Heliyon 9 (2023) e18104

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon

Rip current knowledge: do people really know its danger? do lifeguards know more than the general public?

Pelayo Diez-Fernández [a,b], Brais Ruibal-Lista [b,c,*], Fernando Lobato-Alejano [d], Sergio López-García [a,b]

[a] *Facultad de Educación. Universidad Pontificia de Salamanca, Spain*
[b] *Grupo de Investigación en Actividad Física y Salud (GIADES), Departamento de Educación. Universidad Pontificia de Salamanca, Spain*
[c] *EUM Fray Luis de León. Universidad Católica de Ávila, Spain*
[d] *Facultad de Informática. Universidad Pontificia de Salamanca, Spain*

A R T I C L E I N F O

Keywords:
Rip currents
Education
Aquatic safety
Beaches

A B S T R A C T

Introduction: Drowning is a global problem. This so-called "silent killer" claims hundreds of thousands of lives every year around the world. Despite this, beaches are a fundamental space in the lives of many people throughout the world. The scant knowledge regarding aspects of safety, accident prevention and the identification of risks in these natural aquatic environments, all contribute to the number of aquatic accidents that happen. The objective of this study was to establish the reality about the Spain population's knowledge of risks on the beaches.
Methods: A study was carried out using a questionnaire, generated through Google Forms©. The questionnaire was available for 7 days, from May 12 to 19, 2022. 289 responses were selected. The Chi-square statistic was used to analyze the associations while Cramér's V statistics and the Odds Ratio were applied to analyze their strength. The significance level was $p < 0.05$ for the entire study.
Results: 50.5% of the participants knew how to correctly identify a rip current. In terms of definition, identification and response to a current, those who were lifeguards were more likely than the general population to answer correctly.
Conclusions: Sex, age or place of residence do not seem to explain knowledge about rip currents in an active population group. Finally, as a factor in avoiding possible accidents related to currents, the importance of having professional lifeguards in natural aquatic environments is confirmed.

1. Introduction

The World Health Organization has declared that drowning is an issue requiring attention throughout the world [1]. It is a global problem [1–3], as well as a "silent killer", which claims hundreds of thousands of lives every year [4,5,6]. Although it has also been established that this data is difficult to ascertain, since many deaths are not adequately recorded, and many countries may not even have reliable data.

Multiple studies place drowning among the most common causes of death in childhood [1,6–11]. Despite this, beaches are a fundamental location in the lives of many people across the globe. Limited knowledge in terms of safety, accident prevention and the

* Corresponding author. EUM Fray Luis de León. Universidad Católica de Ávila C/ Tirso de Molina, 44, 47010, Valladolid, Spain.
E-mail address: brais.ruibal@frayluis.com (B. Ruibal-Lista).

https://doi.org/10.1016/j.heliyon.2023.e18104
Received 21 March 2023; Received in revised form 28 June 2023; Accepted 7 July 2023
Available online 8 July 2023

identification of risks around water combine to create a public health issue specific to aquatic locations [12].

It is estimated that deaths caused solely by these coastal phenomena exceed 1,000 annually worldwide [13]. In Spain, approximately 400–500 people die from drowning each year, but there is no report specifying the exact location of these drownings or whether they occurred in a rip current or not [14]. These strong currents of water directed towards the sea are generated by bathymetric differences on the coastal seabed, thus creating variations in wave height at the breaking zone [15,16]. These variations in wave height cause the energy carried by the water masses reaching the shore to break the sandbar and consequently form an outlet channel, creating a rip current [17,18]. Therefore, in order to identify them, the population should be educated to look for dark areas, sand or suspended objects, and channels of water flowing towards the sea [19]. In this way, the recommendations when caught in a rip current are to float and swim parallel to the beach to exit the current channel [20].

In Spain, no data has been found regarding the number of drowning deaths caused exclusively by these phenomena on the country's beaches. Internationally, some consulted publications estimate that over 100 people die annually due to rip currents in the United States [21,22]. In the same vein, these dangerous currents account for 80% of the rescues performed by lifeguards each year [23]. Likewise, along the Australian coasts, the average number of drowning deaths caused by rip currents is approximately 21 people per year [24,25], although other sources suggest that this cause of death reaches approximately 80 fatalities annually [26].

Lifeguards and the general population should be trained so that they can identify and prevent all the risks associated with natural aquatic spaces. Since society in general does not know how to identify these risks [27–35] visiting and using these aquatic spaces puts the general public at risk, as well as endangering those professionals who are charged with public safety and are responsible for rescues should an accident occur [36–38].

Therefore, we should acknowledge that, in order to prevent these potential risks, it is necessary to improve knowledge about the subject and how to deal with the risks. Addressing rip currents, in particular, within the educational system is crucial, since, as has been established, they are one of the most significant dangers at the beach. Supporting this line of thinking, Sotés et al. [33] notes that 58% of drownings in Spain occur at the beach.

Spain has established itself as a premier tourist destination on an international level. Its gastronomic offerings, cultural heritage, and beautiful beaches attract millions of tourists every year. According to the National Institute of Statistics (INE), in 2022, Spain welcomed over 70 million international tourists, solidifying its position as one of the most significant global tourist destinations [39].

Our country boasts more than 3,500 beaches, which attract the vast majority of domestic and foreign tourists [14]. The coastal regions are particularly favored by tourists, with the Canary Islands accounting for 29.6% of the total, followed by Catalonia (19.7%) and Andalusia (13.0%) [39]. Therefore, in our country, there is a practice, inherent to the spanish culture, of going to the beach as a means of enjoyment.

A program to learn these risks and to provide this information to the public is essential since it has been established that, currently, there is a lack of knowledge in this area, and that, after brief training, it is possible to acquire basic water safety principals [12,32,33,40,41]. For this reason, teachers take on an important role, as they are able to educate their pupils in the basics of aquatic safety and the prevention of drowning [42], educating these individuals as future beachgoers worldwide, thus contributing to reducing the number of drownings caused by this phenomenon.

The objective of this paper is to carry out a first assess on the knowledge of safety on the beach and rip currents in a sample made up of active people. As a second objective, we intend to compare the differences between participants who are lifeguards and those who are not.

2. Material and methods

2.1. Procedure

A questionnaire was devised, then reviewed by six experts in aquatic lifesaving, with nine questions focusing on knowledge regarding Rip Currents. This was based on a questionnaire used by de Olivera et al., [31]; Sherker et al. [32], and Wilks et al., [41]. Once prepared, it was disseminated through the internet, using the Google Forms program. On the first page of the questionnaire, participants were informed of the entire process, the overall objective of their participation, as well as the policy of always maintaining anonymity and their right to withdraw from the study at any time without giving cause or justification. Access to the questionnaire is available in Spanish and English. The study was approved by the Quality Service of the "Fray Luis de León" Teaching College, attached to the Catholic University of Ávila (UCAV). The research was performed in accordance with the Declaration of Helsinki of 1975.

2.2. Questionnaire

The questionnaire had 2 differentiated thematic blocks.

Block 1 Personal and Professional Characteristics

Questions included:

1. Gender
2. Age.
3. Place of residence.

4. Qualification in aquatic lifesaving.
5. Educational level.

Block 2 Knowledge and identification of Rip Currents

Questions included:

1. Selection of a suitable area for bathing on a specific beach (Fig. 1).
2. Definition of rip current.
3. Identification of a rip current.
4. Actions in response to a rip current.

The questions had a multiple-choice format, where in five (5) questions only one answer could be chosen and, in three (3) of them, several answers could be marked.

2.3. Participants

Once devised and written, the questionnaire was sent to registered users of an Spanish web page dedicated to the dissemination of sports and health sciences. The inclusion criteria for participants were the following: They should; be over 18 years of age, have Spanish nationality, reside in Spain, engage in physical activity in natural settings, and answer all the questions in the questionnaire.

Bearing in mind the period necessary for the distribution of the questionnaire through the different dissemination channels, access to the questionnaire was maintained for 7 days, from May 12 to 19, 2022. A total of 422 people answered the questionnaire, of which 289, who met all the inclusion criteria, were selected.

2.4. Data analysis

Statistical analysis was carried out using statistical software (SPSS, version 22.0, SPSS Inc.). First, a descriptive analysis of the answers obtained was carried out, converted into categorical variables and expressed in terms of percentages.

After this, a statistical analysis was carried out using contingency tables to search for associations between the different variables. The Chi-square statistic was used to analyze said connections, and Cramér's V statistics and the Odds Ratio were applied to analyze their strength. The significance value stipulated in the study to demonstrate the association between the different variables was $p < 0.05$.

Pearson's chi-square test is used to determine if there is a statistically significant difference between the expected frequency and the observed frequencies in one or more categories of a contingency table. This allows knowing if there is an association between variables that can be explained beyond chance. Cramer's V is a measure that indicates the strength of the associations reflected in the Chi-Square statistic. The values of this measure are between 0 and 1. If the association is less than 0.2, the strength of that association is weak, if it is between 0.2 and 0.6 it is moderate, and if it is greater than 0.6 it is strong. Finally, the statistic called Odds Risk tells us the probability of presenting an event compared to the probability of not presenting it.

3. Results

3.1. Descriptive analysis results

A total of 289 people answered the entire questionnaire (Table 1), 182 men (63.0%) and 107 women (37.0%). The age of the participants was broken down into four sections: forty-six (46) people were between 18 and 24 years old (15.9%), fifty-nine (59) between 25 and 34 (20.4%), one hundred and twenty-five (125) 35 to 50 (43.3%) and fifty-nine (59) from 51 to 65 years (20.4%). Everyone surveyed resided in Spain, of which 200 (69.2%) lived on the coast and 89 (30.8%) lived inland. Regarding the educational

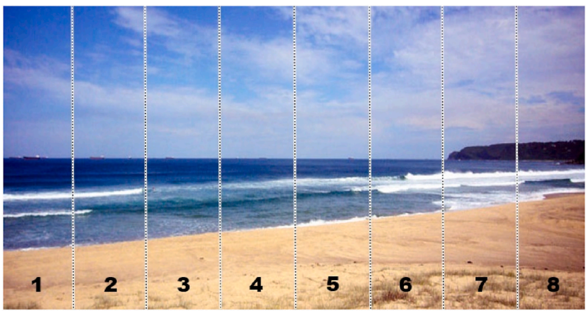

Fig. 1. Selection of a suitable area for bating utilized in the questionnaire.

Table 1
Breakdown of independent variables in relation to dependent variables.

Variable	Sub-variable	Bathing zone (%)	Definition of the current (%)	Identification of the current (%)	Responding to current (%)
General	Correct	146 (50.5)	260 (90.0)	246 (85.1)	231 (80.0)
	Incorrect	143 (49.5)	29 (10.0)	43 (14.9)	58 (20.0)
Gender	Male	91 (50.0)	164 (90.1)	156 (85.7)	155 (85.1)
	Female	57 (53.3)	96 (89.7)	90 (84.1)	93 (87.7)
Age	18 to 24 years	26 (45.8)	43 (93.5)	41 (89.1)	30 (64.4)
	25 to 34 years	27 (56.5)	51 (86.4)	47 (79.7)	46 (78.3)
	35 to 50 years	69 (55.2)	112 (91.5)	106 (84.8)	107 (86.3)
	51 to 65 years	26 (51.2)	54 (89.5)	52 (88.1)	50 (84.7)
Residence	Coastal	103 (51.5)	179 (89.5)	169 (84.5)	158 (79.4)
	Inland	45 (50.6)	81 (91.0)	77 (86.5)	73 (82.0)
Education	Secondary E.	18 (48.6)	29 (78.4)	25 (67.6)	22 (59.5)
	Vocational Training	40 (56.3)	62 (87.3)	61 (86.7)	59 (82.9)
	University E.	98 (54.1)	169 (93.4)	163 (90.1)	152 (84.3)
Lifeguard	Yes	34 (69.4)	46 (93.9)	46 (93.9)	45 (91.8)
	No	114 (47.5)	214 (89.2)	200 (83.3)	187 (77.8)

level, 37 people (12.8%) completed Secondary Education, 71 Vocational Training (24.6%) and 181 University Education (62.6%). It was observed that two hundred and forty (240) people were not lifeguards (83.0%), compared to forty-nine (49) who were (17.0%). Of the people who were lifeguards, forty (40) worked in aquatic facilities (81.6%) and nine (9) in natural aquatic spaces (18.4%).

It was also observed that twenty-seven (24) had less than 2 years of experience as a lifeguard (49.0%), fifteen of them (15), between 3 and 5 years (30.6%), and the remaining ten (10), between 5 at 10 years (20.4%).

In the second part of the questionnaire, in choosing the most suitable bathing area, it was broken down into: Zone 1 (24.9%), Zone 2 (8.7%), Zone 3 (9.3%), Zone 4 (25.3%), Zone 5 (4.8%), Zone 6 (1.4%), Zone 7 (11.8%) and Zone 8 (13.8%). The correct zones (1, 7 and 8) were selected by one hundred and forty-six (146) participants (50.5%), while the incorrect zones (2, 3, 4, 5 and 6), by one hundred and forty-three (143), the remaining 49.5%.

Regarding the direct questions about rip currents, it was observed that two hundred and sixty (260) people (90.0%) selected one of the correct answers in terms of its definition, compared to twenty-nine (29), who answered incorrectly (10.0%).

Furthermore, two hundred and forty-nine (249) people (86.2%) correctly answered how to accurately identify the current, but the other forty (40) failed to do so (13.8%).

Finally, two hundred and thirty-one (231) people (80.2%) correctly answered how to respond to a rip current as opposed to the remaining eighteen (57), who did not select any possible option (19.8%).

3.2. *Statistical analysis results*

The results obtained after the analysis from contingency tables are shown here. The aim was to establish connections between the independent variables (sex, age, educational level, residence, lifeguard), and the dependent variables (choice of bathing area, definition, identification, and responses to a current).

3.2.1. *Connections with the choice of bathing area*

In this comparison, only one statistically significant association was observed (Table 2). This shows that the lifeguards tended to correctly select the area chosen for bathing ($x^2 = 7.802$; df = 1; p = 0.004; V = 0.164). Cramer's V value was 0.164, which indicates that there is a significant association, but its strength is weak. Lastly, the Odds Ratio indicates that they were 2.5 times more likely to answer correctly than those who were not lifeguards (OR = 2.505). The percentage of lifeguards who chose the bathing area correctly was 69.4%, while 47.5% of those who were not lifeguards were correct. The other variables were analyzed, but none of them showed significant associations, therefore, the correct choice of the bathing area is not related to sex (p = 0.591), age (p = 0.359), educational level (p = 0.508) or place of residence (p = 0.883). To establish the safe bathing zone in our study, based on the research conducted by Wilks et al. (2016b) and after administering the questionnaire to an expert committee, it has been determined that zones 1, 7, and 8 are considered safe. As indicated by the consulted literature (Aragón & de la Cruz, 2005), areas with white foam are identified as zones without rip currents, whereas dark and deep areas are considered dangerous.

Table 2
Contingency table for “Bathing Area".

Independent variable	x^2	*df*	*Sig.*	Cramér's V	Odds Ratio
Sex (2 × 2)	0.289	1	0.591	0.032	0.877
Age (4 × 2)	0.359	3	0.359	0.106	–
Educational Level (3 × 2)	1.353	2	0.508	0.068	–
Residence (2 × 2)	0.021	1	0.883	0.090	1.038
Lifeguard (2x2)	**7.802**	**1**	**0.004**	**0.164**	**2.505**

x^2 = Chi squared; df = degree of freedom; sig. = statistical significance.

3.2.2. Connections with the correct current definition

This comparison shows two statistically significant associations (Table 3). First, it is shown that there is a significant association between being a lifeguard and the correct definition of a rip current ($x^2 = 8.230$; df = 1; p = 0.004; V = 0.169). Cramer's V value was 0.169, which indicates that there is a significant association, but its strength is weak. Lastly, the Odds Ratio indicates that they were 5 times more likely to answer correctly than those who were not lifeguards (OR = 4.998). The percentage of lifeguards who correctly defined a rip current was 93.9%, while 89.2% of those who were not lifeguards were correct. There is little difference in the percentages, which explains the low value of Cramer's V.

In addition, it was observed how the educational level reached was also related to the probability of correctly defining a rip current ($x^2 = 8.376$; df = 2; p = 0.015; V = 0.168). As before, Cramer's V indicates that the association is weak. Participants who reached secondary education responded correctly when identifying a rip current in 78,4% of cases, as opposed to the group that reached vocational training, with 87.3% correct; and those who achieved university education, with 93.4% correct.

3.2.3. Association with the correct current identification

This comparison shows statistically significant associations in the same variables as the previous one (Table 4). In the first place, it is shown that there is a significant association between being a lifeguard and the correct identification of a rip current ($x^2 = 3.572$; df = 1; p = 0.040; V = 0.110). Cramer's V value was 0.110 which indicates that there is a significant association, but its strength is weak. Lastly, the Odds Ratio indicates that they were 3 times more likely to answer correctly than those who were not lifeguards (OR = 3.067). The participants who were lifeguards responded correctly when identifying a current in 93.9% of cases, compared to 83.3%, among the others.

Secondly, a significant association is observed again between the educational stage reached and the correct identification of a rip current ($x^2 = 12.056$; df = 2; p = 0.002; V = 0.204). Cramer's V value (V = 0.204) indicates that the strength of association is moderate. Participants who reached secondary education responded correctly when identifying a return current in 67.6% of cases, as opposed to the group that reached vocational training, with 86.7% correct; and those who achieved university education, with 90.1% correct.

3.2.4. Connection with response to a current

In this comparison, three statistically significant associations are shown (Table 5). The first association is found again, in the variable "lifeguard". Lifeguards tend to select better how to act when faced with a rip current ($x^2 = 3.807$; df = 1; p = 0.034; V = 0.115). The Odds Ratio indicates that they were almost 2.5 times more likely to answer correctly (OR = 2.402).

As in the previous analyses, it was observed that the educational level is also related to the choice of how to act in a rip current. In this case, people with a higher educational level tended to select a correct performance in a stream ($x^2 = 11.343$; df = 2; $p < 0.001$; V = 0.235). Those who finished secondary education answered correctly in 59.5% of the cases, the group that completed vocational training, 82.9%; and for those who completed university studies, 84.3%. Finally, in terms of age, a significant connection is observed ($x^2 = 13.045$; p = 0.005; V = 0.200), with younger participants being less likely to know how to answer correctly. The participants who responded correctly to any of the action options before a current, was 64.4% in the age group of 18 to 24 years, 78.3% in the age group of 25 to 34 years, the 86.3% in the 35–50 age group and 84.7% in the older age group, 51–65 years. In these last two comparisons, the strength of the association is moderate (V = 0.235, V = 0.200).

It has been shown that the educational level has a significant association with the definition (p = 0.015), identification (p = 0.002) and performance in the face of a rip current (p = 0.010). However, no explanation has been found for this association. Due to this, another analysis has been carried out where it has been observed that the group with people with a university degree has more lifeguards than the groups with lower degrees (Table 6).

It has been shown that the group with a secondary education degree has 2 lifeguards (5.4%), the group that has completed vocational training has 10 (14.8%) and the group with a university degree has 41 (22.6%). This may indicate that the "academic degree" variable is not responsible for the association with return knowledge, but that the number of lifeguards in each group may be the real cause of said association ($x^2 = 7.207$; df = 2; p = 0.040; V = 0.147).

4. Discussion

In this study an attempt has been made to provide an initial information regarding the awareness and knowledge of rip currents in an active adult population. Drowning is one of the highest causes of accidental death in the world [1] and accidents due to water

Table 3
Contingency table for "Current Definition".

Independent variable	x^2	df	Sig.	Cramér's V	Odds Ratio
Sex (2 × 2)	0.011	1	0.915	0.060	1.044
Age (4 × 2)	1.618	3	0.655	0.075	–
Educational Level (3x2)	**8.376**	**2**	**0.015**	**0.168**	–
Residence (2 × 2)	0.156	1	0.693	0.023	0.842
Lifeguard (2x2)	**8.230**	**1**	**0.004**	**0.169**	**4.998**

x^2 = Chi squared; df = degree of freedom; sig. = statistical significance.

Table 4
Contingency table for "current identification".

Independent variable	x^2	*df*	*Sig.*	*Cramér's V*	*Odds Ratio*
Sex (2 × 2)	0.039	1	0.483	0.012	1.067
Age (4 × 2)	2.658	3	0.447	0.096	–
Educational Level (3x2)	**12.056**	**2**	**0.002**	**0.204**	–
Residence (2 × 2)	0.259	1	0.374	0.030	0.835
Lifeguard (2x2)	**3.572**	**1**	**0.040**	**0.110**	**3.067**

x^2 = Chi squared; df = degree of freedom; sig. = statistical significance.

Table 5
Contingency table for "correct response to a current".

Independent variable	x^2	*df*	*Sig.*	*Cramér's V*	*Odds Ratio*
Sex (2 × 2)	0.444	1	0.303	0.039	0.821
Age (4x2)	**15.930**	**3**	**<0.001**	**0.235**	–
Educational Level (3x2)	**11.343**	**2**	**0.010**	**0.200**	–
Residence (2 × 2)	0.528	1	0.285	0.043	0.798
Lifeguard (2x2)	**3.807**	**1**	**0.034**	**0.115**	**2.402**

x^2 = Chi squared; df = degree of freedom; sig. = statistical significance.

Table 6
Contingency table for "lifeguard".

Independent variable	x^2	*df*	*Sig.*	*Cramér's V*	*Odds Ratio*
Educational Level (3x2)	**7.207**	**2**	**0.040**	**0.147**	–

x^2 = Chi squared; df = degree of freedom; sig. = statistical significance.

currents in natural environments are a documented issue in the scientific literature [24,32,33,43–47].

Initial results show that half of the respondents could not correctly determine a suitable bathing area in a photograph of a natural beach. Similar results have been found in earlier studies [27,29,30,32–34]. However, at a general level, it was observed that the population surveyed was capable of correctly defining and identifying a current (>85%).

Regarding this question, a study by Wilks et al. [41], observed lower levels than those found in ours, because the respondents had to directly write a definition of a rip current and not simply select the correct definition from several options.

In addition, it has been analyzed if the professional lifeguards of this population have greater knowledge about rip currents than those who are not. It has been shown that lifeguards have greater knowledge about the correct choice of bathing area, as well as about rip currents than those who are not ($p < 0.05$). Lifeguards have a greater mastery of rip currents and a greater knowledge of how they work, due to the specific training on aquatic safety that they receive before starting their profession.

This confirms the importance of the presence of lifeguards on beaches, since, according to a report published by MAPFRE Foundation (Mutualidad de la Agrupación de Propietarios de Fincas Rústicas de España), the preventive task most commonly performed by lifeguards on Blue Flag beaches is changing the flag and bathing area, while the fifth most common was informing bathers about rip currents [14].

More accurate identification and better response to rip currents among lifeguards demonstrates, once again, the importance of their presence on beaches. In their interventions in the aquatic environment, the percentage of deaths drops from 51% to 26% if the accident occurs where lifeguards are present [48].

Furthermore, it has been observed that younger people are at a greater risk of drowning due to greater exposure to the aquatic environment and an over-confidence in their abilities in the water [31,42,43,49–51]. In addition, in drownings where alcohol consumption is involved, most of the victims are young people [1].

In our study, we found that the youngest respondents, between the ages of 18 and 24, tended to give the wrong answer as to how to respond to a rip current ($p < 0.05$). All the factors above, combined with a greater ignorance of currents, make this group especially vulnerable.

However, after a subsequent statistical analysis, it has been observed that the group with a university degree had a greater number of lifeguards than the groups with lower degrees ($p < 0.05$). This may mean that knowledge about rip currents is not directly related to the educational level, but rather to the possibility of being a lifeguard. In this regard, more studies are necessary to be able to draw objective conclusions.

In relation to this, as in other studies, it has been found that the general public may claim to know how to recognize a rip current, but they are rarely able to identify it in a beach photograph, instead choosing a dangerous area as the ideal location for swimming [27,32].

62% of the university students consulted know what a rip current is, but 64% of these were not able to identify one [27]. In accordance with this, the understanding, perception, and behavior of people in the face of the danger that rip currents represent have been studied, establishing that around 87% of people were not able to identify rip currents at the beach [30,34,50,51].

Finally, as in other studies [32], it is certain that one of the limitations of this study is not being able to use a moving image, nor one where other beach users are visible, both of which could give clues about where would be the best location to bathe on a day at the beach. In this respect, future lines of research are proposed, using real images on video, so that the danger can be analyzed in situ. In this way, it would be possible to get users closer to the reality of identifying risks in these natural aquatic environments.

5. Conclusions

At a social level, education into the prevention of aquatic accidents must be pursued and encouraged. As observed in the study, greater learning about currents (define them, visualize them, avoid them …) increases the likelihood of avoiding water accidents and drowning. In the case of being caught in a current, more knowledge helps prompt a safer response, which may in turn save your life.

Bathers with basic knowledge of rip currents would be significantly more likely to avoid being caught in one. For precisely this reason, it is important to educate and raise awareness among the population about this risk. Basic knowledge of rip currents is an essential component of an overall focus on reducing drowning on beaches.

Bathers clearly need to know how a current is identified, and how to avoid unintentionally wading into one. Therefore, as in other studies, it is suggested that lessons related to knowledge about first aid and safety in the aquatic environment should form part of basic educational content.

Furthermore, it is necessary to emphasize the importance of having lifeguards available in natural bathing areas, since they have shown greater knowledge about currents than the rest of the participants.

Al last, it is also necessary to continue research into aspects related to rip currents and create a national prevention drowning plan in order to try to reduce the number of drownings and aquatic accidents.

Author contribution statement

Pelayo Díez-Fernández, Ph.D.: Conceived and designed the experiments; Performed the experiments; Wrote the paper.
Brais Ruibal-Lista, Ph.D.: Conceived and designed the experiments; Analyzed and interpreted the data; Wrote the paper.
Fernando Lobato-Alejano, Ph.D: Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data.
Sergio López-García, Ph.D.: Performed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Data availability statement

Data will be made available on request.

Additional information

No additional information is available for this paper.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] World Health Organization [WHO], Informe mundial sobre ahogamientos: prevenir una importante causa de mortalidad, Ginebra, Suiza: World Health Organization [WHO], 2016. Available at: https://apps.who.int/iris/handle/10665/251498.
[2] W. Koon, A. Peden, J.C. Lawes, R.W. Brander, Coastal drowning: a scoping review of burden, risk factors, and prevention strategies, PLoS One 16 (2) (2021), e0246034, https://doi.org/10.1371/journal.pone.0246034.
[3] D. Warner, J. Bierens, S. Beerman, L. Katz, Drowning: a cry for help, Anesthesiology 110 (2009) 1211–1213, https://doi.org/10.1097/ALN.0b013e3181a4c3d3.
[4] D. Spilzman, Afogamento na infancia: Epidemiologia, tratamento e prevençao, Rev Paul Pediatr 23 (3) (2005) 142–153.
[5] L. Cortés, S. Hargarten, H. Hennes, Recommendations for water safety and drowning prevention for travelers, J. Trav. Med. 13 (1) (2006) 21–34, https://doi.org/10.1111/j.1708-8305.2006.00002.x.
[6] J. Fleta, L. Moreno, M. Bueno, Ahogamiento y semiahogamiento: recuerdo fisiológico y tratamiento, 46(3), 2016, pp. 84–89.
[7] R. Franklin, J. Pearn, Drowning for love: the aquatic victim-instead of- rescuer syndrome: drowning fatalities involving those attempting to rescue a child, J. Pediatr. Child Health 47 (1–2) (2011) 44–47, https://doi.org/10.1111/j.1440-1754.2010.01889.x.
[8] F.E. Martinez, A.J. Hooper, Drowning and immersion injury, Anesthesiol. Intensive Care Med. 15 (9) (2014) 420–423, https://doi.org/10.1016/j.mpaic.2014.06.006.
[9] D. Meddings, J.P. Scarr, K. Larson, J. Vaugan, E.G. Krug, Drowning prevention: turning the tide on a leading killer, Lancet Public Health 6 (9) (2021) 692–695, https://doi.org/10.1016/S2468-2667(21)00165-1.
[10] M. Nitta, T. Kitamura, T. Iwami, V. Nadkarni, R. Berg, A. Topjian, Y. Okamoto, C. Nishiyama, T. Nishiuchu, Y. Hayashi, Y. Nishimoto, A. Takasu, Out-of-hospital cardiac arrest due to drowning among children and adults from the Utstein Osaka Project, Resuscitation 84 (11) (2013) 1568–1573, https://doi.org/10.1016/j.resuscitation.2013.06.017.
[11] D. Szpilman, J. Sempsrott, J. Webber, S. Hawkins, R. Barcala, A. Schmidt, C. Queiroga, Dry drowning and other myths, Cleve. Clin. J. Med. 85 (7) (2018) 529–535, https://doi.org/10.3949/ccjm.85a.17070.
[12] J. Hatfield, A. Williamson, S. Sherker, R. Brander, A. Hayen, Development and evaluation of an intervention to reduce rip current related beach drowning, Accid. Anal. Prev. 46 (2012) 45–51, https://doi.org/10.1016/j.aap.2011.10.003.

[13] H. Ritchi, P. Rosado, M. Roser, Natural Disasters. OurWorldInData.org. Accedido el 1 de junio de, 2023. https://ourworldindata.org/natural-disasters.
[14] J. Palacios-Aguilar, Estudio sobre prevención de ahogamientos y otras situaciones de riesgo vital en playas con Bandera Azul, Fundación MAPFRE, Madrid, 2018.
[15] O.G. Lizano, Corrientes marinas en algunas playas de Costa Rica, in: En Viales R, J. Amador, F. Solano, editores (Eds.), Concepciones y representaciones de la naturaleza y la ciencia en América Latina. San José, C.R., Editorial Universidad de Costa Rica, 2009, pp. 261–274.
[16] J. MacMahan, A. Reiners, J. Brown, R. Brander, E. Thornton, T. Stanton, J. Brown, W. Carey, An introduction to rip currents base nob field observations, J. Coast Res. 27 (4) (2011) 3–4.
[17] R.W. Brander, A.D. Short, Flow kinematics of low-energy rip current systems, J. Coast Res. 17 (2) (2001) 468–481.
[18] V.A. Gensini, W.S. Ashley, An examination of rip current fatalities in the United States, Nat. Hazards 54 (2010) 159–175, https://doi.org/10.1007/s11069-009-9458-0.
[19] F.J. Aragón, A. De La Cruz, Seguridad y calidad del turismo de playa mediante la prevención de ahogamientos y rescates ocasionados por las corrientes de resaca. En: Palacios Aguilar J, editor. I Congreso Internacional de Seguridad y Turismo Sostenible. VIII Jornadas de Socorrismo basado en la evidencia científica; 2015 Abr 17-19; Oleiros, A Coruña. Facultad del Deporte y la Educación Física. Universidad de A Coruña, 2015.
[20] B. Castelle, T. Scott, R.W. Brander, R.J. McCarroll, Rip current types, circulation and hazard, Earth Sci. Rev. 163 (2016) 1–21.
[21] B.C. Brewster, Rip current misunderstandings, Nat. Hazards 55 (2010) 161–162.
[22] W. Carey, S. Rogers, Rip currents — coordinating coastal research, outreach and forecast methodologies to improve public safety, in: Proceedings of the Solutions to Coastal Disasters Conference, 2005, pp. 285–296, https://doi.org/10.1061/40774(176)29.
[23] United States Lifesaving Association (USLA), United States Lifesaving Association Rip Current Survival Guide, 2011.
[24] B. Brighton, S. Sherker, R. Brander, M. Thompson, A. Bradstreet, Rip current related drowning deaths and rescues in Australia 2004-2011, Nat. Hazards Earth Syst. Sci. 13 (4) (2013) 1069–1075, https://doi.org/10.5194/nhess-13-1069-2013.
[25] Surf Life Saving Australia (SLS), National Coastal Safety Report 2011: A Summary of Coastal Drowning Deaths in Australia, Surf Life Saving Australia, Sydney, 2011.
[26] Surf Life Saving Australia (SLS), National Coastal Safety Report 2008, Surf Life Saving Australia, Sydney, 2008.
[27] R. Ballantyne, N. Carr, K. Hughes, Between the flags: an assessment of domestic and international university student's knowledge of beach safety in Australia, Tourism Manag. 26 (2005) 617–622, https://doi.org/10.1016/j.tourman.2004.02.016.
[28] C. Brannstrom, H.L. Brown, C. Houser, S. Trimble, A. Santos, You can't see them from sitting here": evaluating beach user understanding of a rip current warning sign, Appl. Geogr. 56 (2014) 61–70, https://doi.org/10.1016/j.apgeog.2014.10.011.
[29] C. Brannstrom, S. Trimble, A. Santos, H.L. Brown, C. Houser, Perception of the rip current hazard on galveston island and North Padre island, Texas, Nat. Hazards 72 (2014) 1123–1138, https://doi.org/10.1007/s11069-014-1061-3.
[30] D. Drozdzewski, W. Shaw, R. Dominey-Howes, T. Walton, A. Gero, S. Sherker, J. Goff, B. Edwick, Surveying rip current: preliminary insights into the experiences of being caught in rip currents, Nat. Hazards Earth Syst. Sci. 12 (4) (2012) 1201–2011, https://doi.org/10.5194/nhess-12-1201-2012.
[31] J. de Olivera, L. Piñeiro-Pereira, A. Padrón-Cabo, A. Alonso-Calvete, O. García-Crespo, C. Varela-Casal, A.C. Queiroga, R. Barcala-Furelos, Percepciones, conocimientos y educación para la prevención del ahogamiento en adolescentes, Rev. Esp. Salud Publica 95 (11) (2021) 1–19.
[32] S. Sherker, A. Williamson, J. Hatfield, R. Brander, A. Hayen, Beachgoers' beliefs and behaviours in relation to beach flags and rip currents, Accid. Anal. Prev. 42 (2010) 1785–1804, https://doi.org/10.1016/j.aap.2010.04.020.
[33] I. Sotés, I. Basterretxea, M. Maruri, Are the Biscanye University students ready to go to the beach safety? Ocean Coast Manag. 151 (2018) 134–149, https://doi.org/10.1016/j.ocecoaman.2017.10.012.
[34] E. Woodward, E. Beaumont, P. Rusell, Public understanding and knowledge of rip currents and beach safety in the UK, Int. J. Aquat. Res. Educ. 9 (1) (2015) 49–69, https://doi.org/10.25035/ijare.09.01.06.
[35] M. Woods, W. Koon, R. Brander, Identifying risk factors and implications for beach drowning prevention amongst an Australian multicultural community, PLoS One 17 (1) (2022), https://doi.org/10.1371/journal.pone.0262175.
[36] R. Franklin, J. Pearn, Drowning for love: the aquatic victim-instead of-rescuer syndrome: drowning fatalities involving those attempting to rescue a child, J. Pediatr. Child Health 47 (1–2) (2011) 44–47, https://doi.org/10.1111/j.1440-1754.2010.01889.x.
[37] A. Turgut, T. Turgut, A study on rescuers drowning and multiple drowning incidents, J. Saf. Res. 43 (2) (2012) 129–312, https://doi.org/10.1016/j.jsr.2012.05.001.
[38] Y. Zhu, X. Jiang, H. Li, F. Li, J. Chen, Mortality among drowning rescuers in China, 2013: a review of 225 rescue incidents from the press, BMC Publ. Health 15 (2015) 631, https://doi.org/10.1186/s12889-015-2010-0.
[39] Instituto Nacional de Estadística [INE], Movimientos Turísticos en Fronteras (Frontur): Estadística de Turismo de España, Accessed June 1, 2023: https://www.ine.es/daco/daco42/frontur/frontur1222.pdf.
[40] J. Wilks, H. Kanasa, D. Pendergast, K. Clark, Emergency response readiness for primary school children, Aust. Health Rev. 40 (2016) 357–363, https://doi.org/10.1071/AH15072.
[41] J. Wilks, H. Kanasa, D. Pendergast, K. Clark, Beach safety education for primary school children, Int. J. Inj. Control Saf. Promot. 24 (3) (2016) 283–292, https://doi.org/10.1080/17457300.2016.1170043.
[42] S. López-García, P. Diez-Fernández, M. Amatria-Jiménez, R. Maneiro-Dios, C. Abelairas-Gómez, J.E. Moral-García, El ahogamiento como principal causa de muerte en las primeras etapas de la vida, el docente como interviniente para la educación y su prevención, Retos 38 (2020) 811–817, https://doi.org/10.47197/retos.v38i38.72134.
[43] E. Beaumont, E. Woodward, P. Russell, A. Wooler, Analysis of rip current incidents and victim demographics in the UK, J. Coast Res. 65 (2013) 850–855, https://doi.org/10.2112/SI65-144.1.
[44] S. Leatherman, Rip current: science and threat communication, J. Coast Res. 72 (2014) 93–95, https://doi.org/10.2112/SI72-017.1.
[45] J. Fletemeyer, S. Leatherman, Rip currents and beach safety education, J. Coast Res. 26 (1) (2010) 1–3, https://doi.org/10.2112/09A-0005.1.
[46] R.J. McCarroll, R.W.A. Brander, J.H. MacMahan, I.L. Turner, J.H.M. Reniers, J.A. Brown, A. Bradstreet, S. Sherker, Evaluation of swimmer-based rip current scape strategies, Nat. Hazards 81 (2013) 1821–1846, https://doi.org/10.1007/s11069-013-0979-1.
[47] D. Morgan, J. Ozanne-Smith, T. Triggs, Descriptive epidemiology of drowning deaths in a surf beach swimmer and surfer population, Inj. Prev. 14 (2008) 62–65, https://doi.org/10.1136/ip.2006.013508.
[48] Asociación Española de Técnicos en Salvamento Acuático y Socorrismo [Internet]. Informe datos de ahogamiento en España. Disponible en:http://www.ahogamiento.com.
[49] J. Howland, R. Hingson, T. Mangione, N. Bell, S. Bak, Why are most drowning victims men? Sex differences in aquatic skills and behaviors, Am. J. Publ. Health 86 (1) (1996) 93–96, https://doi.org/10.2105/ajph.86.1.93.
[50] I. Arozarena, C. Houser, A.G. Echeverria, C. Brannstrom, The rip current hazard in Costa Rica, Nat. Hazards 77 (2015) 753–768, https://doi.org/10.1007/s11069-015-1626-9.
[51] I.A. Llopis, A.G. Echeverria, S. Trimble, C. Brannstrom, C. Houser, Determining beach user knowledge of rip currents in Costa Rica, J. Coast Res. 34 (5) (2018) 1105–1115, https://doi.org/10.2112/JCOASTRES-D-17-00131.1.