BRIEF REPORT

Surf Lifeguard Rescues

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Objective.—This study assessed the utility of lifeguard rescue data for providing information on person and situation factors to inform surf bather drowning prevention research.

Methods.—The dataset comprised 872 beach-days (daily lifeguard reports) obtained from 26 beaches over a 95-day period in Victoria, Australia.

Results.—The rescue rate was 128 per 100,000 in-water bathers. One or more rescues were required on 125 beach-days (14%). Rescue on a beach-day was more likely for offshore wind conditions, relatively high daily air temperatures, and high bather numbers ($P < .05$). Compared to female bathers, males were more frequently rescued (65%) and more likely ($P < .05$) to be from a younger age group (30 years or less), although being older was associated with a relatively poorer condition on rescue.

Conclusions.—Although rescues are proportional to water exposure, frequencies are also influenced by situation and person factors. Bathers at relatively high risk of rescue are hypothesized to be overrepresented in amenable sea and weather conditions, and poor patient condition on rescue may be associated with exposure to a preexisting health condition.

Key words: beaches, rescues, lifeguards, drowning

Introduction

The Australian state of Victoria has a coastline extending some 1230 km, 66% of which comprises 588 ocean beaches.¹ Victorian coastal areas experience warm to hot summers, with Melbourne (capital city, population 3.9 million) having an average daily maximum summer temperature of 26°C.² The state's favorable climate and abundance of attractive coastal swimming locations have resulted in surf bathing being a popular recreational activity for both Victorian residents and visitors. For Victoria's 65 patrolled surf beaches, estimates of beach attendance during patrolled times (from lifesaver counts) totaled more than 2.5 million for the year July 2006 to June 2007.³

While popular, many of Victoria's surf beaches are also hazardous for bathers. An Australian beach hazard rating system assigns a rating from 1 (least hazardous) to 10 (most hazardous).¹ The system accounts for environmental factors, including average wave height and type, water depth variation, and currents to determine a modal

(average) and a prevailing (based on existing sea and weather conditions) rating. Victorian ocean beach hazard modal ratings range from 2 to 10 with a median of 6. Short^{1(p67)} notes beaches with a hazard rating of 6 are characterized by “pronounced changes in depth and current between bars and rips [seaward moving currents], safest bathing is on or behind the [sand] bars during lower waves, hazardous during high waves and high tide.”

Drowning at Victoria's beaches is an identified problem. Eleven coastal drownings were reported in Victoria for the year ending June 30, 2011.⁴ Life Saving Victoria documents that Victorian lifesavers perform more than 750 rescues and resuscitations each year.⁵ Even so, person and situation factors associated with surf bather use of beaches and subsequent drowning events are little understood. This fundamental information is required to direct studies that inform strategies designed to reduce the number of drownings, including the provision of organized bather supervision. One potential source of this information is data collected routinely by lifeguards on beach visitations and rescues.

Data from lifesaver reports have identified plausible drowning risk factors for surf beach bathing. These are

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being male, aged 15 to 24 years, using alcohol before bathing, and having preexisting disease.⁶ However, the quality and reliability of lifesaver data collection may be compromised by missing information due to other priorities necessitated by visitor health and safety.^{7,8} Previous studies provide important descriptive information on person factors and data accuracy but do not provide a full assessment of person and situation factors associated with rescue events.

Life Saving Victoria collates a comprehensive data set associated with surf beach supervision. The data are collected by professional lifeguards (employed lifesavers) each summer season. Using a standard form, lifeguards report daily beach and weather conditions, beach attendance, lifeguard activity plus situation, and person factors for persons rescued. The study aim was to assess the conditions in which rescues were performed and the association of person-factors on beaches in Victoria to improve bather safety.

Methods

Daily professional (paid) lifeguard reports held by Surf Life Saving Victoria for 95 calendar days over the period November 18, 2002, to March 1, 2003, inclusive ($n = 872$ beach report days) comprised the dataset. These reports were obtained from 26 lifeguard patrolled surf beaches situated along Victoria's coastline. Over the calendar period, daily reports for 23 or more beaches were available on 25 days. Seven or fewer reports were available for the remaining 70 days. A daily lifeguard report was not available where a beach was unpatrolled or stationed by volunteer (unpaid) lifesavers. Professional lifeguards were employed mostly on week days over school holidays. Daily reports completed by volunteer lifesaver teams were not included after Surf Life Saving advice that these data were often incomplete or lacked accuracy. The data coverage and other limitations are discussed later. The study was approved by the Monash University Standing Committee on Ethics in Research Involving Humans (Project 2001/431).

Recorded variables as listed on report forms were entered by a research assistant into a database with accuracy checked by the first author. Variables recorded for each beach-day were as follows: beach name; date; day; number of lifeguards employed; tide times; wind direction and strength (nil, slight, moderate, strong); air temperature maximum (10°C; 15°C; 20°C; 25°C; 30°C; 35°C; 35°C or more); sea conditions (flat, rolling, choppy); wave height (0.5 m–1.0 m; 1.0–1.5 m; 1.5–2.0 m; 2.0–2.5 m; 2.5–3.0 m; 3.0 m+); total number of persons on beach and in water each day (sum of counts taken at 10:00 AM, 12:00 PM, 3:00 PM, and 6:00 PM); and lifeguard

activity (number of rescues, preventive actions [for potential aquatic injury], first aid, lost children, and resuscitations).

For rescue events, variables recorded were age grouping in years (0–5, 6–10, 11–15, 16–20, 21–30, 31–40, 41–60, 60+); sex; distance from shore in meters (<50 m, 50–99 m, 100–149 m, and ≥ 150 m); position with respect to the supervised zones (between flags—the closely supervised area, patrolled area, unpatrolled area); time of day; patient condition (recorded subjectively as good, average, or poor); and nationality. A variable for prevailing beach hazard rating following Short^{1(p65–68)} was calculated from the assigned modal beach rating adjusted for wind strength, wind direction, and wave height reported that day by lifeguards. This variable was added to the dataset.

DATA ANALYSIS

Data are reported in case counts, medians, and percentages. Rates are reported for rescues, preventative actions, and resuscitations per 100,000 persons in the water, and for lost children and first aid per 100,000 total beach visitors. Statistical tests were determined based on the nature of data distributions. Alpha level was set at $P < .05$ with 2-tailed tests. Beach-days ($n = 872$) were grouped by rescue or no rescue to test for association with situation factors. Rescue events were grouped by sex and age to test for associations with person and situation factors. Pearson χ^2 statistic was tested for associations between categorical variables with effect size estimated by Cramer's v . Variable categories with small sample sizes were combined or Fisher's exact tests were applied to obtain statistically meaningful results. Mann-Whitney U test assessed group differences on continuous variables, with the effect size estimate r calculated manually. The Spearman (r_s) correlation was tested for associations where both variables had continuous distributions.

Further analysis of the data was considered for this study using logistic regression to determine predictors of rescue days controlling for water exposure. However, the limitations in data validity (internal and external), missing data, violation of the statistical assumption of linearity in the logit (for the predictor variable "prevailing beach hazard rating"), poor model fit based on analysis of standardized residuals, and collinearity indicated by the condition indexes reduced substantially the opportunity to obtain meaningful results beyond those reported here. A study overcoming these limitations would be a useful future endeavor.

Results

A total of 406 rescues occurred over 37 calendar days (39% of total). No rescues were recorded at any beach on 58 calendar days (61%). For rescue calendar days only, the rescue frequency (persons per beach) distribution mean was 3.2 (SD 4.2), median 2, and mode 1. The most frequent number rescued for a single day was 67 persons on December 30, 2002, across 9 beaches. The most rescues performed at a single beach on a single day was Woolamai with 28 persons (December 30, 2002), followed by Portsea with 27 persons (January 17, 2003). Rates for preventative actions (26,472), rescues, and resuscitations (3) were 8346.6, 128.0, and 1.0 per 100,000 in-water bathers, respectively. First aid and lost children rates were 39.7 and 14.4 per 100,000 total beach visitors, respectively. From data reported by Morgan et al.,⁹ 3 surf bather drowning deaths were recorded in Victoria during the 95-day reporting period.

Data were analyzed by beach-days (with each beach for each day being the unit of analysis) grouped according to whether rescues were recorded. Over the study period, 1 or more rescues was recorded on 125 beach-days (14%), and no rescues recorded on 747 beach-days (86%). Table 1 lists situational variables associated with this grouping. Rescue on a beach-day was more likely to occur (although by weak association) with offshore wind direction and relatively high daily maximum temperature. No association was found between rescue on a beach-day and wind speed, wave type, or wave height. Rescue occurring on a beach-day was positively associated with total persons on the beach, total persons in water, preventative actions, and number of lifeguards on duty. Rescue on a beach-day was not associated with first aid, lost children, and the prevailing beach hazard rating.

Situation and person data were recorded for 361 of the 406 rescue events (89%). Males comprised 232 rescues (65%) and females, 123 (35%); sex was not recorded for 6 rescues. For rescue events, no association was found between sex and age grouping, distance out, position, time of day, sea conditions, or nationality (Table 2). Age group (recoded as 0–10 years, 11–20 years, 21–30 years, and >30 years) was associated positively with distance out ($r_s = 0.14$, $P = .01$). The frequency of older age groups being rescued in a patrolled area was less than expected by chance (Fisher's exact test, $P < .01$, $\nu = .23$). Being in an older age group was associated with average or poor patient condition on rescue (Fisher's exact test, $P < .01$, $\nu = 0.25$). Age group was not associated with time of rescue ($\chi^2 [9, n = 314] = 6.9$, $P = .65$, $\nu = .09$) or nationality (Fisher's exact test, $P = .05$, $\nu = .17$). Assessing the discrete influence of tide on rescues proved problematic as this variable is not fixed in

time or across location and accurate exposure data were not available. Over the study period, 173 rescues (56.4%) were recorded within 3 hours of low tide and 134 (43.6%) were recorded within 3 hours of high tide.

Discussion

The analysis of data from Victorian lifeguard report forms suggests that rescues are associated with factors related to water exposure, environmental conditions, and persons. Rescue days (as opposed to nonrescue days) were more likely in higher temperatures and for high beach attendance, high water attendance, and high numbers of preventative actions (toward bathers). This finding suggests the logical conclusion that rescues occur proportionally to the number of people in the water, given the influences from other factors remain equal. Other factors presumably influence the risk of rescue given that first aid and lost children variables would also be expected to be associated with beach attendance but were not associated in this study with rescue days.

A link between rescues and sea conditions is difficult to justify from the data. December 30, 2002, for example, sustained the most rescues on a single day, yet this day ranked sixth highest in median day beach attendance and had a below average wave height. Other variables related to conditions such as wind speed or hazard rating had no association with rescue days, although for the latter case beach attendance may act as a confounder given many of Victoria's most popular beaches have relatively high modal hazard ratings. Where rescue details were recorded, most were male and aged from 11 to 20 years (inclusive). Sex and age may be associated with rescues, although this conclusion cannot be confirmed in the absence of corresponding water exposure data. Bathing in older age groups may have engaged in behavior placing them at relatively greater risk of rescue, given they were more likely to be farther from shore and outside a patrolled area.

A 2008 Australian study found that compared to female surf bathers, male surf bathers drowned more frequently (male to female ratio of 6.1:1).⁹ Hypothesized risk factors for surf bather drowning were being an international tourist, preexisting cardiovascular disease, and being exposed to rip (seaward moving) currents. The drowning hazard presented by rip currents is proportional to wave size.¹ Wave size should therefore be statistically associated with rescues. Finding no association between rescues and wave height in the present study suggests that bathers at higher risk of rescue may have relatively more frequent water exposure when environmental conditions conducive to bathing are operating (eg, offshore winds and high temperatures). Poor patient outcomes found among older rescued bathers in this study

Table 1. Association of situation factors with rescues for 872 beach-days along the Victorian coast, summer season 2002 to 2003

	<i>Rescues required on beach-day (n = 125)</i>		<i>No rescue required on beach-day (n = 747)</i>		<i>Test statistic</i>
	<i>Case count</i>	<i>%</i>	<i>Case count</i>	<i>%</i>	
Wind direction					
Off shore (NW, N, NE)	35	32.7	111	16.8	χ^2 (2, $n = 768$) = 15.54, ^a $\nu = 0.14$
Cross shore (E, W)	16	15.0	104	15.7	
On shore (SW, S, SE)	56 ^b	52.3	446 ^b	67.5	
Totals	107	100	661	100	
Wind speed					
Slight	55	48.7	304	43.8	$U = 42597.0$ $r = -0.06$
Moderate	51 ^b	45.1	292 ^b	41.1	
Strong	7	6.2	98	14.1	
Totals	113	100	694	100	
Temperature, °C					
≤15	5	4.6	80	11.8	$U = 28770.5^a$ $r = -0.14$
20	31	28.4	249	36.8	
25	38 ^b	34.9	226 ^b	33.4	
30	24	22.0	85	12.6	
≥35	11	10.1	36	5.3	
Totals	109	100	676	100	
Sea conditions					
Flat	13	11.4	118	17.1	χ^2 (2, $n = 804$) = 4.67, $\nu = 0.08$
Rolling	68 ^b	59.6	340 ^b	49.3	
Choppy	33	28.9	232	33.6	
Totals	114	100	690	100	
Wave height					
0.5–1.0	71 ^b	63.4	460 ^b	69.6	$U = 34456.5$ $r = -0.05$
1.0–1.5	30	26.8	160	24.2	
≥1.5–2.0	11	9.8	41	6.2	
Totals	112	100	661	100	
	<i>Case count</i>	<i>Median</i>	<i>Case count</i>	<i>Median</i>	<i>Test statistic</i>
Person estimates					
On the beach	108	700.0	628	365.0	$U = 21968.0^a$ $r = -0.22$
In the water	104	365.0	591	192.5	
Preventative actions	118	30.0	569	15	$U = 21952.5^a$ $r = -0.18$
First aid	56	1	157	1	
Lost children	15	1	53	1	$U = 20452.0^a$ $r = -0.26$
Lifeguards on duty	125	2	742	2	
Prevailing hazard rating	109	5	645	5	$U = 4174.5$ $r = -0.04$
					$U = 353.5$ $r = -0.09$
					$U = 38457.0^a$ $r = -0.12$
					$U = 35111.0$ $r < -0.01$

Note: Case count totals and sample size differences due to unrecorded data.

^a Significant at $P < .001$.

^b Median of distribution; total % errors due to rounding.

Table 2. Association of person and situation factors with sex in rescue events ($n = 361$) occurring over 872 patrol days for the Victorian coast, summer season 2002–2003

	Male		Female		Totals		Test statistic
	Case count	%	Case count	%	Case count	%	
Age group, years							
0–5	0	0.0	1	0.9	1	0.3	$U = 11,959.5$ $r = -0.07$
6–10	42	18.9	28	23.9	70	20.6	
11–15	55	24.8	29	24.8	84	24.8	
16–20	60 ^a	27.0	28 ^a	23.9	88 ^a	26.0	
21–30	39	17.6	20	17.1	59	17.4	
31–40	13	5.9	8	6.8	21	6.2	
41–60	11	5.0	2	1.7	13	3.8	
60+	2	0.9	1	0.9	3	0.9	
Total	222	100.0	117	100.0	339	100.0	
Distance out, meters							
<50	67	28.9	42	34.7	109	30.9	$U = 13803.5$ $r = -0.01$
50–99	78 ^a	33.6	32 ^a	26.4	110 ^a	31.2	
100–149	58	25.0	28	23.1	86	24.4	
≥150	29	12.5	19	15.7	48	13.6	
Total	232	100.0	121	100.0	353	100.0	
Position							
Between flags	23	10.3	8	7.0	31	9.2	$\chi^2 (2, n = 338)$ $= 1.98, \nu = 0.08$
Patrolled area	153 ^a	68.6	87 ^a	75.7	240 ^a	71.0	
Unpatrolled area	47	21.1	20	17.4	67	19.8	
Total	223	100.0	115	100.0	338	100.0	
Time of day							
10:00 AM–11.59 AM	36	16.7	23	20.5	59	18.0	$\chi^2 (3, n = 328)$ $= 4.31, \nu = 0.12$
12:00 PM–1.59 PM	59	27.3	21	18.8	80	24.4	
2:00 PM–3.59 PM	79 ^a	36.6	39 ^a	34.8	118 ^a	36.0	
4:00 PM–5.59 PM ^b	33	15.3	29	25.9	62	18.9	
6:00 PM–7.59 PM ^b	9	4.2	0	0.0	9	2.7	
Total	216	100.0	112	100.0	328	100.0	
Patient condition							
Good	118 ^a	57.6	67 ^a	61.5	185 ^a	58.9	$U = 10,814.0$ $r = -0.03$
Average	70	34.1	32	29.4	102	32.5	
Poor	17	8.3	10	9.2	27	8.6	
Total	205	100.0	109	100.0	314	100.0	
Nationality							
Australian	139 ^a	88.5	89 ^a	94.7	228 ^a	90.8	$\chi^2 (1, n = 251)$ $= 2.67, \nu = 0.10$
Other	18	11.5	5	5.3	23	9.2	
Total	157	100.0	94	100.0	251	100.0	

^a Median of distribution; total % errors due to rounding.^b These two groups combined for χ^2 analysis; case count total and sample size differences due to data not being recorded.

may have resulted from preexisting health conditions. Further study is warranted on exposure to these and other risk factors to determine respective risk contributions.

STUDY LIMITATIONS

The value of this study (in regard to informing surf bather drowning investigation) rests on the untested assumption that factors associated with rescue events fol-

low a similar association with drowning events. From consultation with subject matter experts, it has been reported that in the absence of life saving services, 5% of rescues and 1% of preventive actions would result in drowning deaths.¹⁰ It follows that circumstances leading to rescues in many instances may differ from those associated with drowning. For example, a bather in a supervised zone may have spent longer in the water or ventured farther from shore, aware that potential rescue

was available. Alternatively, a recorded rescue may have been a preventative action on the part of a lifeguard where, given other circumstances, the bather may have been able to return to shore unaided. Caution is therefore warranted in assuming that factors associated with rescue events are also associated with drowning events.

Other limitations reduced the strength of conclusions or generalizability. Firstly, the study only considered bathers at patrol zones or patrolled beaches, within or close to patrolled areas. Bather populations outside patrolled areas may have different water exposure patterns or person characteristics, such as swimming ability or surf experience. Secondly, data were gathered only on days staffed by professional lifeguards (mostly weekdays). Bathers using the beach on other days may similarly have different patterns of exposure or person characteristics. The third limitation arose from recording data across multiple beaches on the same day. This procedure may have overrepresented the influence of some variables (eg, temperature) within the data. A fourth limitation concerned possible data inaccuracies or errors. For example, recorded variables such as wind speed or wave height may change over the course of a day. Also, reported rates may have been artificially lowered when the same person was included twice or more in a summed day count.⁸ Moreover, the data quality was not assessed independently.

A study conducted on Australian beaches found that paid and trained data collectors reported lower percentages of missing data compared to recordings by safety professional (ie, lifesavers) for all collected variables except air temperature, wave height, and age of rescued person.⁷ For both recording groups, variables associated with rescues were characterized by relatively high proportions of missing data. This was more than 20% for age group, language, swimming ability (self-rated or rated by the data collector), and drug or alcohol involvement; and more than 50% for year of age, resident postal code, and first aid used. Comparable measures reported in the present study, collected by Victorian professional lifeguards, had for the most part lower proportions of missing data (variables associated statistically with rescue days or rescue events ranged from 76% to 99% complete).

Conclusions

The results from the analysis of lifeguard rescue reports indicate factors warranting further consideration in the context of surf bather drowning. These are comparable water exposure to bathing locations (eg, distance out, bathing at unpatrolled beaches) and other factors associated with persons and sea conditions. Future analytical studies on surf bather drowning should consider these factors and assess the validity of rescue events as a drowning proxy measure.

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