WILDERNESS & ENVIRONMENTAL MEDICINE, **27,** 10–18 (2016)

ORIGINAL RESEARCH

Injuries and Fatalities on Sailboats in the United States 2000–2011: An Analysis of US Coast Guard Data

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Background.—Prior sailing injury studies have been small, focused investigations. This large, population-based study examined the mechanisms and factors contributing to sailboat-related injuries and deaths.

Methods.—A retrospective data analysis of the Boating Accident Report Database compiled by the US Coast Guard between 2000 and 2011 was performed. The database was analyzed looking at frequency of events. For each subgroup, proportions were determined and 95% CIs were calculated. These data, used in conjunction with the 2011 US Coast Guard National Recreational Boating Survey, were used to estimate a fatality rate.

Results.—Two hundred seventy-one sailing-related fatalities and 841 injuries were reported. A fatality rate was calculated at 1.19 deaths per million sailing person-days. Weather or hazardous waters were listed as primary contributing factors in 28.0% (95% CI, 22.7–33.4) of deaths; 70.1% (95% CI, 64.7–75.6) of deaths occurred after falling overboard or capsizing. Drowning was the most common cause of death (73.1%; 95% CI, 67.8–78.4), and 81.6% of victims were not wearing a life jacket. Alcohol intoxication contributed to 12.2% (95% CI, 8.3–16.1) of deaths. Operator- or passenger-preventable factors contributed to 52.7% (95% CI, 49.3–56.1) of all injuries; 51.6% (95% CI, 46.1–57.1) of injuries on nonmotorized sailboats were the result of capsizing, and 46.4% (95% CI, 42.1–50.7) of all injuries on motorized sailboats were the result of collisions or grounding.

Conclusions.—The calculated fatality rate is similar to that of alpine skiing. Falls overboard and capsizing were the most common fatal accidents. Operator inattention, inexperience, and alcohol use were common preventable factors contributing to fatal and nonfatal injury.

Key words: drowning, alcohol, sailing, injuries, dinghies, life jacket

Introduction

Sailing has existed as a means of transportation for thousands of years and emerged as a recreational activity in Europe in the 18th century. The sport of yacht racing was first formalized in 1851 when the schooner *America* beat the *Aurora* in a race around the Isle of Wight in what has since become the America's Cup, the oldest major international sporting event in the world.[1]

Sailboats vary in size and complexity, from 2.3-m 1-person Optimist dinghies to America's Cup catamarans powered by 40-m-tall rigid sails capable of speeds in excess of 65 km/h. Most sailboats less than 6 m in length use the crew's weight to maintain stability, are easily capsized, and are not equipped with a motor, whereas most sailboats greater than 6 m in length are equipped with an auxiliary engine, are dependent on a weighted keel for ballast, and are less easily overturned. Federal law requires that all motorized sailboats be registered; however, the registration requirements for nonmotorized sailboats vary among states, and many nonmotorized sailboats are not registered.[2]

Modern-day sailing encompasses a broad spectrum of activities ranging from day-sailing a small boat on a lake, cruising a sleep-aboard catamaran along the coast, to racing a 21-m keelboat around the world. The US Coast Guard (USCG) estimated that there were 16.9 million sailing person-days in US waters in 2011, and that 3.7% of US households owned a sailboat.[3,4]

The majority of prior sailing-injury studies have a small sample and focus on a particular sailboat race, a specific

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type of sailboat, or an instructional program. These studies have found that injury rates in sailing are low in relation to those of other sports, and that the most common injuries are minor contusions, abrasions, overuse injuries, and lacerations.[5–8] Among novice dinghy sailors, the incidence of injury was found to be 0.29/1000 hours of sailing, with abrasions and contusions accounting for 72.0% of those injuries.[8] A study of the 2003 America's Cup found an injury rate of 2.2/1000 hours of sailing, which is significantly lower than that of contact team sports,[9] such as NCAA Division 1 US football (34.8/1000 games).[10] Sailing was found to be among the safest sports in the 2008 Olympics,[11] and of the 380 sailors participating in the 2012 Olympics, only 1.0% sustained an injury resulting in the loss of a day or more of training or competition. Comparative injury rates in the London Games were 15.3% for soccer, and 10.0% for the triathalon.[12]

Despite the fact that most sailing injury studies have found relatively low rates of injury, the recent spate of sailing tragedies in the America's Cup, Chicago-Mackinac, Farallon Island, and Newport-Ensenada races, serves as a stark reminder that severe injuries and deaths can and do occur.[13–15] High winds, slippery, unstable decks, and heavily loaded equipment can create hazardous conditions. Falls overboard, particularly when sailing offshore, carry a high risk of drowning. There are also many well-documented cases of fatal head injuries caused by impact with the boom.[16]

Although in-depth retrospective analyses of individual sailing disasters have been undertaken, no large population-based studies have systematically reviewed sailing casualties over time. The aim of this study is to examine the mechanisms and contributing factors leading to fatal and nonfatal sailboat-related injuries occurring in US waters between 2000 and 2011 using the Boating Accident Report Database (BARD) compiled by the USCG. Furthermore, we sought to calculate a fatality rate based on annual sailor exposure data from the USCG 2011 National Recreational Boating Survey (NRBS).[3] Analysis of these data will help identify recurrent patterns of injury that may be useful when developing evidence-based injury prevention strategies.

Methods

This is a retrospective analysis of boating incident data collected by the USCG. Under federal regulation, the operator of any recreational vessel is required to file a Boating Accident Report (BAR) "when as a result of an occurrence that involves a vessel or its equipment" a person on board dies, disappears from the vessel (under circumstances indicating death), or has an injury requiring more than first aid, or when there is more than $2000 of damage to the vessel.[4] These reports are collected by state agencies and forwarded to USCG headquarters in Washington, DC, where they are manually entered into the BARD. In an attempt to make sure all boating fatalities are included in the BARD, the USCG continuously monitors news media sources for stories relating to boating fatalities and notifies state boating management officials of any fatal accidents occurring in their jurisdiction for which a report has not been received. All boating fatalities are investigated by state boating authorities or the USCG, and that information is entered into the BARD. During the years 2007 to 2011 for which data are available, an average of 0.7% of fatalities and 2% of all injuries (among all boat types) were discovered by the USCG via media scrutiny.[2,4,17–19]

Boating accident reports are not required if a person died of natural causes while on board or died or was injured while swimming from a vessel that was docked or moored, or if the vessel was being used as a platform for other activities, such as scuba diving, in which the vessel did not directly contribute to injury or death. It should be noted that not all boating accidents resulted in injury or death.

The BAR form is divided into 13 sections that contain check box responses to most queries. A copy of the form can be found at http://www.uscg.mil/forms/cg/CG_3865.pdf.

The BARD is managed by personnel at the Boating Safety Division of the USCG in Washington, DC, who provided the study investigators with customized, deidentified tables containing aggregate data regarding all reported accidents, injuries, and fatalities occurring on sailing vessels from 2000 to 2011. The USCG categorizes sailing vessels into 2 types: auxiliary sail, meaning they are equipped with a motor (motorized), or sail only, indicating they have no motor (nonmotorized).

Composite data were provided to investigators for the following fields:

- Accident mechanism: capsizing, falls overboard, collisions, grounding, sinking, and fires. The BAR allows up to 3 types of accidents to be listed in order of occurrence. For example, if a collision caused a vessel to capsize, collision would be listed as the primary accident mechanism. Unless otherwise specified, investigators were given access to data regarding primary accident mechanism.
- Contributing factors such as operator inexperience, weather (defined as stormy or windy conditions usually connoting rough or high seas and dangerous operating conditions), hazardous waters (defined as rapid tidal flow or currents resulting in hazardous