Coastal drowning in Costa Rica: incident analysis and comparisons between Costa Rican nationals and foreigners

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Abstract

International and domestic tourism is a growing industry in Costa Rica, with the most attractive places located along the coast. Despite their beauty, Costa Rican beaches can pose a high risk for foreign visitors: Drowning is the primary cause of unintentional death among international visitors. This study presents a comprehensive analysis of demographics, spatial and temporal trends of national and foreigner fatal drowning occurring at Costa Rican beaches during 2001–2019. For national beachgoers, teens and young male adults, ages 15–30 years are at greatest risk of drowning, while for foreigners, older adults ages 45–60 years exhibit higher risk. Temporal trends in drowning appear to be correlated with the number of beach visitors, which seem to be driven mainly by a combination of socio-economical and climatic/weather factors. For instance, strong economic indicators for the Costa Rican population combined with good weather fostered during warm phases of El Niño Southern Oscillation attract more national beachgoers, which may increase the number of drowning deaths. These results will help authorities better understand the complex and dynamic drowning situation to develop better prevention strategies and policies that improve beach safety and raise awareness about coastal hazards and risk. Such actions will bolster the reputation of Costa Rica as a safe touristic destination.

Keywords Drowning · Beach hazard · Tourism management · Costa Rica

1 Introduction

Prior to recent global challenges and restrictions related to COVID-19, the tourism industry was considered to be increasing worldwide as more people afforded travel within their country and abroad (UNWTO 2020). Tourism in Costa Rica, a country of five million residents, represents the largest source of national income driven by nearly three million

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international visitors per year (Instituto Costarricense de Turismo 2018). With pristine Pacific and Caribbean coastlines, many national parks and overall good safety indicators, Costa Rica has solidified itself as a world class tourist destination in Latin America and is particularly well known for its beaches.

Most international visitors in Costa Rica visit the coast, (Instituto Costarricense de Turismo 2019b), which has accelerated real estate and economic development in these areas (Van Noorloos 2013). The increase in both international and national coastal tourism also implies greater human exposure to coastal hazards that result in both fatal and non-fatal injuries and/or drowning. Indeed, drowning is the leading cause of unintentional death among foreigners and second among nationals (Poder Judicial 2018). Between 2002 and 2012, an average of 50 fatal drowning events per year were recorded on Costa Rican beaches (Arozarena et al. 2015), a relatively high number compared to annual averages in more populous countries such as the USA, Turkey and Australia (100, 50 and 30 fatal beach drowning events, respectively; Barlas and Beji 2016; SLSA 2019; Gensini and Ashley 2009).

Previous work has shown that international beachgoers may be more at risk of drowning than residents due to their unfamiliarity with local hazards and risks (Wilks 2017; Wilks et al. 2003), language barriers and an overall relaxed attitude to safety while on holidays (Arozarena et al. 2018; Wilks 2017; Williamson et al. 2012). This attitude, aptly named “tourist brain,” (Houser 2019) can also increase the consumption of alcohol during aquatic activities (Guse et al. 2007). American citizens are up to 40 times more likely to drown overseas than in the USA, with alcohol increasing that risk (Guse et al. 2007). In general, despite their significance, analysis of international tourist drowning statistics is scarce in the literature. While in Australia, international visitors represent about 5% of drowning deaths (Peden et al. 2016) annually in Costa Rica, foreigners represented more than 30% of drowning fatalities (study period: 2002–2012) with American visitors constituting the largest group (Arozarena et al. 2015).

Although foreigners represent a large proportion of Costa Rican drowning statistics, the approach to reduce these drowning death events has been limited. The Costa Rican Tourism Bureau (*ICT: Instituto Costarricense de Turismo*), the main agency charged with managing tourism issues, has relied on beach hazard signage (e.g., rip currents) as a primary method to maintain people’s safety. However, the effectiveness of signage is limited: Multiple studies have demonstrated that beachgoers generally do not pay attention to signs (Arozarena et al. 2018; Brannstrom et al. 2015; Wilks 2017) and find it difficult to translate and understand image representations of beach hazards (e.g., drawing of a rip current; Brannstrom et al. 2014; Ménard et al. 2018). In contrast, the presence of lifeguards at beaches is frequently recommended in the literature (Koon et al. 2021) and considered to be one of the most effective strategies to reduce drowning risk (Gilchrist and Branche 2016; Ramos et al. 2015; Wilks 2017). In 2019, the Costa Rican National Assembly passed a bill requiring coastal counties to provide permanent professional lifeguards at the most popular beaches; however, implementation of the law was significantly delayed due to COVID-19. Also, a pilot program started in January 2020 deployed permanent lifeguards in six popular beaches at Costa Rica and has generated positive initial indicators including rescues and preventive actions (ICT and Cruz Roja de Costa Rica 2019).

Previous analysis found variation in demographic characteristics and spatiotemporal trends between national and foreigner fatal beach drowning events in Costa Rica (Arozarena et al. 2015). Specifically, Arozarena et al. (2015) identified differences in seasonal trends and the locations of where Costa Rican nationals and foreigners died by drowning, information that could inform more effective and targeted prevention interventions

and the allocation of resources. Drowning prevention and beach safety interventions that prioritize a specific population are likely to be more effective compared to a one-size-fits all approach. To better inform future prevention efforts, our aim was to further characterize the differences in fatal drowning trends of Costa Ricans and foreigners by evaluating seven additional years (2013–2019, in respect to Arozarena 2015) of time series data, with a focus to identify geographic areas of increased incidence. These results will ultimately contribute reducing the occurrence and burden of drowning at Costa Rican beaches.

2 Methodology

2.1 Study area

Costa Rica exhibits approximately 640 beaches spanning over 1200 km of coastline which is shared among three coastal provinces: Guanacaste and Puntarenas at the Pacific side and Limón facing the Caribbean Sea (Fig. 1). The Pacific coast is more irregular and rocky than the Caribbean coast, showing several peninsulas, bays and pocket beaches featuring parallel and rhythmic sand bars and strong rip currents. Moreover, the Pacific coast experiences a more energetic wave climate and has a larger tidal range (> 2 m) than the Caribbean (< 1 m) (Lizano 2003, 2007; Gutiérrez-Echeverría Soley-Alfaro 1988). The most

Fig. 1 Map of Costa Rica showing the political limits of the provinces and the locations of the 24 beaches that accounted for 50% of drowning deaths (period 2001–2019). These locations will be analyzed later in the paper

visited beaches are located along the Central Pacific coast (Jacó, Hermosa PC, Espadilla, Ballena) as they are the closest to San José, the capital (see Fig. 1).

2.2 Data sources and analysis

The Costa Rican Judicial Investigation Department (*OIJ: Organismo de Investigación Judicial*) is a branch of the federal court system which investigates all unintentional deaths occurring in Costa Rica. The Statistics Section of OIJ maintains a robust database of such events with information provided by the Department of Forensic Sciences (DFS), which has incorporated information on unintentional drowning deaths since 2001. Cases from this database used in this analysis are unintentional drowning death events (e.g., not homicides or suicides) that occurred in coastal areas where the primary cause of death was registered as submersion asphyxia by DFS-OIJ. For this analysis, we evaluated all unintentional drowning deaths occurring on beaches from 2001 to 2019. The database and subsequent analysis include the following variables: age, gender, civil/marital status, nationality, time and date and geographic location. Civil status includes several levels: single, married, de facto, divorced and widowed, which we reduced to two levels: married (which includes de facto) and single (including the rest). Nationality is determined and recorded by the OIJ agent at the time of identification of the body. Location information such as province, county, district and beach where the drowning death occurred is also registered. In 2001 and 2003, the civil status was not recorded and thus, there are 157 events (17%) without these data. In addition, the 68 (7%) events which occurred in 2002 lack incident location and there are 17 (1.8%) events without nationality.

We calculated descriptive statistics and conducted independent sample *t* tests to assess for demographic differences in age, civil status and gender between nationals and foreigners, stratified by province where the drowning death occurred. In addition, we assessed for time trends in drowning events for nationals and foreigners. We conducted a subanalysis at the beach level for the 24 beaches that accounted for 50% of drowning incidents in the study period, assessing for trends by beach and country of origin.

Cumulative drowning rates per 100,000 visitors for the study period 2001–2019 were estimated using data from Costa Rican Tourism Bureau of overseas visitors entering the country by airport and that spent less than three months in Costa Rica. Following Wilks et al. (Wilks et al. 2003), the rate was calculated by dividing the drowning death events averaged over 2001–2019 by the average number of visitors that entered the country for the same period. Similarly, for nationals, the drowning rate was calculated using the population in Costa Rica over 2001–2019 (Programa Estado de la Nación 2019).

All analyses were conducted using R Studio V4.0.1 (R Core Team 2019). Data used in this study, collected and maintained by OIJ, are publicly available; ethics approval was not required for this study as the analysis of de-identified data previously collected for administrative purposes does not meet the definition of human subjects research by the Universidad Nacional de Costa Rica.

3 Results

From 2001 to 2019, 936 people died from drowning in Costa Rica. While most decedents (62%, $n=580$) were nationals, foreigners (from 36 different countries) comprised a substantial proportion (38%, $n=356$). Males represented the majority of decedents for both

nationals and foreigners, 92 and 86% respectively. Nearly half (45%, $n=264$) of national decedents were aged between 15 and 30 years old, while a much lower percentage (15%, $n=88$) belonged to older ages (45–60 years old). In contrast, for foreigners, the 45–60 age category was most frequent (31%, $n=109$) followed by the 15–30 category (26%, $n=92$). The mean age of national drowned decedents was statistically lower than that of foreigners (Table 1). No statistical age differences were found in between men and women in either the national or foreigner groups (Table 1). For civil status, single decedent mean age was statistically lower than married ones for both nationals and foreigners. Guanacaste exhibited the oldest decedents for both groups, followed by Limon and Puntarenas (Table 1).

Most drowning deaths for nationals and foreigners (70 and 62%, respectively) took place at Puntarenas followed by Guanacaste (18 and 22%) and Limon (12 and 16%). Most of the drowning death events involving nationals occurred during weekends and January and April, while for foreigners, events occurred mainly on Sundays and in March and July (Fig. 2a–b). The annual drowning trend for each province showed different patterns for both nationals and foreigners, especially in Puntarenas and Guanacaste (Fig. 2c). Drowning deaths among nationals decreased from 2001 to 2007 at Puntarenas but increased in Guanacaste during the same period. In contrast, from 2007 to 2013, there was an overall reduction in drowning deaths at both provinces for nationals, followed by an increment of one per year at Guanacaste during 2013–2018 (Fig. 2c).

For foreigners, there was a steady increase in drowning death cases that took place in Guanacaste during 2001–2019 and also at Puntarenas during 2014–2018, where it

Table 1 Descriptive statistics (mean, median, standard deviation) and t-statistics (p value and 95% confidence intervals for the mean age difference) of age separated by gender, nationality, civil status and province

Age difference by			N	Mean age	Median age	Standard deviation	T-Statistics	
							P value	95% Confidence interval of mean difference
Nationality		Nationals	580	31	27	17.5	<0.001	[11.1, 15.7]
		Foreigners	356	45	46	16.6		
Gender	Nationals	Male	532	31	27	16.3	0.23	[− 2.3, 9.2]
		Female	48	28	22.5	19.0		
	Foreigners	Male	306	45	45.5	17.3	0.57	[− 3.9, 7.1]
		Female	50	43	46	18.3		
Civil status	Nationals	Married	153	46	46	12.7	<0.001	[18.2, 23.2]
		Single	334	25	21	13.6		
	Foreigners	Married	147	53	54	13.1	<0.001	[13.2, 20.3]
		Single	145	36	32	17.5		
Province	Puntarenas	Nationals	398	30.0	26	16.5	<0.001	[8.8, 14.3]
		Foreigners	215	41.5	41	16.5		
	Guanacaste	Nationals	107	35.2	32	17.6	<0.001	[13.4, 23.5]
		Foreigners	83	53.6	56	16.6		
	Limon	Nationals	75	31.1	26	16.0	<0.001	[31.0, 43.0]
		Foreigners	58	43.1	44.5	16.8

Fig. 2 **a** Percentage of national and foreigner drowning decedents per day of the week; **b** Percentage of national and foreigner drowning decedents per month; **c** Time series of fatal drowning events separated by province for foreigners (dashed lines) and nationals (solid lines)

shows an increase of approximately three deaths per year resulting in more drowning fatalities involving foreigners by 2018 at this province. In Limón, the trend for fatalities among both nationals and foreigners exhibited an oscillatory pattern for the study period (Fig. 2c).

The majority of drowning deaths for nationals and, at times, for foreigners were concentrated in Puntarenas, especially at beaches located on the central Pacific coast including Jacó, Esterillos West, Hermosa, Bejuco PC and Palo Seco (Fig. 3; see Fig. 1 for map). In Guanacaste, pre-2011 drowning deaths involved mostly nationals while post-2011 events involved mostly foreigners. At the Caribbean coast, drowning fatalities decreased after 2008, especially for foreigners, but started to increase from 2017 for nationals.

During the period 2001–2019 those from the USA constituted the largest proportion of foreign drowning deaths (40%, $n=142$), followed by Europeans (19%, $n=66$; from which one fourth were from Germany), Nicaraguans (16%, $n=57$), Canadians ($n=8\%$, $n=28$) and people coming from other Latin American and Asian countries (8%, $n=29$ and 5%, $n=16$, respectively). The relative proportions of these geographic groups varied for each beach (Fig. 4b). Drowning deaths involving people from the USA primarily occurred on the Central and North Pacific beaches (except for Jacó). Foreigners from Nicaragua constituted the largest percentage of foreign drowning deaths at the beaches of Puntarenas and Caldera (Fig. 4b). As a total, foreigners have a drowning death rate of 1.00 per 100,000 visitors, while Costa Ricans show a death rate of 0.61 per 100,000 inhabitants.

Fig. 3 The 24 beaches that accounted for 50% of drowning deaths (period 2001–2019) separated by province. Beaches are placed in a descending order of number of total drowning deaths (nationals plus foreigners). The size and the color of the marker represent the number of drowning deaths. (PC: Central Pacific coast. PN: North Pacific coast. PS: South Pacific coast. W: West. N: North)

4 Discussion

In this analysis of 936 fatal beach drowning deaths in Costa Rica, we found variability in demographic characteristics and spatiotemporal occurrence between drowning events of nationals and foreigners. Costa Rican drowning fatalities tend to be single male teenagers and young adults, similar to beach drowning trends from the USA and France (Gensini and Ashley 2009; Tellier et al. 2019). Younger men and women are the dominant domestic beach users in Costa Rica and are involved in beach recreation in similar proportions (Aro-zarena et al. 2018). However, males dominated beach drowning statistics for nationals and

Fig. 4 **a** The 24 beaches that accounted for 50% of drowning deaths (period 2001–2019) placed in a descending order of number of total drowning deaths (nationals plus foreigners). (PC: Central Pacific coast. PN: North Pacific coast. PS: South Pacific coast. W: West. N: North). Color indicates the proportion of Costa Rican (white) and Foreigners (black). **b** Percentages of each region of origin per beach (USA: United States of America, CAN: Canada, NIC: Nicaragua, LA: Latin America, EU: Europe, AS: Asia)

foreigners similar to other countries (Gensini and Ashley 2009; Woodward 2015; Tellier et al. 2019; Lawes et al. 2020). This fact has been attributed to the tendency for men, compared to women, to overestimate their own swimming skills, underestimate risk or their own vulnerability, and to increased exposure to water activities (Arozarena et al. 2018; Moran 2011; Willcox-Pidgeon et al. 2018; Woodward 2015; Lawes et al. 2020). Thus, Costa Rican single male teenagers and young adults are a high-risk population at beaches.

In contrast, foreigners who fatally drowned tended to be older than Costa Ricans who died from drowning, especially in Guanacaste where most deaths were 45–60 years old (Table 1). Guanacaste's airport receives an average of 10% more visitors aged 45+ compared to other airports in Costa Rica (Instituto Costarricense de Turismo 2019b), and Guanacaste is a popular spot for relocating foreign retirees (Van Noorloos 2011, 2013).

This suggests that an older foreign population is more predominant in this province which is reflected in its drowning demographic profile. Observations of injuries of US citizens traveling abroad demonstrate that the likelihood of drowning overseas greatly increases with age (Guse et al. 2007) further emphasizing the increased vulnerability of older people.

Our results show that foreigners exhibit more risk of drowning than nationals (drowning rate of 1.00 per 100,000 compared to 0.60), similar with studies at other locations (Guse et al. 2007; Peden et al. 2016; Wilks et al. 2003). This situation is likely related to unfamiliarity with the beach environment and its hazards, health issues related to aging and an aptitude that underestimates threats during holidays (Arozarena et al. 2018; Guse et al. 2007; Wilks 2017).

At a provincial scale, the inter-annual trends in number of drowning incidents over the study period (Fig. 2c) may be largely governed by societal, economic and meteorological factors that dictate beach user preferences, especially on the Pacific Coast. For Costa Ricans, the decreasing trend in drowning in Puntarenas during 2001–2007 accompanied an overall increasing trend in Guanacaste (2001–08), presumably attributed to a change in holiday destinations for domestic tourism as Guanacaste's resorts rapidly developed during that period. Guanacaste's tourist industry and real estate experienced record growth between 2001 and 08 which tripled new construction in the area (Instituto Costarricense de Turismo 2007; Van Noorloos 2013) and increased tourist accommodation by 50%, compared to just 4% in Puntarenas over the same period (Chen Mok 2014). Likewise, the subsequent reduction in domestic drowning deaths over 2009–13 at Guanacaste and Puntarenas might have been a consequence of a reduction in beach visitors. Tourist accommodation occupancy rates fell rapidly from 2011 in these provinces (Instituto Costarricense de Turismo, 2019a; Vindas 2013), despite continued expansion of the tourism industry nationally (Chen Mok 2014; Instituto Costarricense de Turismo 2019a). By 2013, occupancy rates were the lowest of the study period, coinciding with the least number of annual drowning events in Puntarenas and Guanacaste.

Decreased Costa Rican beach visitation from 2009 to 2013 is likely related to an economic crisis during those years which resulted in increased unemployment, cost of living and poverty (Programa Estado de la Nación, 2019). Similarly, but at an international scale, the 2008-global financial crisis likely influenced the deceleration in number of foreigners visiting Costa Rica in the following years (Instituto Costarricense de Turismo 2019a). It is possible that reduction in foreigner drowning deaths at the Pacific Coast observed over the period 2009–13 is due to the impact of both local and global economic downturns, and limited efforts to prevent beach drowning deaths during this time.

Meteorological conditions also affect the number of beachgoers, who in general prefer sunnier and hotter days (Castelle et al. 2019). On the Costa Rican Pacific Coast, these conditions are exacerbated during the onset of the warmer phase of El Niño-Southern Oscillation (ENSO; Instituto Meteorológico Nacional 2020) causing a reduction in rainfall and frequency, and an increase in ambient temperatures along Puntarenas and Guanacaste (Wayle et al. 1996; Waylen and Sadí, 1999). During 2014–16, a drier and hotter climate was triggered by a strong warm ENSO event which produced one of the worst droughts ever registered in the region (Instituto Meteorológico Nacional 2020; La Nación, 2015). These favorable weather conditions (more frequent hot and sunny days) together with rebounding international tourism likely increased beach attendance as reflected by the recovery in hotel occupancy rates over that period (Instituto Costarricense de Turismo 2019a; Programa Estado de la Nación, 2019). Alignment of climatic and economic conditions may be related to the increased fatal drowning numbers in Guanacaste and Puntarenas in those years (Fig. 3c), consistent with observations by Castelle et al. (2019), in

which drowning was more likely to occur on warm sunny days due to increased number of beachgoers.

Beaches in the Central Pacific districts of Jacó and Parrita represent the greatest burden of fatal beach drowning events both for Costa Ricans and foreigners (Fig. 4). Arozarena et al. (Arozarena et al. 2015) ascribed the hazard of these popular beaches to a combination of high beach attendance (nationals prefer these sites due to their proximity to the capital San Jose) (Arozarena et al. 2018), presence of rip currents and not enough lifeguards. Although signage at these sites indicate the main hazards, their effect has been recognized as limited not only in Costa Rica (Arozarena et al. 2018), but worldwide (Brannstrom et al. 2015; Ménard et al. 2018; Wilks 2017).

Future efforts to prevent drowning in Costa Rica should consider demographic trends and differences to effectively prioritize the right population with effective interventions. To foster a beach safety culture among the national population, strategies such as school-based aquatic safety programs or targeted messages for segments of the population, such as young single men, should be considered.

Approaches to prioritize safety among the foreign population require strong collaboration with the tourism industry, especially businesses located close to beaches. Educational programs such as brochures, posters and videos describing beach hazards and promoting safe aquatic behaviors should be tailored for the foreigner and international tourist audience and available at airports, hotels and restaurants (Wilks et al. 2005). In addition, courses in aquatic safety and beach hazards could be provided to people working with international visitors such as hotel managers, tour guides and even the drivers of tourist vehicles.

Principally, a strong national lifeguarding system which guarantees permanent and professional supervision, prevention and rescue services at beaches is required. Importantly, the sustainability and success of any lifeguard system in the country will require support from local, provincial and central government, in addition to that of the tourism industry. Lifeguards can also help in reporting variables (Koon et al. 2020) that the existing drowning database lacks such as the exact time and location where the event occurs. Timestamped and geographic information on incidents allows for a plethora of other data linkage opportunities, including climate and ocean variables (e.g., wind speed, wave height, tide) and the exact cause of the drowning death (e.g., rip currents, high waves). Not only would this information improve understanding of the climatic variables and conditions that increase the likelihood of fatal drowning in Costa Rica but could also potentially lead to prediction and ultimately data-driven prevention of future fatalities.

4.1 Strengths and limitations

This study is the first of its kind to specifically examine variance between foreigners and nationals who have fatally drowned in Costa Rica. A major strength of this study is the detailed death data on which it is based, collated and maintained in a robust system by the Costa Rican government. However, for our specific study domain examining variance in drowning trends between nationals and foreigners, there are some limitations. First, OIJ fatal drowning data are based on the nationality of the decedent, not residency. It is possible that some decedents identified as foreigners were also legal residents of Costa Rica at the time of death, which is a limitation of the recording system. Moreover, ICT visitation data are based on the residence or citizenship, so comparisons and calculated rates using both OIJ and ICT data sources should be noted with caution. Additionally, not all visitors arriving to Costa Rica go to the beach, and the distribution of both national and foreigner

visitors among the different beaches around the country remains unknown. Actual beach visitation data would better approximate exposure and risk and improve the strength of analyses such as this.

5 Conclusions

Clear demographic and geographic differences exist between national and foreigner drowning events in Costa Rica resulting in two distinct at-risk populations: young males and teens (15–30 years old) for nationals and older males (45–60) for foreigners. These insights provide both government and non-government actors responsible for drowning prevention and beach safety an evidence-based foundation to prioritize prevention efforts. Future interventions addressing these at-risk populations should be designed and implemented with consultation from members of these groups and must be evaluated to assess their effectiveness and impact.

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Availability of data and material Available upon request to the corresponding author.

Declarations

Conflict of interest The authors declare no competing financial interests or non-financial interests.

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