Tourism (2022) Tourism Statistics. https://www.ktb.gov.tr/EN-249283/tourism-statistics.html (June 26, 2022)
65. Thomas V (2017) Climate change and natural disasters: Transforming economies and policies for a sustainable future. Routledge, London. https://doi.org/10.4324/9781315081045
66. Turgut A (2012) A study on multiple drowning syndromes. Int J Inj Contr Saf Promot 19:63–67. https://doi.org/10.1080/17457300.2011.603154
67. Turgut A, Turgut T (2012) A study on rescuer drowning and multiple drowning incidents. J Saf Res 43:129–132. https://doi.org/10.1016/j.jsr.2012.05.001
68. Turgut A, Turgut T (2014) A population-based study on deaths by drowning incidents in Turkey. Int J Inj Contr Saf Promot 21:61–67. https://doi.org/10.1080/17457300.2012.759238
69. Turgut T, Yaman M, Turgut A (2016) Educating Children on Water Safety for Drowning Prevention. Soc Indic Res 129:787–801. https://doi.org/10.1007/s11205-015-1109-0
70. Turkish Coast Guard Command (2022) Statistics: Irregular Migration. Ankara: Republic of Türkiye Coast Ministry of Interior of Interior Guard Command. (Available at https://en.sg.gov.tr/irregular-migration-statistics)
71. Turkstat (2022) Population and demography. https://data.tuik.gov.tr/ (May 29, 2022)
72. Ulukan U (2016) Fish, boats and crews: working and living conditions in the fishing sector of Turkey. Labour Soc 48:115–142
73. Van Leeuwen BR, McCarroll RJ, Brander RW et al (2016) Examining rip current escape strategies in non-traditional beach morphologies. Nat Hazards 81:145–165. https://doi.org/10.1007/s11069-015-2072-4
74. Vinet F, Lumbroso D, Defossez S, Boissier L (2012) A comparative analysis of the loss of life during two recent floods in France: The sea surge caused by the storm Xynthia and the flash flood in Var. Nat Hazards 61:1179–1201. https://doi.org/10.1007/s11069-011-9975-5
75. Vinkel J, Bak P, Hyldegaard O (2016) Danish diving fatalities 1999–2012. Diving Hyperb Med 46:142–149
76. Warner K, Hamza M, Oliver-Smith A et al (2010) Climate change, environmental degradation and migration. Nat Hazards 55:689–715. https://doi.org/10.1007/s11069-009-9419-7

77. Webber W, Moran K, French C, Fozard F, Pearless O (2020) Fatal coastal drowning incidents: A 10-year review of body recovery times in New Zealand. Forensic Sci Int 317:110573. http://dx.doi.org/10.1016/j.forsciint.2020.110573
78. White KM, Zhao X, Hyde MK, Hamilton K (2018) Surviving the swim: Psychosocial influences on pool owners' safety compliance and child supervision behaviours. Saf Sci 106:176–183. https://doi.org/10.1016/j.ssci.2018.03.020
79. WHO (2014) Global report on drowning: preventing a leading killer. Geneva, World Health Organization Press
80. WHO (2019) International statistical classification of diseases and related health problems. – 11th revision. Geneva, World Health Organization Press
81. Willcox-Pidgeon S, Kool B, Moran K (2018) Perceptions of the risk of drowning at surf beaches among New Zealand youth. Int J Inj Contr Saf Promot 25:365–371. https://doi.org/10.1080/17457300.2018.1431939
82. Willcox-Pidgeon S, Peden AE, Franklin RC, Scarr J (2019) Boating-related drowning in Australia: Epidemiology, risk factors and the regulatory environment. J Saf Res 70:117–125. https://doi.org/10.1016/j.jsr.2019.06.005
83. Yanes Luque A, Rodríguez-Báez JA, Máyer Suárez P et al (2021) Marine storms in coastal tourist areas of the Canary Islands. Nat Hazards 109:1297–1325. https://doi.org/10.1007/s11069-021-04879-3

Figures

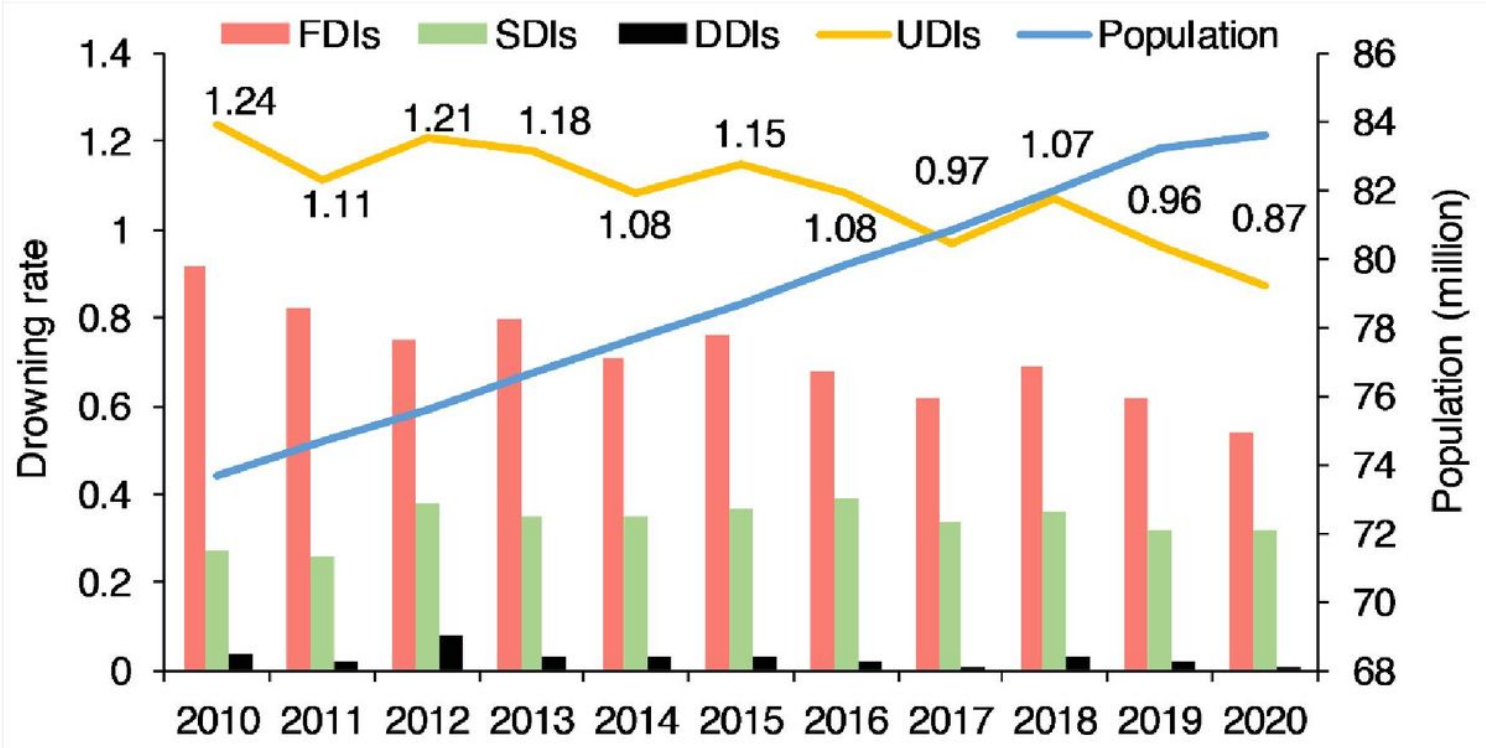

Figure 1

Details of yearly drowning incidents between 2010 and 2020 in Turkey

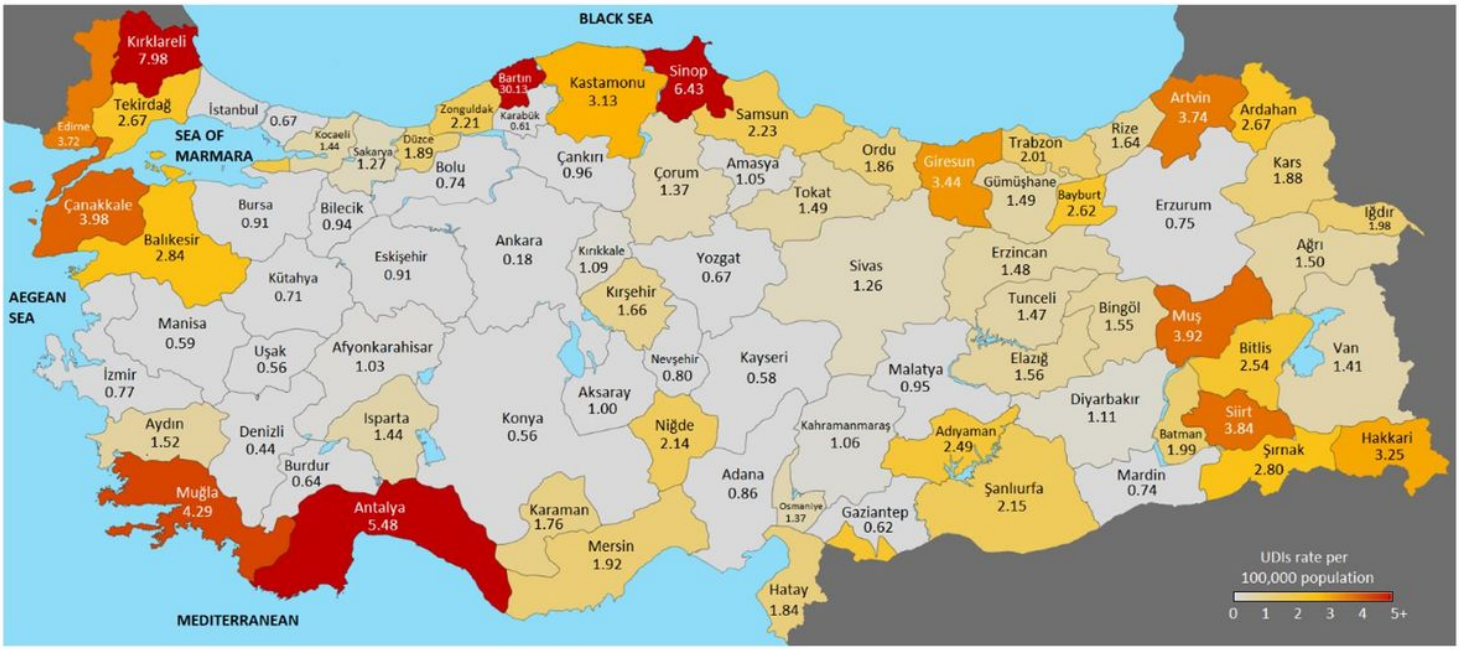

Figure 2

Unintentional drowning incident rates (per 100,000 population yearly) by cities in Turkey, from 2010 to 2020.

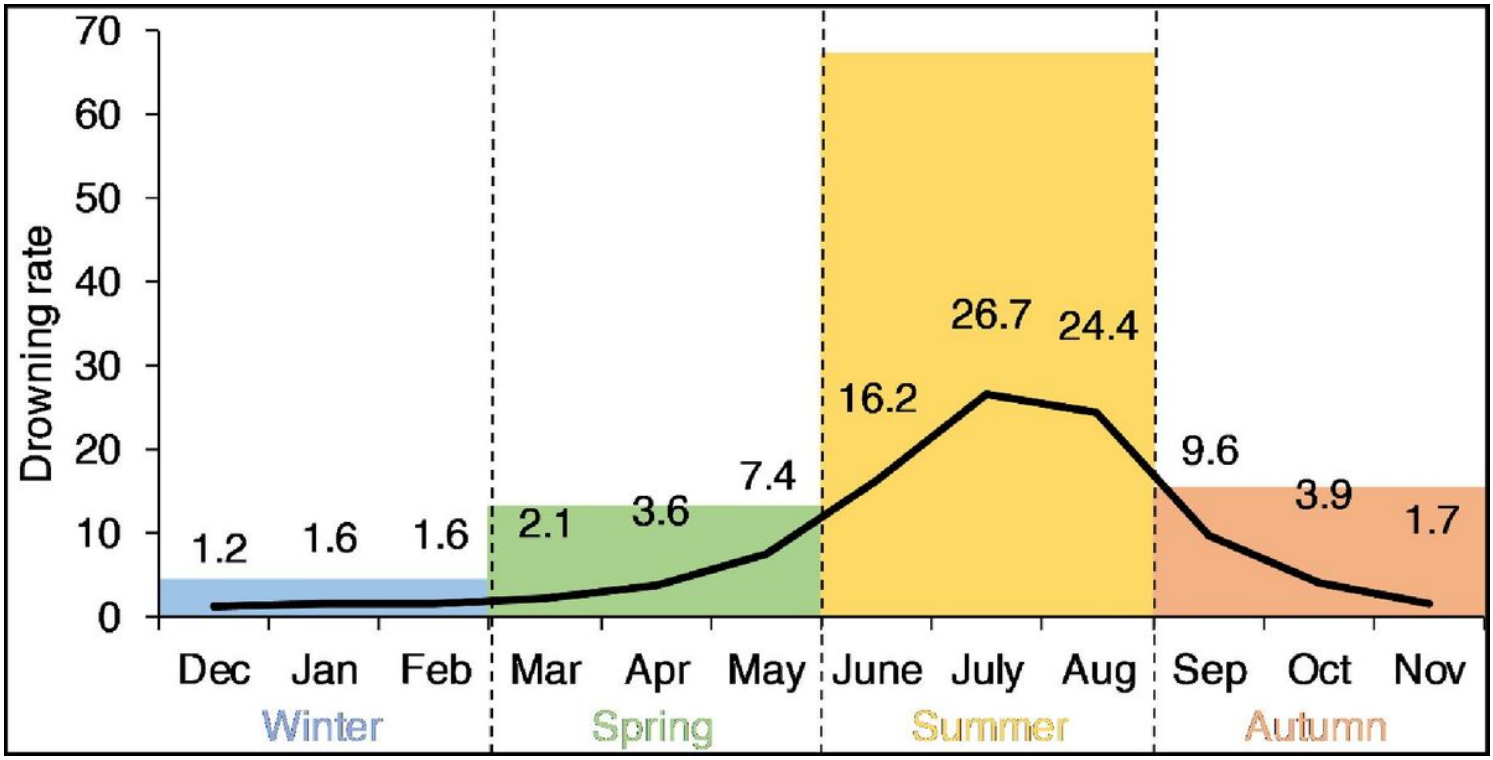

Figure 3

Temporal distribution characteristics of drowning incidents in Turkey according to months and seasons

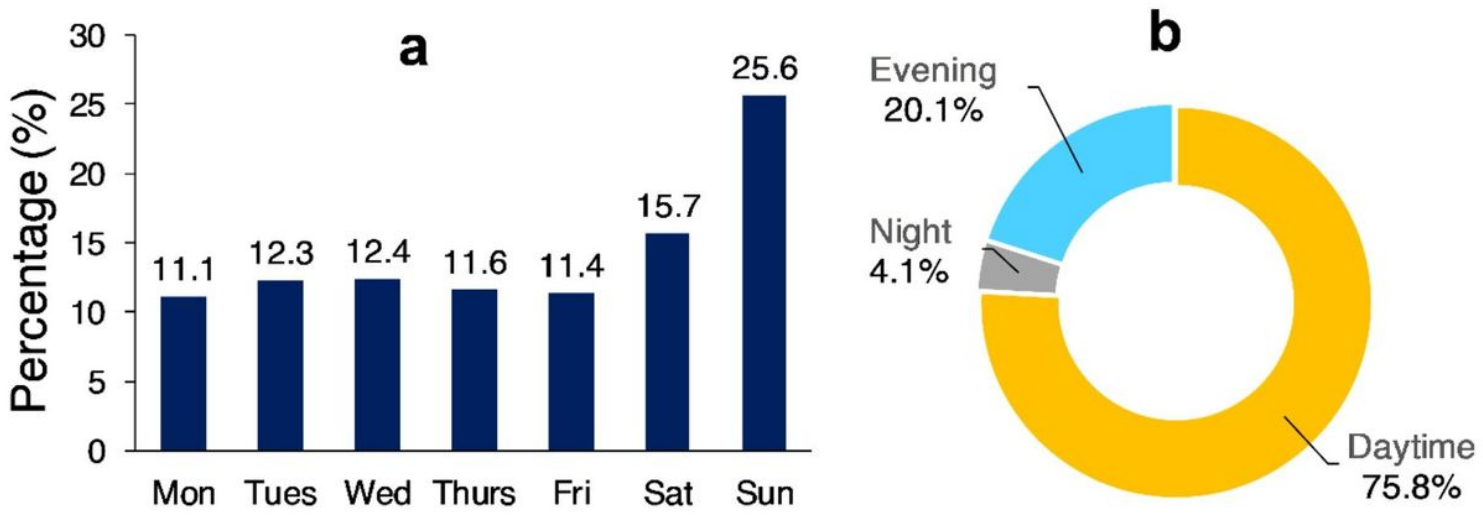

Figure 4

Drowning incidents distribution over day of the week (A), and time of day (B) in Turkey.

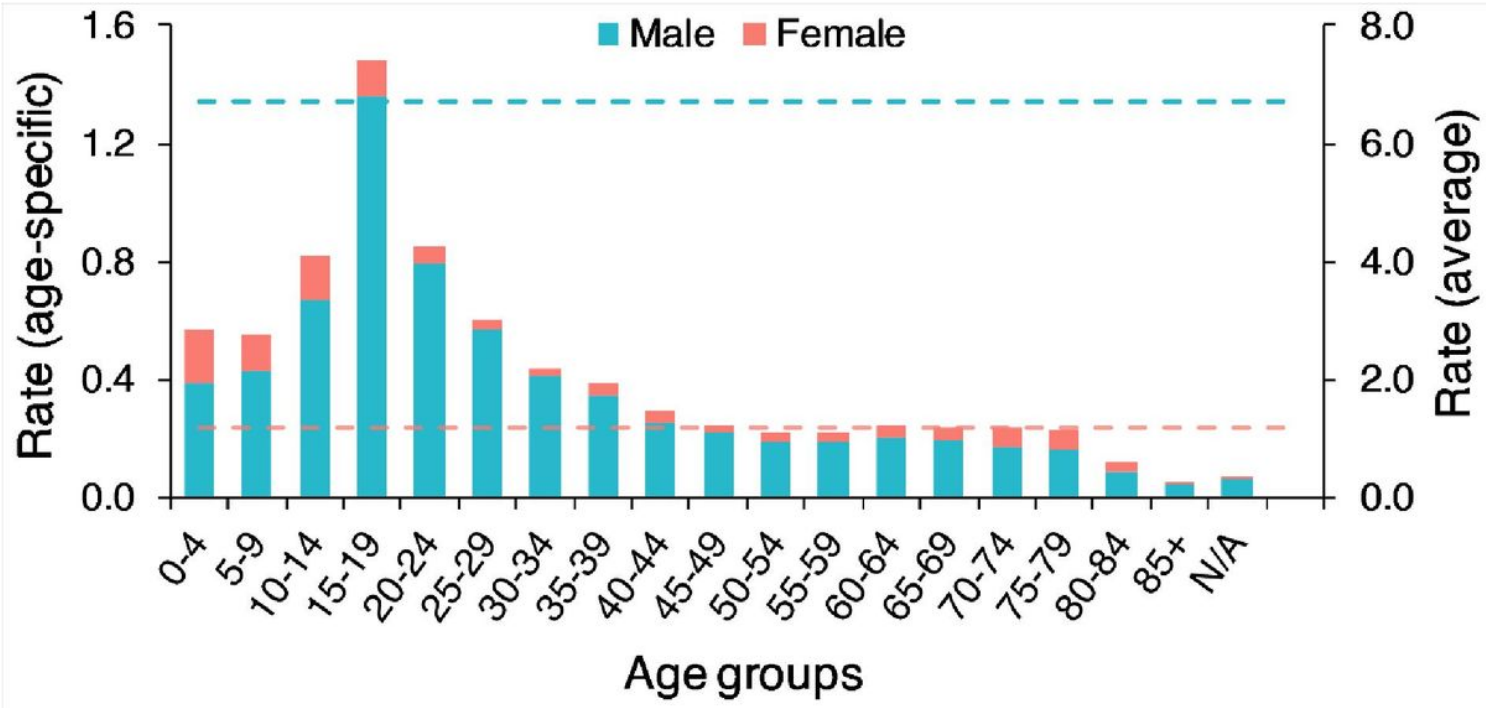

Figure 5

Unintentional drowning fatality rates (per 100,000 population) stratified by gender among age groups in Turkey. The bars represent the fatality rates stratified by age groups, while the dashed lines represent the average fatality rates (N/A: unknown).

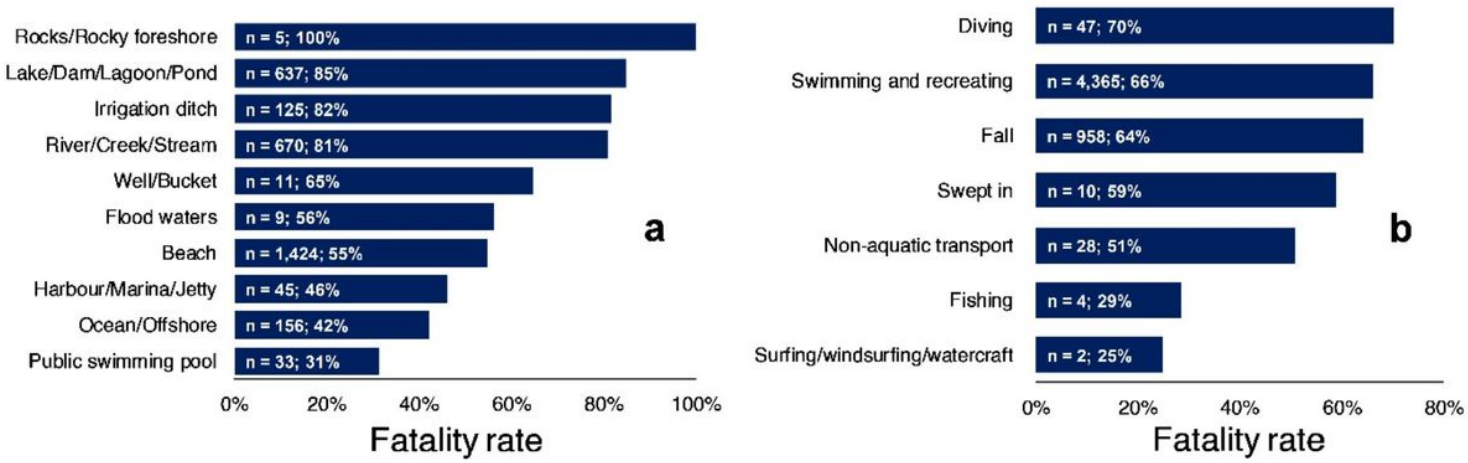

Figure 6

Unintentional drowning fatality rates (per 100,000 population) stratified by location of incidents (A) and type of activity (B) in Turkey.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- ESM1.pdf
- ESM2.pdf