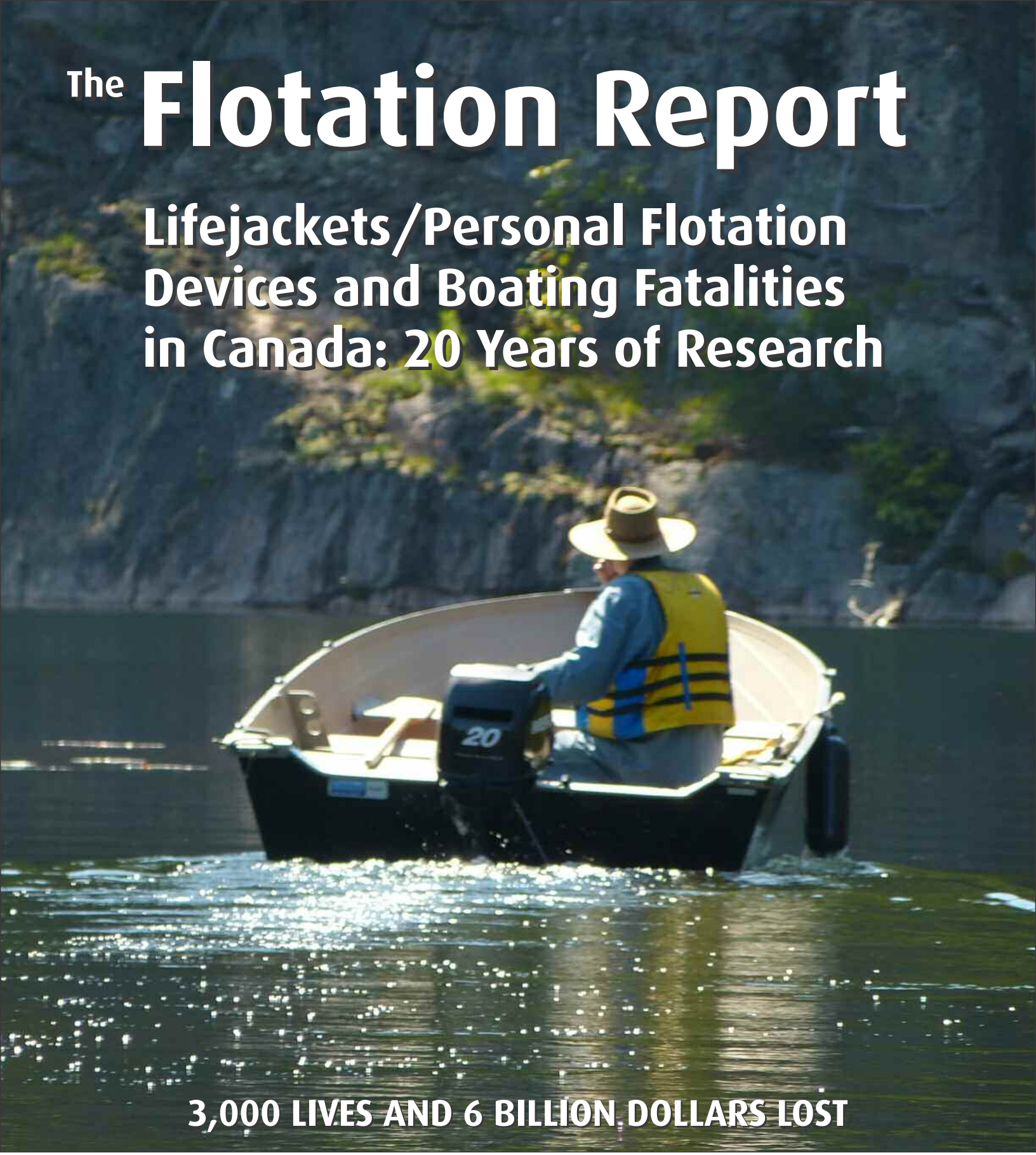
The Flotation Report

Lifejackets/Personal Flotation Devices and Boating Fatalities in Canada: 20 Years of Research



3,000 LIVES AND 6 BILLION DOLLARS LOST

CANADIAN RED CROSS

THE COOK-REES MEMORIAL FUND

For Water Search And Safety

This research is dedicated to the 3,324 people who died while boating in Canada during 1991-2010, and to the families and friends they left behind. May the evidence of the circumstances of these deaths be a guide to safety for those who venture onto Canadian waterways for recreation, daily life, or work, and for decision-makers and professionals with a duty to protect the vulnerable.

Inuit hunters in typical open powerboats – freighter canoes – hunt narwhal after a pod was spotted entering the bay near Clyde River, Nunavut 2015. Cold survival gear and life rafts would be advisable. (From "Opening the Canadian Arctic". By Leyland Cecco in Iqaluit, Canada, for Al Jazeera America. Published 6 December, 2015 at: http://byers.typepad.com/arctic/)

A special dedication to the more than 400 Indigenous persons – men, women, youth, and children – who perished from immersion during 1991 to 2010, accounting for 20% of victims of known ethnicity and at least 15% of all victims. Cultures, boats and equipment, activities, and environments where Indigenous peoples live and travel on water and ice are challenging, and changing rapidly. May communities and professionals collaborate to avert future deaths by inspirational work on culture-specific boating and ice safety measures, such as PFDs, boats, life rafts, cold survival gear, communications equipment, and safety promotion.

Small boat, transported by sled, used to retrieve seals shot, and floating due to blubber. Taloyoak, Nunavut, 1988-1990.
(From: People of the Arctic, Unit 2, Food Sources, Inuit Food, John Tyman, Tyman, John. "Inuit: People of the Arctic," Bill Hillman's EduTech Research Project, at Brandon University, Canada, 2008. © Pitt Rivers Museum, University of Oxford.)

The Flotation Report – Lifejackets/Personal Flotation Devices and Boating Fatalities in Canada: 20 Years of Research

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Peter Barss, MD ScD MPH FRCPC, was responsible for planning, directing, and coordinating the research, editing and finalising the written report, as well as coordinating design, including photos. Karlyn Olsen, MPH Epidemiology, and Jane Hamilton, MSc Epidemiology, did data analysis and data management including quality control. Karlyn Olsen prepared figures and tables, did the final regression analyses, and wrote an initial draft of the report. Clara Reinhardt coordinated production of the report, under the direction of Shelley Dalke.

Data collectors during 1991-2010 included provincial and territorial volunteers and staff of the Canadian Red Cross and the Lifesaving Society. Data collection was made possible through the assistance and co-operation of provincial and territorial coroners and medical examiners, their statistical staff, and the National Association of Coroners. Financing of that work was done collaboratively by sharing resources and staff. Data collection predominantly involved the Canadian Red Cross, the Lifesaving Society, provincial/territorial coroners or medical examiners and police.

Data management was supported during 1991-2010 by the Canadian Red Cross and in earlier years by the Lifesaving Society. Isabelle Masson and Sophie Lapointe made important contributions to data management, data verification, and research during 1991-2004. Former Red Cross managers who advanced the water-related injuries surveillance system included Cindy Lyon of British Columbia, Dawn Stegan of Nova Scotia, Caroline Gagnon of Quebec, and Rosemary Hong of Ontario.

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Further information on Red Cross water-related injury surveillance and research: www.redcross.ca/training-and-certification/swimming-and-water-safety-tips-and-resources/drowning-research. ***Contact persons:*** shelley.dalke@redcross.ca, clara.reinhardt@redcross.ca, or peter.barss@gmail.com

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TABLE OF CONTENTS

TABLE OF CONTENTS

Boating accounts for more than one-third of immersion/drowning deaths in Canada, and has been the most frequent activity among 10,000 immersion/drowning deaths during the past two decades. Most boating deaths involve recreational activities.

The most frequent risk factor for boating deaths has been non-wearing of flotation, mainly personal flotation devices (PFDs). Only in 12% of deaths was a flotation device reported to have been worn properly by the victim, while in 24% to possibly more than 50% a PFD was not present. Absence of PFDs represented violation of current regulations requiring PFDs in the boat, even if wearing is not required. As many as 80% of Indigenous boaters may have had no PFD present.

Capsizing, falling overboard, and swamping were the most frequent boating incidents, associated with more than 75% of immersion deaths. Only 4% of persons who fell overboard were wearing a PFD. The vast majority (88%) of victims were males 15 to 74 years of age. Wearing was three times lower among adults and children five years and older who were weak or non-swimmers, four times lower among persons 15 years and older with alcohol above the federal limit, and five times lower among Indigenous people. Boating experience was not protective. Among the small numbers of child victims, nearly half were Indigenous. Incidents involving Indigenous people more frequently claimed multiple victims, including women and children. Small open fishing boats and canoes were most frequently involved in fatal incidents; however, non-wearing of PFDs was high for all types and sizes of boats, both powered and non-powered. Environmental factors such as cold water, wind, and waves were common.

By far the most effective boating safety intervention internationally has been legislation mandating PFD wearing, coupled with effective enforcement. Key target groups for PFD wearing and other boating safety interventions include youth and adult males, Indigenous children, weak and non-swimmers, and boaters who use alcohol. Swimming and water safety instruction including PFD wearing in boats is a key element of boating safety.

Male youth and adults are the primary risk group for boating immersion and merit regulations for mandatory wearing. This type of PFD is good for quiet activities such as fishing from a boat. (Photo: Jean Louis Martin)

SUMMARY FOR DECISION MAKERS

INTRODUCTION Boating is the activity most frequently associated with water-related immersion and trauma deaths in Canada. The most frequent factor associated with immersion/drowning deaths during the past two decades has been non-wearing of flotation such as personal flotation devices (PFDs). This report reviews 20 years of data on water-related injury deaths in Canada with a special interest in use of flotation.

METHODS Data from the Canadian Surveillance System for Water-related Fatalities were analysed for 1991-2010. The source was annual collection of provincial and territorial coroner and medical examiner data by a 15-page structured questionnaire, conducted by volunteers and staff of the Red Cross and Lifesaving Societies. Analysis focused on activity, purpose, and personal, equipment, and environment risk factors, as well as trends.

RESULTS (A) FROM RED CROSS SURVEILLANCE AND RESEARCH There were 10,511 water-related deaths, 9,961 from immersion including drowning and hypothermia, 513 from traumatic injury, and 37 from other types of injury. Excluding land and air transport immersions, 37% of fatal immersions involved boating. 86% of the 3,324 boating deaths involved recreational or daily life activities, 11% occupational, and the remainder other/unknown. Capsizing, falling overboard, and swamping were the most frequent incidents, associated with more than 75% of boating deaths.

Only in 12% of deaths was a flotation device reportedly worn properly by the victim, in 3% improperly worn, and in 21% present but not worn. In 24% a PFD was not present, in 20% not worn and unknown if present, and in 19% unknown whether present or worn. Hence in many deaths – possibly 50% or more – a PFD was not present. Non-presence violates current regulations requiring PFDs in the boat, even if wearing is not mandatory. For Indigenous victims, at least 39% of boats were in violation, with no PFDs present or known to be present. The true number of boats in violation is likely closer to 80% as presence was unknown for another 44%. Powerboats accounted for about two-thirds of deaths and unpowered one-third, with small open powerboats and canoes most frequently involved, followed by large powerboats. Low wearing of flotation among immersion victims was observed for nearly all categories of activities, incidents, boaters, and boats, with some variability. Only 4% of persons who fell overboard were wearing a PFD.

The vast majority (88%) of boating immersion victims were males 15 to 74 years of age, while women and children were uncommon victims. Wearing was 20% among victims 15 and older with zero blood alcohol, and 5% for those with alcohol above the federal limit of 80 mg%. For persons 5 years and older, among non-swimmers wearing was 4% and for weak swimmers 9%. In the rare cases where level of experience was reported, experienced boaters had lower wearing of 15% than inexperienced at 23%. Among Indigenous persons, wearing was 3% and for other ethnicities 15%. As for type of boat, wearing was 10% for powerboats and 16% for unpowered. 42% of Indigenous victims died in incidents with more than one victim, compared with 26% for other ethnicities. Women and children were more frequently victims of multiple-victim incidents than were men, who more often boat alone. In incidents with victims and survivors, 11% of victims swam for shore immediately, compared with 27% of survivors. As for completeness of reporting of PFD wearing among victims, this was highest in New Brunswick, Quebec, Alberta, and Newfoundland, and lowest in British Columbia and Ontario. As for trends, there was no change during 1991 to 2010 in the proportion of wearing among victims; however, there was an increase in compliance with current regulations requiring a PFD in the boat (whether worn or not), from 19% to 25%. Unknowns decreased from 23% to 11%, presumably due to improved reporting by police and coroners.

Among children 0-14 years old, 43% of boating victims of known ethnicity were Indigenous. Of those, none was wearing a PFD, while for other ethnicities 33% were. 63% of Indigenous child victims were in boats in violation of current regulations, i.e., no flotation devices present, compared with 21% for other ethnicities. Among youth 15-19 years of age, 23% of victims of known ethnicity were Indigenous. None of the Indigenous youth was wearing a PFD, compared with 13% for other ethnicities.

SUMMARY

Remarkably, only 6% of weak and non-swimmers 5 years and older were wearing a PFD. Between 36% and 61% of the boats involved were in violation of regulations with no PFD(s) aboard. 43% died in capsizes and 31% falling overboard, likely with little or no chance to retrieve a PFD even if one had been present, let alone at hand. Most such incidents involved small open boats and canoes. Perhaps the most surprising, important, and not necessarily intuitive regression finding is that non-swimmers and weak swimmers were significantly less likely to have worn a PFD than average or strong swimmers.

The small proportion of victims who died wearing a PFD were assessed. Most incidents involved capsizing or swamping, with few involving falling overboard or alcohol. Various cold factors were frequent, including extremely cold water, cold month, and reported hypothermia. Hypothermia garments, in addition to flotation, could have been helpful in many of these and other incidents.

As for trauma deaths, the most frequently involved boats were personal watercraft (PWC), followed by large and small powerboats, and unpowered. 41% involved head injuries, 10% spinal, and 25% major lacerations. While 24% of trauma victims were wearing a PFD, other preventive measures would have been advisable, such as helmets, energy absorbing padded cockpits and safety belts to prevent head and spinal injuries, and propeller guards to prevent major lacerations. Trauma deaths were proportionally most frequent in Ontario, followed by British Columbia. PFD wearing for occupational boating immersion deaths was 11%. The proportion of boats in violation of current regulations with no PFD(s) present was in the range of 9 to 64%, with many unknowns. The majority of vessels involved were fishing commercially. 31% of deaths occurred by capsizing, 27% by falling overboard, and 25% by swamping. Only 5% who died falling overboard were wearing a PFD, and 9% in capsizes. At least 55% of deaths involved very cold water less than 10°C. Most occupational deaths occurred in Nova Scotia, British Columbia, and Newfoundland/Labrador.

For rescue work and high speed sport using a PWC, a helmet is suggested. Specialised PWC helmets reduce forces on the neck if immersion occurs. (Photo: https://boatinginstructornetwork.wikispaces.com/Personal+Watercraft+and+other+Jet+Propelled+Watercraft)

SUMMARY

RESULTS (B) FROM LITERATURE AND LEGISLATION REVIEWS By far the most effective boating safety intervention internationally has been legislation mandating PFD wearing, accompanied by effective enforcement. Deaths averted have been greater than predicted by assessing the potential impact of modifying various combinations of risk factors, including PFD wearing. If similar legislation as in Victoria State, Australia had been implemented in Canada, together with effective enforcement, as recommended repeatedly in Canadian Red Cross drowning surveillance reports during the past two decades, this could have prevented in the order of 2,115 of 3,140 boating immersion deaths during 1991-2010. The cost savings of mandatory PFD wearing could have exceeded $4 billion, based on an average cost of $2 million per boating victim due to lost wages to families, friction costs of replacing workers to employers, medical costs, and various other losses associated with premature deaths of relatively young victims.

CONCLUSION Current findings of Red Cross injury research and surveillance support the need for effective interventions to increase wearing of flotation devices among Canadian boaters, primarily males 15 years of age and older. The greatest effectiveness elsewhere has been legislation mandating wearing, coupled with enforcement. Hypothermia protective garments may also be required in cold water conditions, frequent in the Canadian context. Child victims are relatively few, and their best protection is afforded by ensuring that parents and other adults are wearing PFDs; indeed focusing enforcement mainly on children could divert scarce resources from the key target group, and be difficult to administer given diverse sizing requirements. However, for Indigenous peoples – who more often travel as families – adults, children, and youth merit special attention in order to raise rates of wearing and carrying of PFDs in boats.

Enforcement of current regulations which require only the presence of an appropriate number of flotation devices in boats is relatively ineffective and inefficient, since it is costly, difficult, and invasive. Boats must be stopped, operators questioned, and devices inspected to verify whether the appropriate number and sizes of flotation devices are in the boat. Enforcement of regulations requiring wearing of flotation should be considerably easier, faster, less invasive, and less costly. Observation of boat occupants at a distance should generally suffice, rather than stopping, questioning, and inspecting.

If in Canada our legislators and other decision makers replicate the results in Victoria State, Australia, especially for youth and adult males in their productive wage earning years, cost savings should be in the range of $200 million to $1 billion per year. This would represent the single greatest decrease in Canadian immersion deaths and therewith the greatest increase in cost savings ever observed from a single water safety intervention. Swim programs that certify everyone in basic water competence should also be supported, provided the key preventive measure for boating safety, PFD wearing, is integral. Interprovincial coordination by work safe legal staff accountable for boating safety in each province and territory should prioritise constant wearing of task appropriate PFDs.

TWENTY YEARS OF PFD NON-WEARING AND WEARING IN CANADA: IMPACT ON RECREATIONAL AND OCCUPATIONAL BOATERS

BACKGROUND Boating is the most frequent activity for water-related immersion and trauma deaths in Canada. Central in immersion/drowning is non-wearing of personal flotation devices (PFDs). Enforcing presence in boats is inefficient, costly, and invasive.

OBJECTIVES Assess compliance with PFD regulations in boating deaths; ascertain trends and factors associated with non-wearing of flotation among recreational and occupational boating fatalities in Canada; review international practices in prevention.

METHODS Annual Red Cross collection of 1991-2010 Canadian coroner data by structured questionnaire. Analysis using STATA included activity, purpose, personal, equipment, environment factors, and trends. Searches reviewed interventions internationally.

RESULTS Surveillance identified 10,511 deaths, including 9,961 immersions involving drowning and hypothermia, 513 trauma deaths, and 37 other injuries. Excluding land and air transport, 37% (n=3,324) involved boating. The most frequent incidents were capsizing, falling overboard, and swamping, which accounted for >75% of all deaths.

A) RECREATIONAL AND DAILY LIFE BOATING FATALITIES In 12% PFDs were worn properly, 3% improperly, 21% present unworn, 24% absent, 20% unworn unknown presence, 19% unknown present/worn. Hence in a range between 24 to ≥50% PFDs were absent, violating regulations requiring PFDs, even if unworn. Only 4% falling overboard wore PFDs. Wearing didn't change during 1991-2010; PFDs present rose slightly. 88% of immersion deaths were 15-74-year-old males. Among ≥15-year-old wearing, 0 mg% alcohol, 62%; >80 mg%, above the limit 11%. Among weak/non-swimmers ≥5 years, 6% wore PFDs; main issues were capsizing, falling overboard and difficulty retrieving PFDs. A key regression finding is that non-swimmers and weak swimmers were significantly less likely to have worn a PFD than average or strong swimmers. Cold factors were frequent among the small proportion of victims wearing a PFD. 24% of trauma victims wore PFDs, non-protective for head, spine, and major lacerations. Wearing by Indigenous boaters was 3% for immersion deaths, other ethnicities 15%; 39% of Indigenous victims drowned in boats without PFDs present, other ethnicities 24%; women and children frequently died in incidents with >1 victim. Among 0-14-year-olds, 43% of known ethnicity were Indigenous, 0% wearing, others 33%; no Indigenous youth wore PFDs, others 13%. Internationally, mandatory wearing with enforcement was the most effective boating safety intervention. Deaths averted exceeded predictions.

B) OCCUPATIONAL BOATING FATALITIES 11% (n=376) of 3,324 boating deaths involved occupation and 86% recreational or daily life. Occupational boating immersions included 297 drownings, 53 drownings with hypothermia, 5 deaths due to hypothermia complicated by drowning, and 11 hypothermia deaths. At least 55% involved very cold water less than 10°C. 62% were commercial fishing and 14% marine shipping; 9% of fishers and 12% of shipping victims were properly wearing a flotation device. Overall, 11% were properly wearing, 2% improperly wearing, and at least 54% not wearing flotation, possibly more since flotation was unknown for 33%. For 9% flotation was absent in the boat, and for 55% presence of flotation was unknown. Range of boats in violation of current regulations, with no flotation, ranged from 9 to 64%, with many unknowns. Incidents included 31% capsizes, 27% falls overboard, and 25% swampings; only 5% who fell overboard wore flotation, 9% in capsizes, 17% in swamping. There was no trend in non-wearing during surveillance. Most deaths occurred in Nova Scotia, British Columbia, and Newfoundland/Labrador. Numbers of deaths declined from 246 during 1991-2000 to 120 during 2001-2010.

ABSTRACT

Specialist foam and inflatable models have proven acceptable to commercial fishers, depending on the type of fishing. The PFD shown does not appear to be a commercial model. Occupational PFDs may be covered by Provincial or Federal legislation. Winches are a common entrapment hazard on many fishing vessels. (Photomatz/Shutterstock.com)

CONCLUSION Surveillance supports interventions to increase wearing of PFDs among Canadian boaters, primarily ≥15-year-old males and all Indigenous people. Review of various boating interventions has found the greatest effectiveness to be legislation mandating wearing, coupled with effective enforcement. Hypothermia protective garments may also be required in cold water conditions, frequent in the Canadian context, especially for occupational boating. While occupational deaths have declined for various reasons, non-wearing of flotation among victims remains high. Legislation on wearing varies and is left to discretion of the operator. Interprovincial coordination on occupational wearing should prioritise constant wearing of task appropriate PFDs.

IMPLICATIONS FOR POLICY Enforcing wearing should be less invasive and faster than observing presence. If Canada replicates Victoria, Australia, savings should be 1,000 lives and in the range of $2 to $10 billion per decade, representing the greatest savings and decrease in immersion deaths ever observed from a single water safety intervention. Swimming instruction should include training in PFD use as a mandatory element of boating safety.

INTRODUCTION

Canada has an abundance of natural and man-made bodies of water. Canadians use water year-round for activities of recreation, work and travel, including boating. During summer, aquatic recreation such as swimming and wading are enjoyed, while in winter adults and children head onto the ice for various activities.

Nevertheless, many Canadians remain unaware of or ignore fundamental yet simple principles of water safety, and year after year many die. Boating is the most frequent activity for water-related deaths, accounting for 30% of immersion and 40% of trauma deaths. During 1991-2010, 3,300 Canadians lost their lives due to boating injuries. More than 90% were males and between the ages of 15 and 74 years. Each incident was a tragedy for one or more families and for our society, often with devastating long-term emotional and financial consequences.

Flotation devices include personal flotation devices (PFDs) and lifejackets. PFDs are designed to be comfortable enough for specific activities so as to be worn at all times, while a lifejacket is meant to be worn in an emergency situation such as abandoning ship (Transport Canada, 2012). Since a lifejacket provides sufficient flotation to keep the head out of the water and protect the airway, it may not be suitable for regular wearing. Wearing of an appropriate PFD at all times when aboard, boarding, and leaving a boat would save many lives. Any flotation device should help the wearer to keep the mouth clear of the water during the brief period of intense gasping after sudden immersion and cold shock.

Safe preparation for any boating outing includes careful assessment of prevailing and predicted water temperature, wind, waves and darkness. When water temperature is below 15°C, boaters should consider certain PFDs providing additional protection against cold immersion. Depending upon the degree of risk, other protective coats and survival suits, as well as life rafts, could be essential for safe boating. Life rafts can avert exposure to immersion; however, without a PFD or lifejacket, an immersed boater may not manage to safely reach and enter a life raft (Chronicle Herald, 2015). For commercial fishing, research has shown that both foam and inflatable occupational PFDs are acceptable (NIOSH 2015, Lucas et al, 2012). Preferences were affected by activity and by type of vessel and gear, including crabbers, gill netters, trawlers, and long liners.

Inflatable PFDs offer comfort and facilitate certain commercial fishing activities such as processing fish. They are generally more costly and require at least annual maintenance. Inflatables are not authorised for white water sports, personal watercraft, nor boaters under 16 years of age or who weigh less than 36.3 kg (80 pounds) (Transport Canada, 2012). Although inflatable devices have been used for millennia, production of a standardised safe product was only initiated in 1952, initially for the British navy (Brooks CJ 2008, Brooks CJ 1995). Research had found that previous designs of flotation devices, inflatable or otherwise, contributed to drowning by tipping victims' faces into the water, or simply allowed them to sink. Without a crotch strap, the device could float up over the head. With a strap, the airways are kept significantly higher above the surface when someone falls or steps in and when immersed in waves (Lunt et al., 2014). This greatly reduces inhalation of water such that survival time could be doubled.

Among boating fatalities, capsizing and falling overboard are the most common incidents, and yet non-swimmers and weak swimmers continue to boat without wearing a PFD. In the range of 50-85% of boating-related deaths could be prevented if all boaters wear a PFD (Treser et al., 1997; Canadian Red Cross and Transport Canada, 2012; Cummings, Mueller, and Quan, 2011). Furthermore, the expected number of victims per vessel decreases by about 80% when the boat operator wears a PFD (Gungor & Viauroux, 2014). However, only one in five Canadian boaters regularly wears one (Starr Group Inc., 2001).

Deaths from immersion mainly occur from drowning and/or hypothermia. An immersed individual, swimmer or non-swimmer, who is not wearing a PFD may drown right away from submersion of the airways under water, together with sudden gasping stimulated by the cold (Canadian Red Cross, 2006). Immersion in cold water adds an extra element of risk for death by drowning, hypothermia and occasionally cardiac effects such as arrhythmia.

An individual wearing a PFD may die from hypothermia, but generally only if immersed in cold water for a prolonged period.

Even wearing a PFD, immersed boaters may not have sufficient strength to get themselves out of the water by climbing back into or onto swamped or capsized boats, unless there is appropriate equipment for this attached to the boat. With increased duration of cold immersion, muscle strength of the hands rapidly diminishes. Climbing onto a personal watercraft is particularly difficult, especially for two persons (NIOSH Fire 2007). To avoid carbon monoxide poisoning, a PWC engine should not be running.

This report was prepared to provide an epidemiologic profile of personal PFD non-wear and wear based on analysis of 20 years of surveillance data on all water-related injury deaths in Canada. The focus is on activities and incidents associated with deaths, together with personal, equipment and environment risk factors. Injury incidents are often multifactorial. Nevertheless, a favourable change in a single factor can be enough to tip the balance sufficiently away from danger in favour of safety to prevent an injury incident from occurring. This is pre-emptive action in the pre-event phase. Appropriate safety equipment such as a PFD and/or action can prevent injury even if an incident does occur; in this case, injury is avoided or attenuated in the event phase. Finally, post-event phase activities after an injury has occurred, such as rapid intervention with lifesaving, first aid, CPR, and so forth, can minimise, stop, or reverse progression of damage from injuries sustained during the event phase.

Although boating is the main activity where a PFD can help prevent injury or death, a PFD should also prevent death in the event of falling into water through ice or from shore. Hence information is provided on other relevant activities. Trends are included; however, changes in completeness of reporting from year to year warrant caution in interpretation.

Publications were also reviewed on legislation respecting flotation device wearing for boating. The report was prepared for all persons involved in water safety, especially decision makers, legislators, organisations that work on boating safety, and safety conscious boaters.

METHODS

NATIONAL SURVEILLANCE DATABASE

The data source for this report was the Canadian Surveillance System for Water-Related Fatalities. This database was developed in the early 1990s by the Canadian Red Cross in collaboration with public health injury prevention professionals in the McGill Public Health Unit of Montreal Public Health, all provincial and territorial coroners including the National Association of Coroners and Medical Examiners, and other water-safety organisations including the Canadian Coast Guard and the Lifesaving Society. The database provides a sound research basis for national water safety programmes by monitoring the incidence and circumstances of all water-related injury deaths in Canada. It includes all unintentional drownings and other water-related injury deaths investigated by coroners or medical examiners in Canada during 1991-2010. It is important to note that all data in this report represent water-related fatalities, and do not represent personal, environmental and equipment risk factors for the general 'live' boating population. Completeness of the database was somewhat affected for deaths during 2001-2008, as discussed below.

STUDY POPULATION AND TIME PERIOD

All drownings and other water-related unintentional injury deaths in Canada were monitored and reviewed between 1 January 1991 and 31 December 2010. Over the study period, the Canadian population increased from 27 million in the 1991 census year to 33 million in 2011 (Statistics Canada, 2013). Thus, immersion and water-related trauma deaths during 1991-2010 occurred on the background of about 600 million person years of potential exposure to risk for all ages in the Canadian population.

DEFINITIONS

IMMERSION DEATHS

For the purposes of this report, immersion deaths include deaths by drowning and/or immersion hypothermia. An immersion death was classified as drowning if drowning was included in the coroner's report, based on autopsy or other findings. Death was classified as immersion hypothermia without drowning if cold was a factor and the coroner's report excluded drowning as among the causes of death based on lack of autopsy findings of drowning. Reporting was done on immersions as a single category because as evident from the earlier Canadian Red Cross 10-year module on cold immersion (2006), cold is a factor in at least 35% of immersion deaths, and hypothermia is inconsistently reported due to lack of clear criteria for such a diagnosis, as well as lack of training on cold immersion for some coroners and police. In Canada, risk factors tend to be similar for both drowning and immersion hypothermia. Persons not wearing a PFD may or may not survive long enough to die of hypothermia.

COLD IMMERSION DEATHS

Since many coroners, injury investigators and pathologists have not received specific training in diagnosis of death from the different stages of cold immersion, and since autopsy findings even when available may not always be definitive, we established case selection criteria for cold water immersion deaths (See Canadian Red Cross 2006). For the purposes of this report, cold water immersion deaths included: drowning and immersion hypothermia as reported by coroner; immersion hypothermia without drowning as reported by coroner; immersion hypothermia and some other cause as reported by autopsy; hypothermia and some other cause as reported by the Red Cross data collector; immersion death in the presence of ice as reported by coroner or police report; immersion death in the presence of extremely cold water temperature (<10°C) as reported by coroner or police; cold month of incident (November to April); and snowmobile travel for non-boating deaths.

TRAUMA DEATHS

As in the World Health Organisation's International Classification of Diseases (WHO, 2013), trauma deaths have been reported as a separate category. Types of trauma injuries include head and spinal injuries, fractures, severe lacerations such as by unshielded propellers, and multiple injuries, mainly from various types of collisions and falls. Whereas the main agents of immersion deaths are lack of oxygen from drowning and/or the effects of cold, the major agent of trauma deaths is kinetic energy.

Severe trauma such as brain injury or heavy blood loss from lacerations such as propeller injuries can cause loss of consciousness, leading to drowning. Paralysis or loss of function of a limb such as from spinal injury and fractures can also do so. Hence major injuries of this nature were classified with trauma as the primary cause of death, even if there was also evidence of drowning.

INDIGENOUS ETHNICITY

In previous Red Cross reports, the term "Aboriginal peoples" was used to refer to Canada's earliest inhabitants. While "Aboriginal" is frequently used in the Canadian context, the term "Indigenous peoples" is more commonly used and understood internationally.

The Indigenous peoples of Canada include First Nations, Inuit and Metis, and represent about four percent of the Canadian population. Due to greater exposure of Indigenous peoples to boat travel, and the location of many Indigenous communities or homes near the water, pertinent data for Indigenous victims are provided. Indigenous ethnicity was considered definite if identified as such by the coroner, police or pathologist. Probable ethnicity was assigned if the address corresponded to a known reserve or if the family name was known to be Indigenous. For the purposes of this report, those of probable Indigenous ethnicity were classified as Indigenous.

Ontario, Canada's largest province, has not consistently facilitated reporting on Indigenous ethnicity, so data are incomplete. Therefore, the true proportion of Indigenous victims is undoubtedly greater than reported, especially since 1996. This affects interpretation of trends for Indigenous peoples.

PERSONAL FLOTATION DEVICE (PFD)

For the purposes of this report, a Personal Flotation Device (PFD) includes both lifejackets and personal flotation devices. The terms lifejacket, personal flotation devices, life vest, and life belt are often used interchangeably, but there are important differences. A Canadian approved standard lifejacket, when worn properly, is designed to turn an unconscious person onto their back with their face up, allowing them to breathe with the airways clear of water. A Canadian approved PFD is designed to keep a person in the water afloat, but has limited capacity to turn a person onto their back. PFDs are generally smaller, less bulky and more comfortable than lifejackets. Distinction is not made by coroners or police and thus it cannot be determined whether victims were wearing a PFD or lifejacket.

TYPES OF BOATS

For the purposes of this report, powerboats are boats mainly propelled by a motor. Unpowered boats are usually not powered by a motor, mainly by human or wind power. The cut-off between small and large powerboats was 5.5 metres when surveillance reporting began in 1991. This classification has since changed with Transport Canada and other organisations, but the original classification has been retained. Police or coroners seldom record the exact length of boats. Hence the most frequent category of powerboat generally specified is small open fishing type boats. Boats designated as personal watercraft (PWCs) by Transport Canada are referred to as jet skis in the World Health Organization's International Classification of Diseases (ICD), 10th edition (WHO, 1992).

ALCOHOL AND DRUG INVOLVEMENT

The testing protocol for alcohol and/or drug involvement varies in Canada depending on the province or territory. For example, in Manitoba, toxicology testing is done on all drowning victims, except for cases where no blood, urine or vitreous samples are available due to decomposition, or where victims die after prolonged survival and no ante mortem samples are available. In BC, toxicology testing is at the discretion of the coroner. Hence, this report may underestimate the true number of victims for which alcohol and/or drugs were involved.

OTHER DEFINITIONS

Boating refers to being in a boat, boarding or leaving a boat, falling from or jumping from a boat (to retrieve a person, animal or object), and being towed by a boat (e.g. water-skier, tuber). In accordance with the ICD, persons voluntarily swimming or diving from a boat are excluded from boating; these are classified as aquatic activities.

DATA COLLECTION

The surveillance database relies upon annual structured reviews of the mandatory coroner and police reports for all water-related injury deaths. A questionnaire with 48 questions is used to obtain data on cause of death, activity and purpose of activity, along with personal, equipment and environment risk factors. Data are collected by dedicated volunteers affiliated with the Canadian Red Cross. Project managers collaborate with statistical staff of the provincial coroner's office in each province to ensure that all unintentional water-related deaths are included. Intentional injuries such as suicide and homicide are excluded. Data are collected for the previous year's deaths in the fall of the following year, by which time the majority of coroners' and medical examiners' reports have been completed for the previous year. While a second visit is made to ensure complete data collection, there could still be some deaths not complete at that time, especially when the body was not recovered. Some such deaths are added to the database in subsequent years. During 2002-2007, data collection was carried out and/or supervised by the Water Incident Research Alliance. This group reportedly closed out data collection earlier than in previous years, and shortened the data questionnaire. During 2001-2008, the proportion of deaths estimated to be missing rose significantly; the situation was corrected when the Red Cross resumed responsibility for their data collection.

DATA VERIFICATION

All completed questionnaires are verified and corrected at the national level by a small team of trained public health injury researchers to ensure validity and consistency across the country. Verification is highly structured and includes issues such as admissibility, completeness, internal consistency of responses, and consistency from year to year. Data entry is done with appropriate quality control, including double entry and compare. Since coroners take a year or more to finalise all cases, and data collection and analysis are also time-consuming, reporting tends to lag incidents by about two years. This is not of serious consequence for prevention; major trends usually develop gradually.

DATA ANALYSIS

Analyses were performed using Stata version 13 and Microsoft Excel spreadsheets. Percentages were rounded to the nearest whole number. Hence, the total percentage for some tables and graphics may add up to 99% or 101%.

LOGISTIC REGRESSION AND MULTIPLE IMPUTATION METHODS

Multiple logistic regression was performed to determine which personal, environment and equipment factors were statistically associated with properly wearing a PFD for immersion deaths. Information for all variables is not always available to coroners/medical examiners

and/or police at the time of death; hence, the Canadian Surveillance System for Water-Related Fatalities contains missing/unknown data for certain variables. The percentage of missing/unknown data points ranged from 0.1% for sex to 60% for wind conditions. To handle the missing values, multiple imputation using chained equations (MICE) was used to impute the missing/unknown data. Multiple imputation generates imputed values using existing information (Royston & White, 2011; Royston, 2009, 2005b, 2005, 2004).

DATA PREPARATION

The Canadian Red Cross's data collection form categorizes PFD involvement into six categories: *PFD properly worn, PFD improperly worn, PFD present but not worn, PFD not present, PFD not worn but uncertain if present,* and *unknown PFD involvement*. These six categories were collapsed to create a new binomial PFD involvement variable – PFD properly worn and PFD not worn. The PFD not worn category was created by collapsing *PFD improperly worn, PFD present but not worn, PFD not present,* and *PFD not worn, uncertain if present* categories. Observations with unknown/missing PFD involvement were deleted before performing imputation.

MODEL BUILDING STRATEGY

A preliminary regression model was built using Hosmer & Lemeshow's Forward Model Building Strategy (Hosmer & Lemeshow, 2000). Independent variables were considered for the model based on review of the literature and chi-square analysis. From review of the literature, 15 variables were considered epidemiologically relevant for the model. These variables included: age, sex, ethnicity, alcohol involvement, boating ability, swimming ability, urban/rural residence, urban/rural location of incident, accompaniment/supervision, wave conditions, wind conditions, current, body of water, water temperature, and powered/unpowered boat.

For each of the 15 variables, chi-square analysis was performed with the dependent variable. A cut-off value of $p<0.10$ was set for a variable to be considered for the model. Thirteen of the 15 variables were found to be important at the $p<0.10$ level; urban/rural location of incident and boating ability were not significant. Urban/rural location of incident was still considered for the model based on previously reported associations in the literature.

MULTIPLE IMPUTATION USING CHAINED EQUATIONS

To prepare the data for multiple imputation, certain categories for independent variables were collapsed to reduce the number of categories with small numbers of observations. Each variable was specified as a continuous, binomial, multinomial or ordinal variable in the MICE model. The number of imputed datasets was set at 5. Once the data had been imputed, multiple logistic regression was performed to obtain odds ratios for the association between PFD wearing and independent variables. Multiple imputation and logistic regression were performed using Stata version 13.

The improperly worn needed to be grouped with either the properly worn or not worn because the number improperly wearing was too low to analyse separately. Review of text files containing details of improper wearing found that about half had not fastened/zipped up the PFD. Intentions of victims properly wearing might have differed from those improperly wearing, i.e., a personal factor; however, improper PFD size, i.e., an equipment factor, might have made it difficult to fasten. Hence, data were analysed to verify the effect on associations and odds ratios of grouping improperly wearing with not wearing, versus with properly worn. There were no significant effects. Univariate analyses of the independent variables were performed with properly worn and improperly worn categories collapsed/combined, and compared to improperly worn and not worn collapsed. The results were similar. It was decided to combine the improperly worn with the unworn.

RESULTS

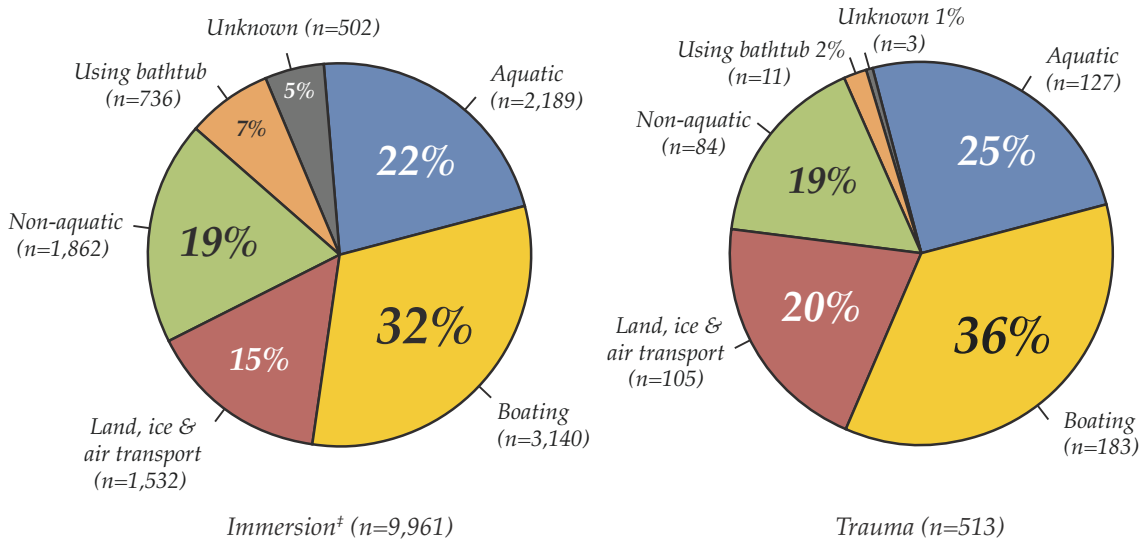
WATER-RELATED FATALITIES

During 1991-2010, there were 10,511 unintentional water-related deaths, including 9,961 from immersion, 513 trauma, and 37 other or unknown causes (Figure 1, Table 1).[a]

IMMERSION DEATHS Immersion deaths included 8,927 drownings, 854 drownings complicated by hypothermia, 30 hypothermia deaths complicated by drowning and 150 hypothermia deaths with no evidence of drowning. The most frequent activity associated with immersion deaths in Canada was boating, followed by aquatic activities such as swimming; falls into water during non-aquatic activities such as playing near water or walking on ice; land, ice and air transport; and bathing in a bathtub.

TRAUMA DEATHS Boating was the main activity associated with water-related trauma deaths, followed by aquatic activities; land, ice and air transport; and non-aquatic activities resulting in falls into water and through ice.

Figure 1 **WATER-RELATED DEATHS* BY ACTIVITY AND CAUSE OF DEATH, CANADA 1991-2010 (n=10,511)†**



* *Includes death from all causes: drowning, immersion hypothermia, trauma, and other/unknown*
† *This figure excludes 37 cases where cause of death was other/unknown* ‡ *Includes drownings and immersion hypothermia deaths*
Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

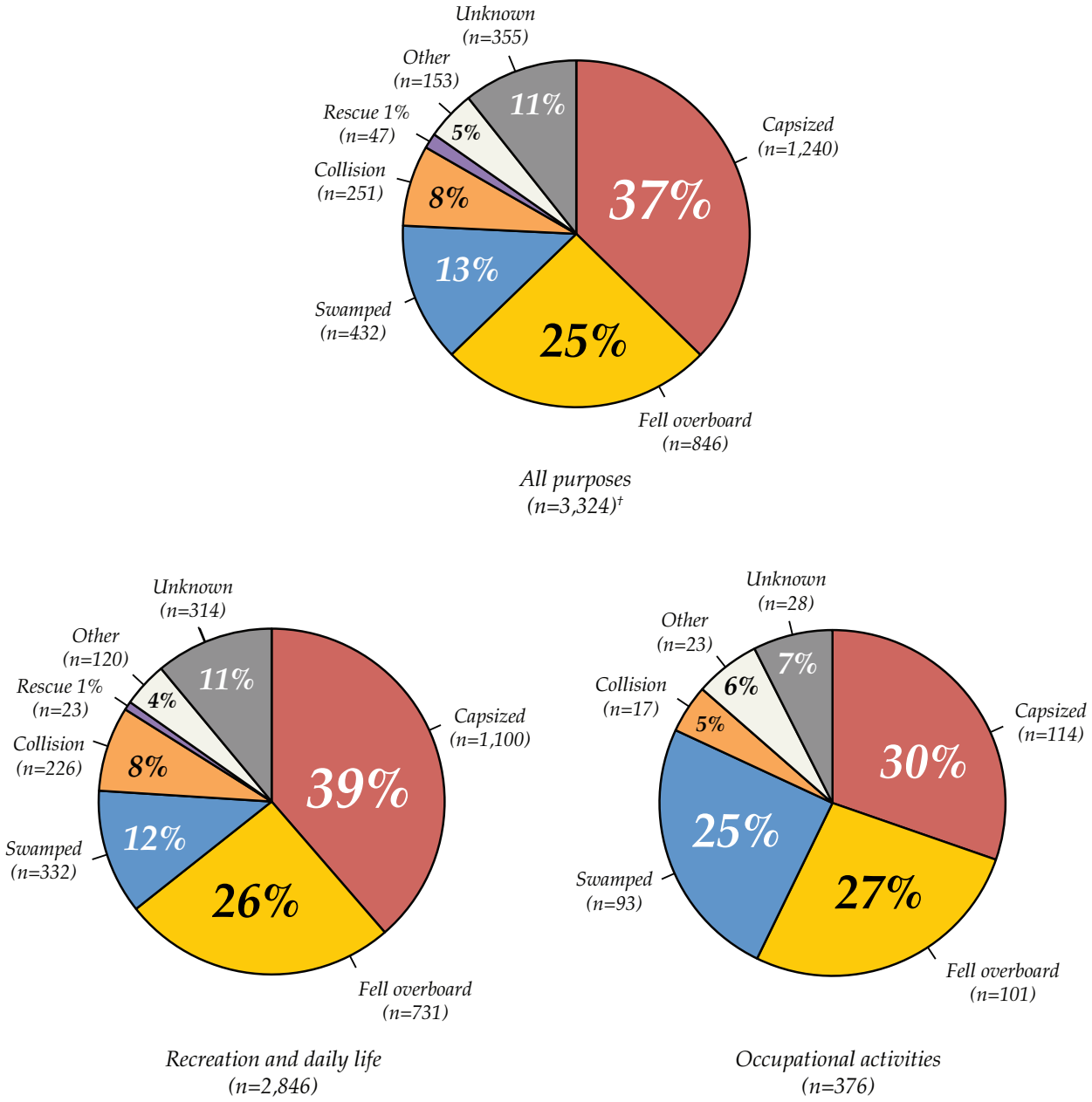
BOATING OVERVIEW

PURPOSE OF BOATING ACTIVITY 77% of all boating deaths involved recreational activities, 11% occupational, 9% daily life, 2% attempting rescue, and 1% other or unknown purpose (Table 2). For immersions, recreational activities accounted for 76% of deaths, occupational 12%, daily life 9%, rescue 2%, and other or unknown 1%. For trauma deaths, 87% were recreational, 5% occupational, 4% daily life and 3% other and unknown (Table 3). Further details for this overview section can be found in Tables 2-8.

TYPE OF INCIDENT BY PURPOSE The most frequent incidents for all boating fatalities were capsizing at 37%, falling overboard 25%, swamping 13%, and collisions 8%. For recreational and daily living deaths, capsizing accounted for 39% and falling overboard 26%. For occupational boating deaths, capsizing accounted for 30%, falling overboard 27%, swamping 25%, and collision 5% (Figure 2, Table 4).

[a] *Results tables can be found in Appendix 1, starting on page 78.*

Figure 2 **BOATING DEATHS* BY PURPOSE AND TYPE OF INCIDENT, CANADA 1991-2010 (n=3,324)**



* *Includes death from all causes: drowning, immersion hypothermia, trauma, and other/unknown*
† *Included 102 cases where purpose of activity was rescue, other, or unknown (50, 12, 40)*

Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

TYPE OF INCIDENT BY CAUSE OF DEATH For immersions, capsizing was most frequent at 39%, falling overboard 26%, and swamping 14%. For trauma deaths, 70% resulted from various types of collisions, 19% falling overboard, and 4% capsizing (Table 5). For trauma deaths resulting from collisions, 43% were between two boats, 41% were between a boat and a fixed object, and 6% between a boat and a person. Of the 8 trauma deaths resulting from collision between a boat and a person, 4 victims were being towed and 4 were swimming. As for causes of the various types of incidents, wind, waves, current, and overloading of the boat were frequently associated with swamping and capsizing. Falling overboard often resulted from standing up and/or urinating, abrupt turns, starting a motor, and boarding

or leaving a boat; in some cases when the operator was alone, the boat continued on without the victim.

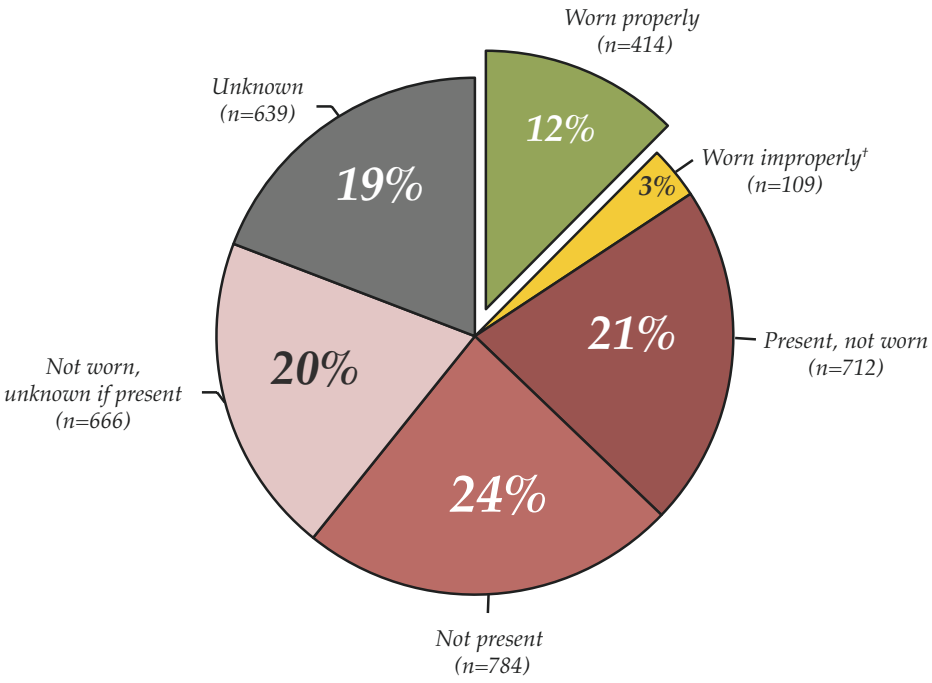
ACTIVITY BY PURPOSE Of 2,553 recreational boating incidents, 36% involved fishing from a boat, 27% power boating, 15% canoeing, and 5% hunting. For the 293 daily life incidents, 55% involved boat travel, 19% fishing for food, and 26% other activities. Of 376 occupational boating incidents, 61% involved fishing, 15% marine shipping, and 3% fishing guiding (Table 6).

FLOTATION Only 12% of all boating victims were reported to be properly wearing a PFD. PFDs were improperly worn by 3% (Figure 3, Table 6). In 24% of deaths, a PFD was not present, and in 39% unknown whether present. Hence in as many as 63% of deaths, there was failure to comply with current legislation requiring presence of a PFD in the boat, even if not worn.

FLOTATION BY PURPOSE A PFD was properly worn by 14% of victims involved in recreational activities, 11% occupational, and 5% daily life (Table 6). Considering immersion deaths, a PFD was worn properly for 14% of recreational deaths, 11% occupational, and 6% daily life. For boating trauma, a PFD was properly worn for 25% of recreational/daily life incidents; however, in such deaths brain injury was frequently a factor.

Sport fishing in small open powerboat. No PFDs worn, low freeboard unsafe for wind, waves, overloading. Osoyoos Lake, BC Interior (from http://www.sportfishingbc.com/forum/forum/sport-fishing-bc-forums/freshwater-fishing-forum/28818-osoyoos-lake/page3)

Figure 3 **BOATING DEATHS* BY USE OF A PERSONAL FLOTATION DEVICE, CANADA 1991-2010 (n=3,324)**

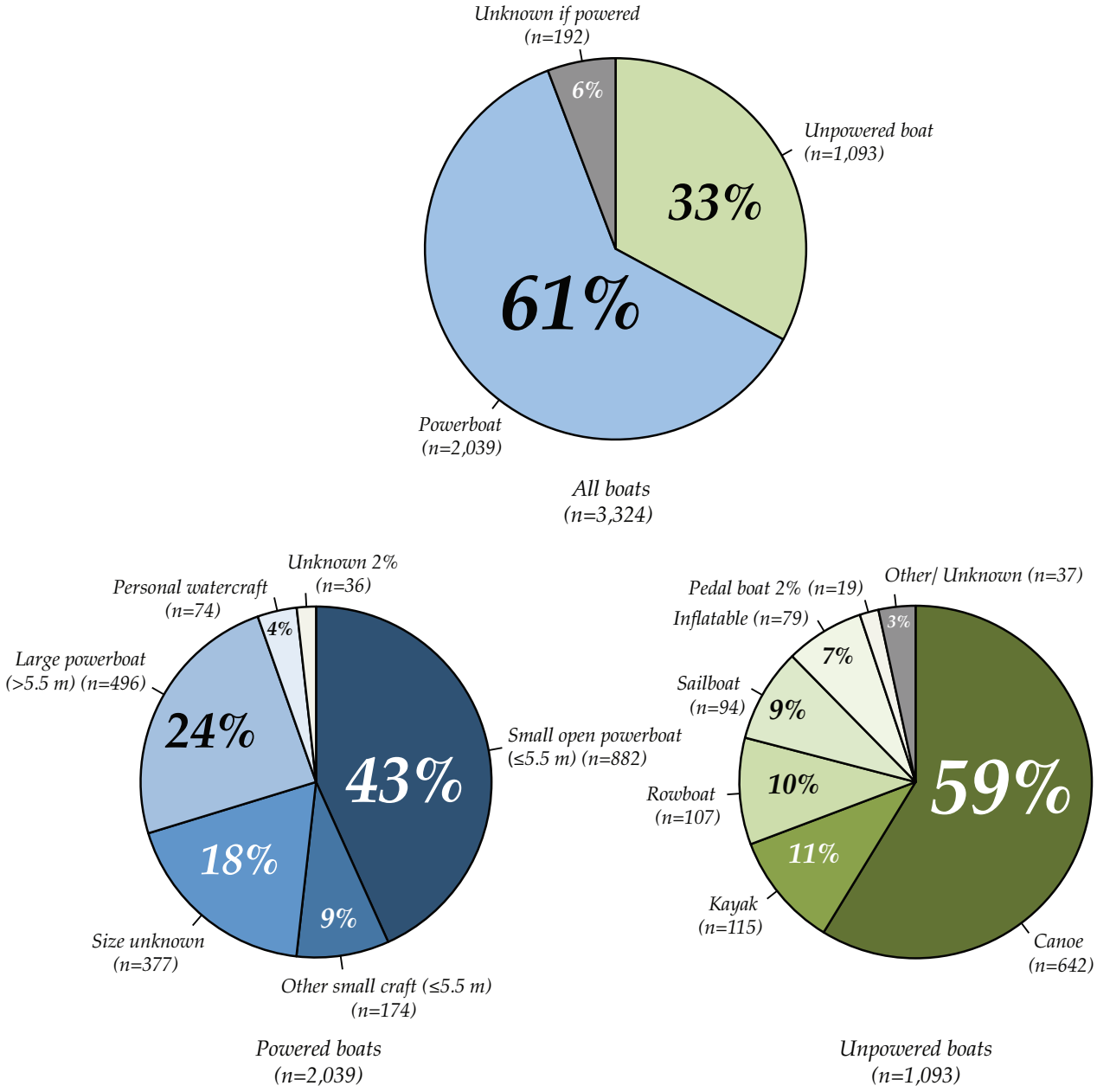


** Includes death from all causes: drowning, immersion hypothermia, trauma, and other/unknown † Not fastened or inappropriate size*
Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

TYPE OF BOAT 61% of boating fatalities involved powerboats and 33% unpowered, while for 6%, it was unknown whether the boat was powered (Figure 4, Table 7). Small open powered boats accounted for at least 43% of powerboat deaths, probably closer to 60% given many unknown. Canoes were involved in 59% of unpowered fatalities.

TYPE OF BOAT BY PURPOSE For recreational fatalities, 57% involved powerboats and 39% unpowered. 50% of powerboats were small open boats. Among unpowered, canoes accounted for 58%, kayaks 11%, and rowboats 9%. For daily life, 62% involved powerboats and 24% unpowered boats. Of the daily life powerboats, 43% were small fishing type boats ≤5.5 metres in length, 26% large >5.5 metres, and 23% unknown length. Of the daily life unpowered boats, 75% were canoes. For occupational deaths, 94% involved powerboats and 3% unpowered, and 66% of all occupational deaths involved large powerboats >5.5 metres in length (Table 8).

Figure 4 **BOATING DEATHS* BY TYPE OF BOAT, CANADA 1991-2010 (n=3,324)**



** Includes death from all causes: drowning, immersion hypothermia, trauma, and other/unknown*
Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

RECREATION AND DAILY LIFE: IMMERSION DEATHS

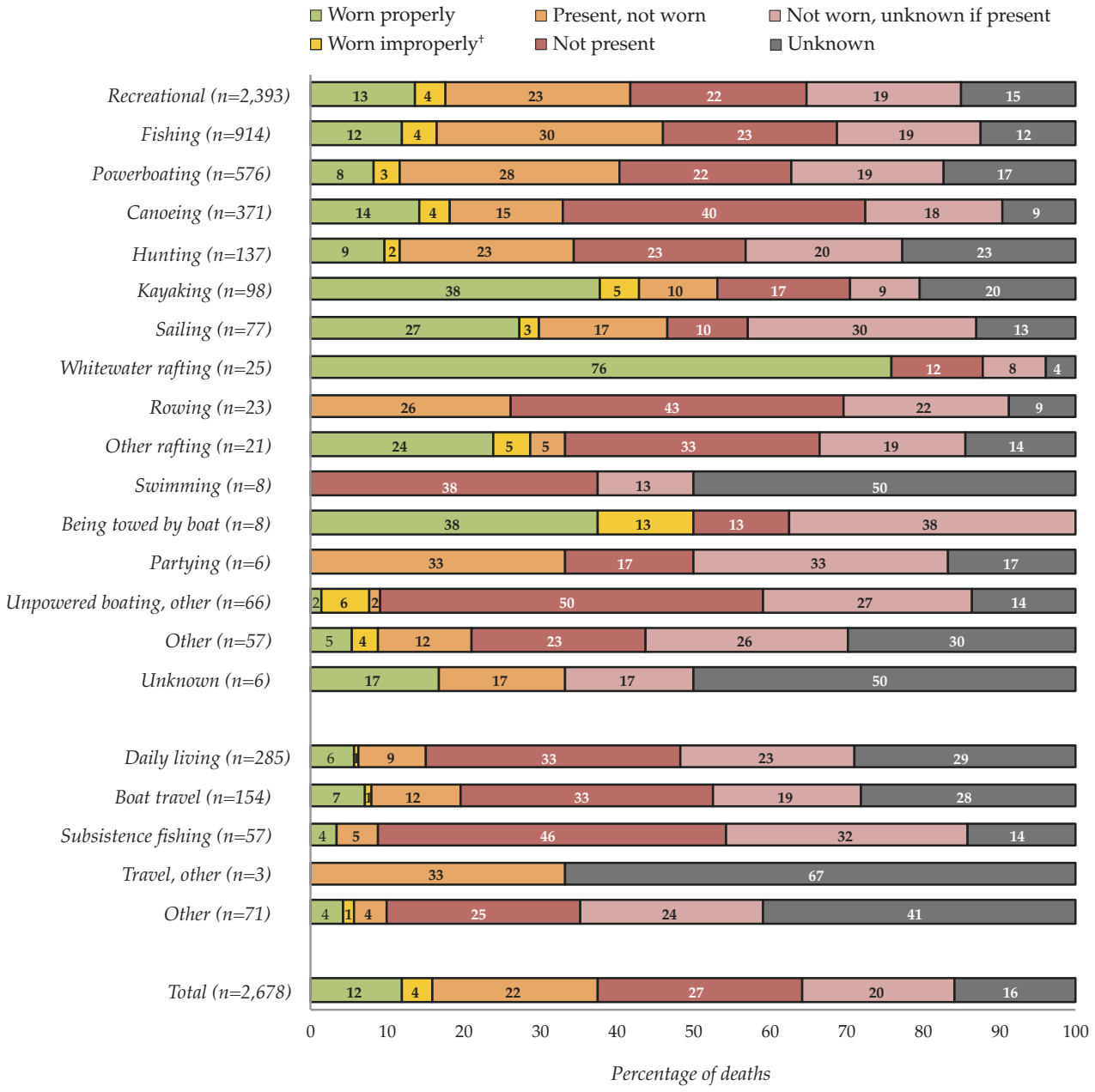
There were 2,678 recreational and daily living immersion deaths involving boating during 1991-2010, including 2,229 drownings, 373 drownings with hypothermia, 17 deaths due to hypothermia complicated by drowning, and 59 deaths due to hypothermia with no evidence of drowning (Table 9). PFD properly worn was 8% for drowning alone, 25% for drowning as primary death factor with hypothermia as secondary death factor, 53% for hypothermia as primary death factor with drowning as secondary factor, and 66% for hypothermia without drowning. Detailed information for this section can be found in Tables 9–52.

ACTIVITY For recreational immersion deaths, 38% of victims were fishing from a boat, 24% were power boating, 16% were canoeing, and 6% were hunting. For daily living immersion deaths, 54% of victims were traveling by boat and 20% were fishing for food. Proper wear of a PFD was highest for white-water rafting, kayaking, sailing, and victims being towed by a boat (e.g. tubers, water skiers, etc.) (Figure 5, Table 10).

TYPE OF INCIDENT Capsizing was the most frequent boating incident, followed by falling overboard and swamping. PFDs were properly worn most frequently during incidents of swamping (20%) and capsizing (15%), but only by 4% of those who fell overboard (Figure 6, Table 11). Failure to have a flotation device in the boat, or unknown, was high in all types of incident.

Specialised training in paddling and rescue, and safety equipment facilitate safe paddling in current. Equipment always includes wearing appropriate PFDs, and may include helmets, flotation bags, spray cover, dry bags for clothes, cold protection jackets, wetsuits, or dry suits, rescue ropes at bow and stern, and personal locator beacon. Strips of foam in PFDs rather than wide pieces facilitate paddling. (Photo: Wooden Boat Forum, Bruce Taylor, Wakefield QC)

Figure 5 **BOATING IMMERSION DEATHS* DURING RECREATION AND DAILY LIFE BY ACTIVITY AND USE OF A PERSONAL FLOTATION DEVICE, CANADA 1991-2010 (n=2,678)**

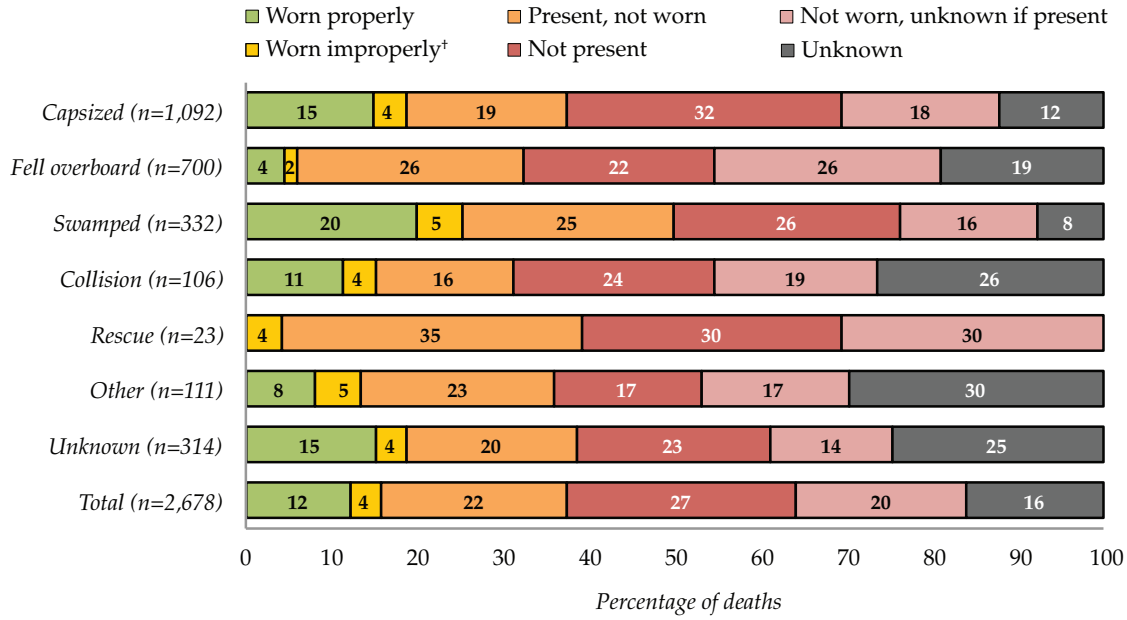


** Includes drownings and immersion hypothermia deaths † Not fastened or inappropriate size*

Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

Figure 6

BOATING IMMERSION DEATHS* DURING RECREATION AND DAILY LIFE BY TYPE OF INCIDENT AND USE OF A PERSONAL FLOTATION DEVICE, CANADA 1991-2010 (n=2,678)



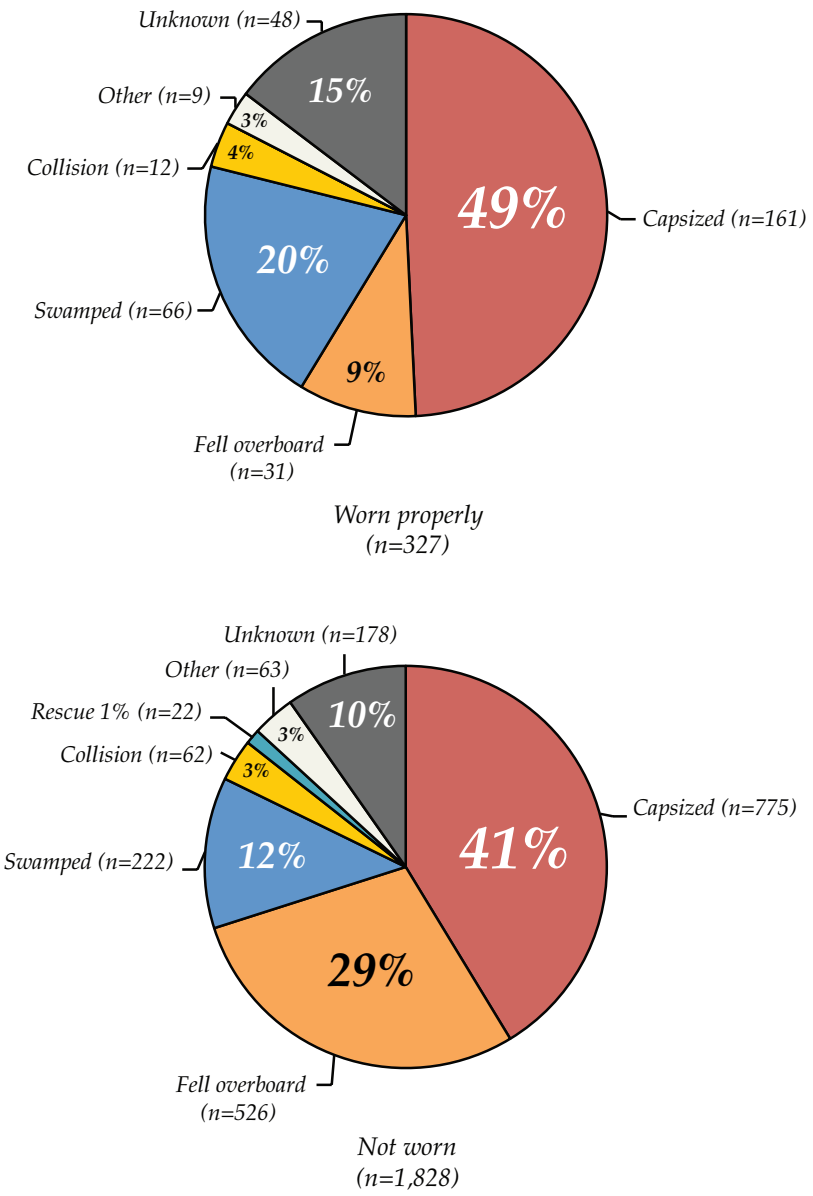
** Includes drownings and immersion hypothermia deaths † Not fastened or inappropriate size*
Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

Large high speed powerboat, with five children on bow. At least one child and two adults not wearing flotation devices. Trois Rivieres, Quebec. Radio Canada International, 4 August, 2015 (Photo: Mario Groleau, english@rcinet.ca)

There was a much greater proportion of deaths from falling overboard among victims not wearing a PFD than among those properly wearing one (Figure 7). Worn improperly and unknowns are excluded from this figure so the sample size is less than for Figure 6.

Figure 7

BOATING IMMERSION DEATHS* DURING RECREATION AND DAILY LIFE BY TYPE OF INCIDENT AND USE OF A PERSONAL FLOTATION DEVICE, CANADA 1991-2010 (PFD WORN PROPERLY VS NOT WORN†; n=2,155)



** Includes drownings and immersion hypothermia deaths † Includes PFD present, not worn; not worn, unknown if present; and not present*
Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

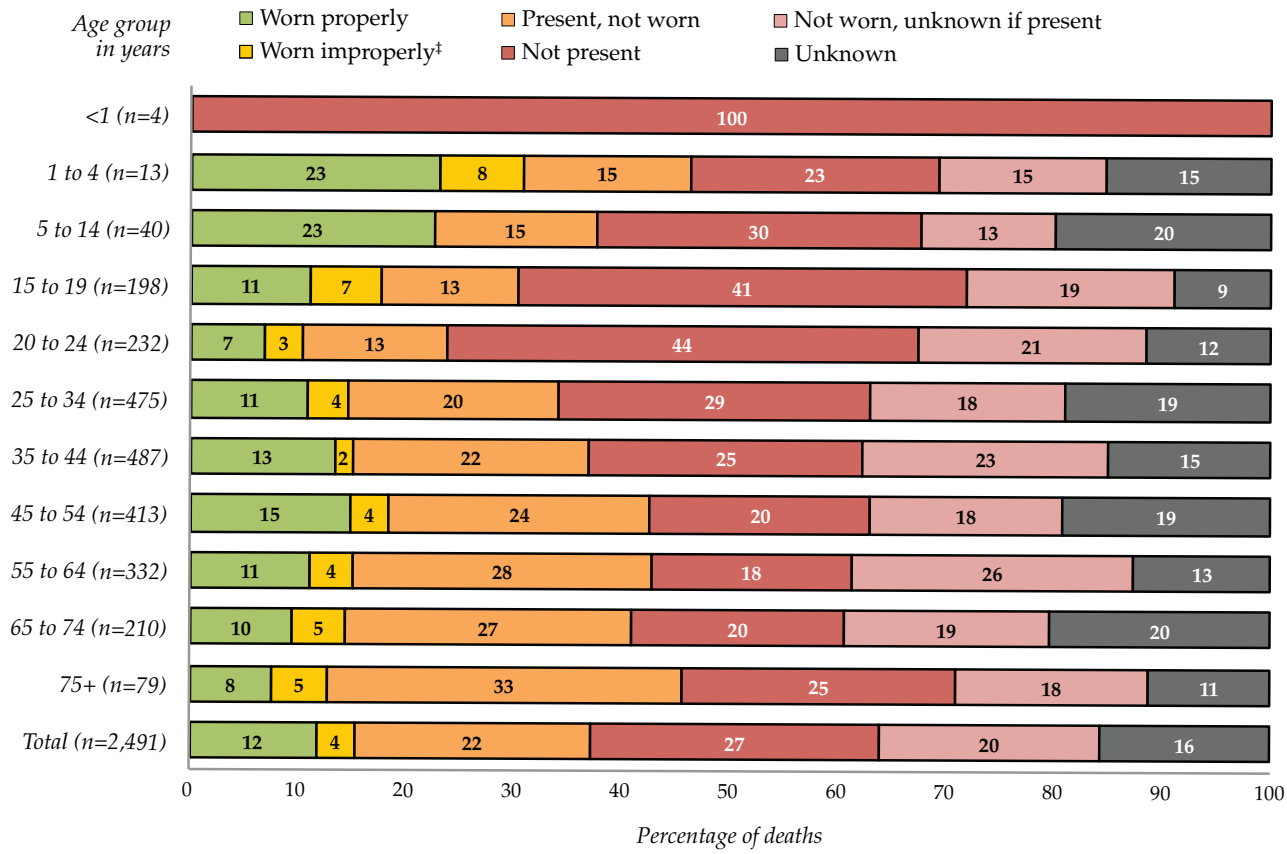
PERSONAL FACTORS

AGE AND SEX Males accounted for 93% of recreational and daily living immersion deaths, and 94% of victims were between 15 and 74 years of age. For males, proper wearing of a PFD was highest among children 1-14 years old; however, the vast majority of boating victims were 15 and older and wearing was low from 15 right up to 75+ (Figures 8 & 9, Table 12). Numbers of immersion deaths for females were low in all age groups. Female victims more frequently wore a PFD than males, except for youth and the elderly. Failure to have a PFD present in the boat as well as unknown presence was high overall, more so for 15-24 year olds, and even for children and 25-44 year olds.

ALCOHOL was known or suspected to be involved in 17% of deaths for victims properly wearing a PFD, compared with 49% of victims not wearing flotation (Figures 10 & 11, Table 13). Improper wearing and unknowns are excluded from Figure 11, so the sample size is less than for Figure 10.

Figure 8

BOATING IMMERSION DEATHS* OF MALES DURING RECREATION AND DAILY LIFE BY AGE AND USE OF A FLOTATION DEVICE, CANADA 1991-2010 (n=2,491)†

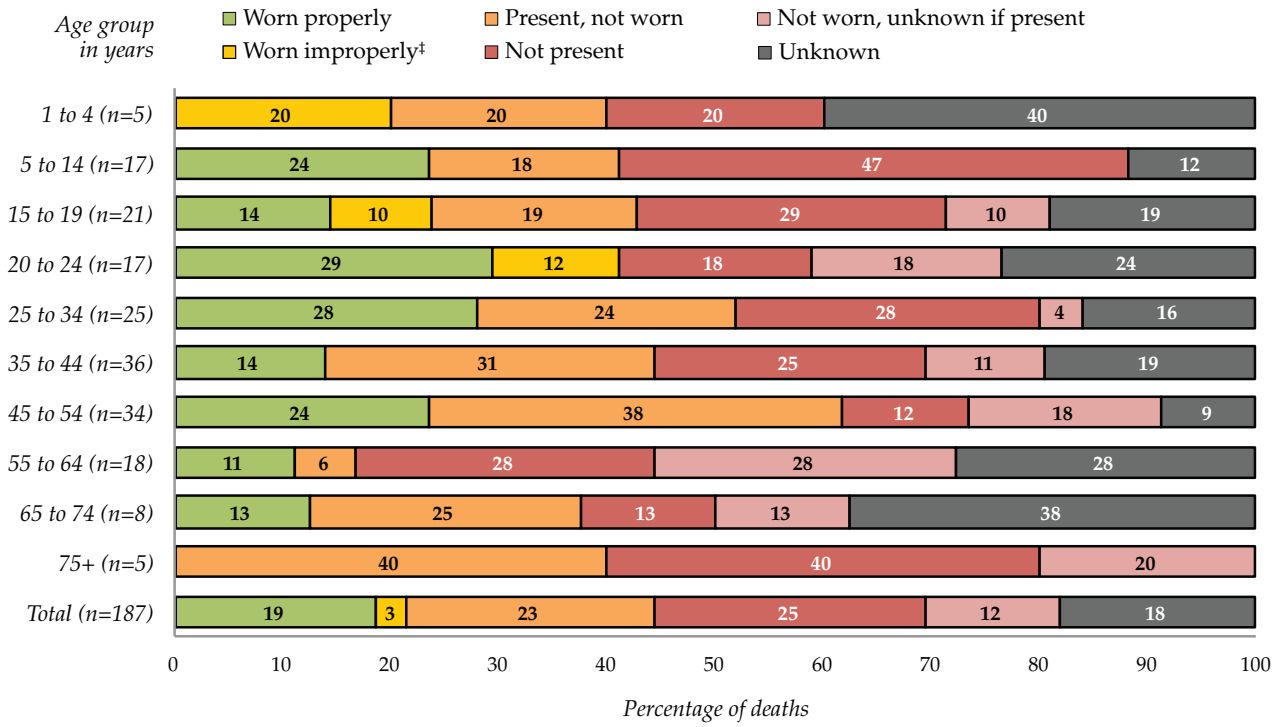


** Includes drownings and immersion hypothermia deaths † Sex was unknown for 3 victims, imputed as male; age was unknown for 8 victims*
‡ Not fastened or inappropriate size

Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

Figure 9

BOATING IMMERSION DEATHS* OF FEMALES DURING RECREATION AND DAILY LIFE BY AGE AND USE OF A FLOTATION DEVICE, CANADA 1991-2010 (n=187)†

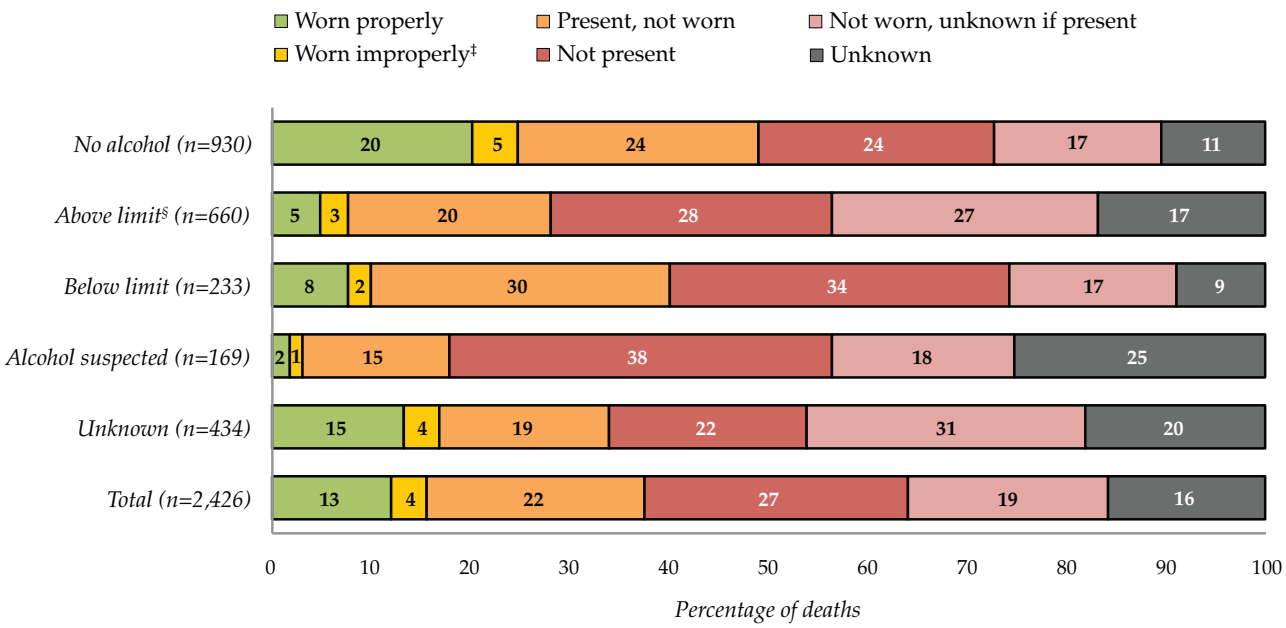


** Includes drownings and immersion hypothermia deaths † Age was unknown for 1 victim*
‡ Not fastened or inappropriate size

Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

Figure 10

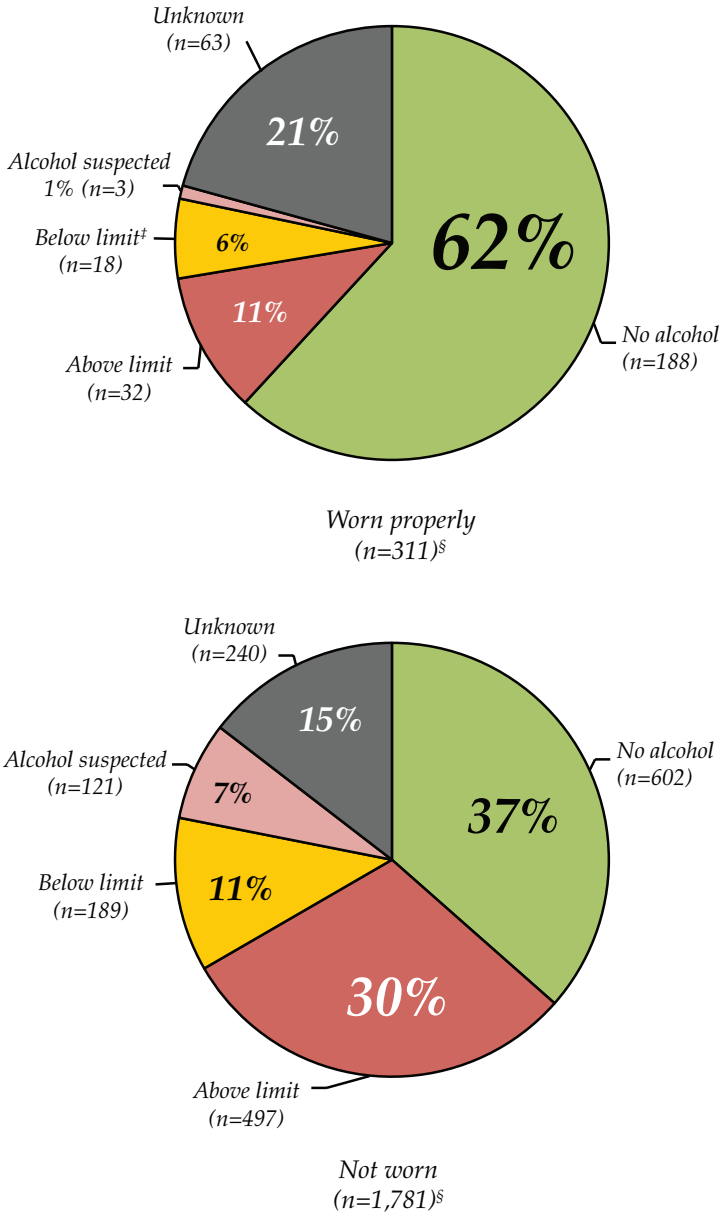
BLOOD ALCOHOL LEVELS FOR BOATING IMMERSION DEATHS* DURING RECREATION AND DAILY LIFE BY USE OF A FLOTATION DEVICE, CANADA 1991-2010 (VICTIMS ≥ 15 YEARS OF AGE; n=2,599)†



** Includes drownings and immersion hypothermia deaths*
† Figure excludes 173 victims for whom decomposition rendered blood alcohol unreliable
‡ Not fastened or inappropriate size § Limit refers to federal legal limit of 80 mg %; some provinces have lower limits

Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

Figure 11 **BLOOD ALCOHOL LEVELS FOR BOATING IMMERSION DEATHS* DURING RECREATION AND DAILY LIFE BY USE OF A PERSONAL FLOTATION DEVICE, CANADA 1991-2010 (VICTIMS ≥ 15 YEARS OF AGE; PFD WORN PROPERLY VS NOT WORN†; n=2,092)**



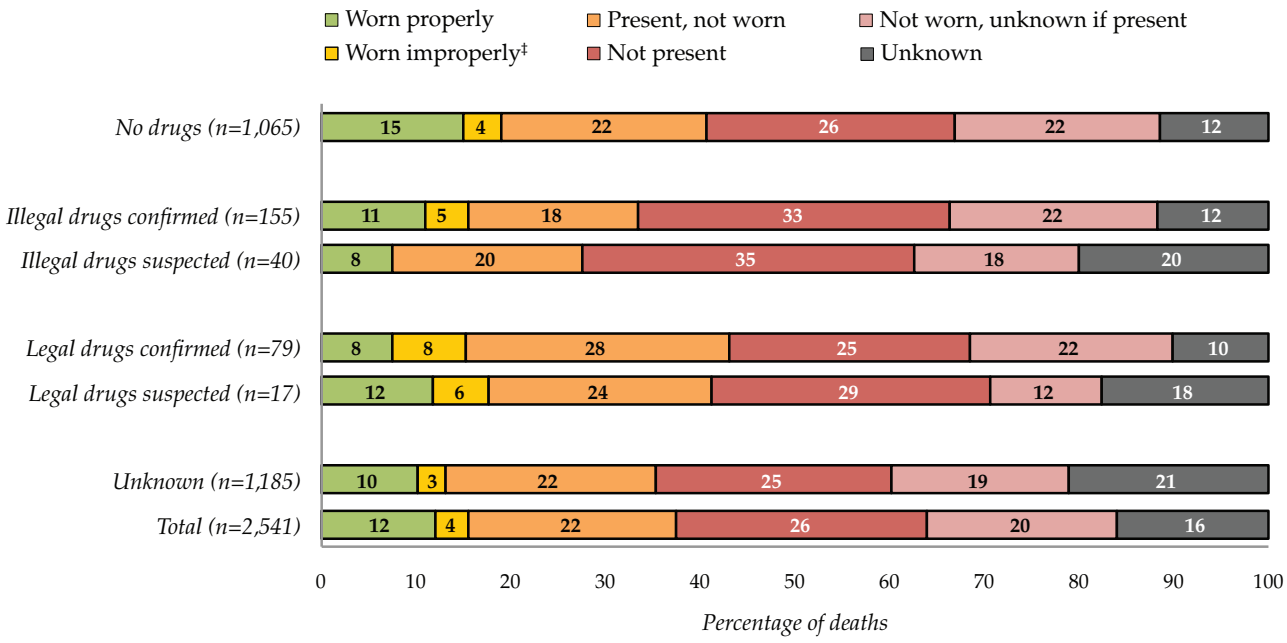
** Includes drownings and immersion hypothermia deaths † Includes PFD present, not worn; not worn, unknown if present; and not present*
‡ Limit refers to federal legal limit of 80 mg %; some provinces have lower limits
§ Charts exclude 139 victims for whom decomposition rendered blood alcohol unreliable (worn properly 7, not worn 132)

Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

DRUGS Illegal drugs were present in the blood or suspected in 8% of victims, but were not always tested for. Illegal drugs were associated with lower PFD wearing than with no drug involvement (Figure 12, Table 14). Cannabis was the mostly frequently detected illegal drug, accounting for 59% of positives, followed by cocaine 17%. Some legal medications that were found could have affected the level of consciousness/alertness, including antidepressants, anti-psychotics, anti-anxiety medications, and antihistamines. Data were not generally present for anticonvulsant medications; however, it is likely that at least 27 victims experienced a seizure due to epilepsy or other causes, based on coroner/medical examiner findings and/or the victim's medical history.

Figure 12

DRUG INVOLVEMENT FOR BOATING IMMERSION DEATHS* DURING RECREATION AND DAILY LIFE BY USE OF A PERSONAL FLOTATION DEVICE, CANADA 1991-2010 (VICTIMS ≥ 15 YEARS OF AGE; n=2,599)†



** Includes drownings and immersion hypothermia deaths † Figure excludes 58 victims for whom decomposition rendered blood sample unreliable ‡ Not fastened or inappropriate size*

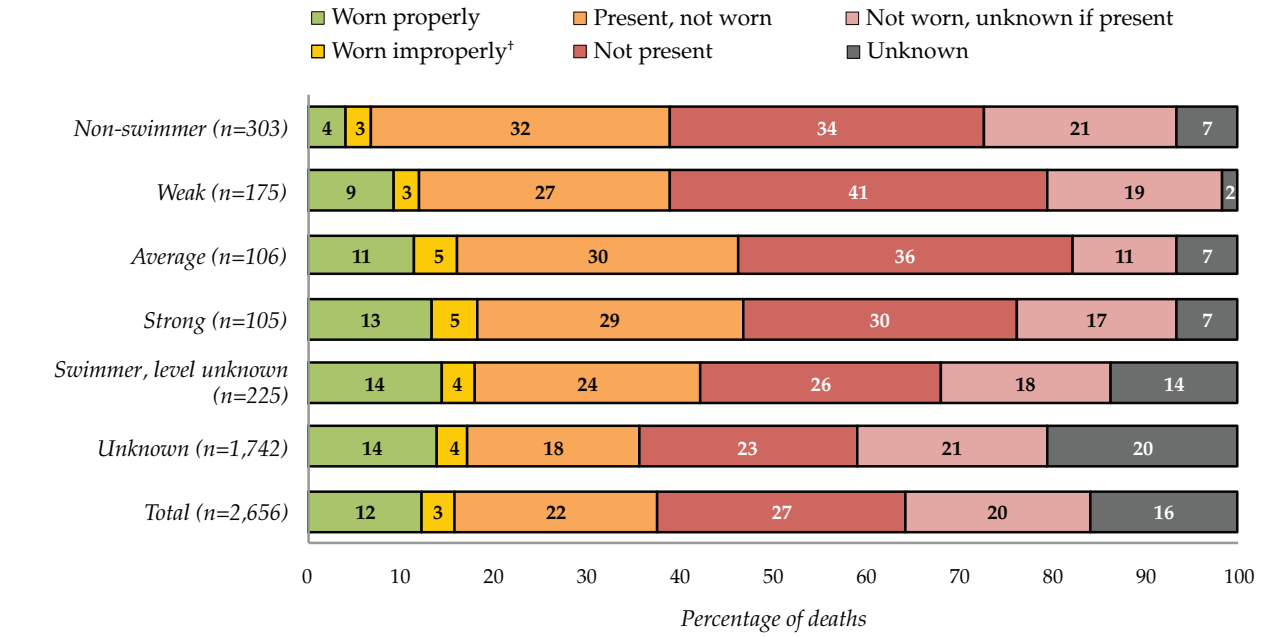
Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

SWIMMING ABILITY Proper PFD wearing was less common among victims reported as non-swimmers than strong swimmers. Only 4% of non-swimmers were properly wearing a PFD, compared to 9% of weak swimmers, 11% of average, 13% of strong, and 12% of all recreational and daily living boaters (Figure 13, Table 15).

BOATING EXPERIENCE was only reported for 34% of boaters. Of these, 23% of inexperienced and 21% of occasional boaters were properly wearing a PFD compared to 15% of those who were experienced. At least 34% of inexperienced, 33% of occasional, and 22% of experienced boaters were in violation of the legal requirement in Canada to have a PFD in the boat. (Figure 14, Table 16). Inexperienced boaters were defined as those who had never boated before or had very limited previous experience. Occasional boaters were those with previous but infrequent boating experience.

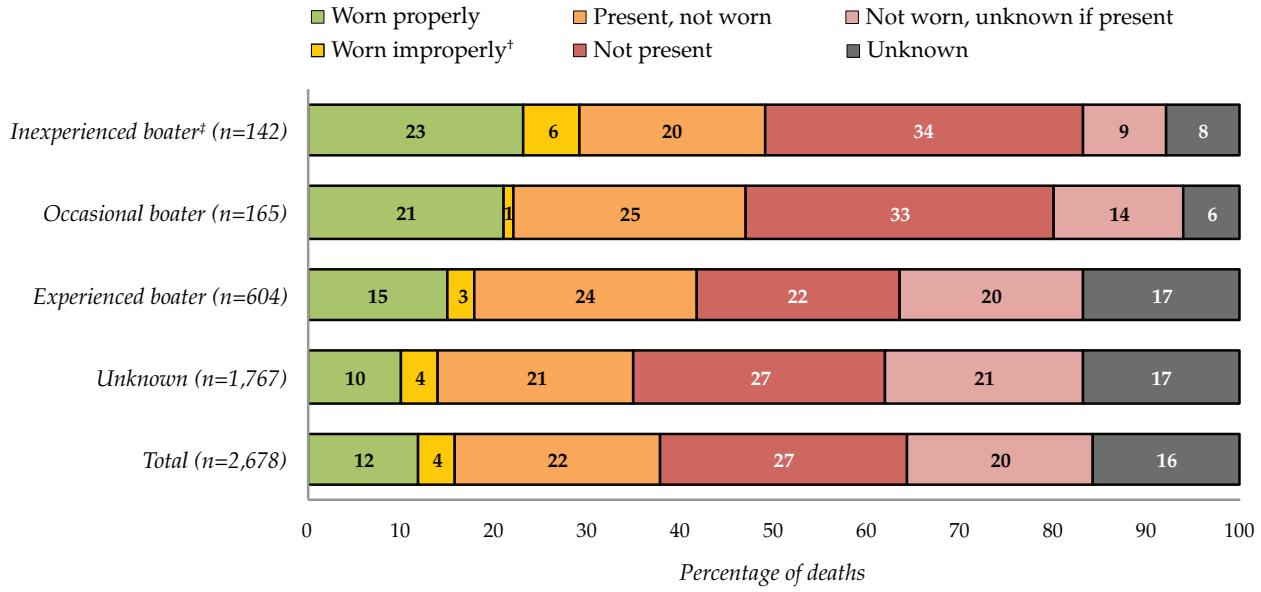
INDIGENOUS ETHNICITY 15% of non-Indigenous victims were properly wearing a PFD, compared with only 3% of Indigenous victims. At least 43% of non-Indigenous victims were wearing or had a PFD in the boat compared with 17% of Indigenous victims (Figure 15, Table 17).

Figure 13 **BOATING IMMERSION DEATHS* DURING RECREATION AND DAILY LIFE BY SWIMMING ABILITY AND USE OF A PERSONAL FLOTATION DEVICE, CANADA 1991-2010 (VICTIMS ≥ 5 YEARS OF AGE; n=2,656)**



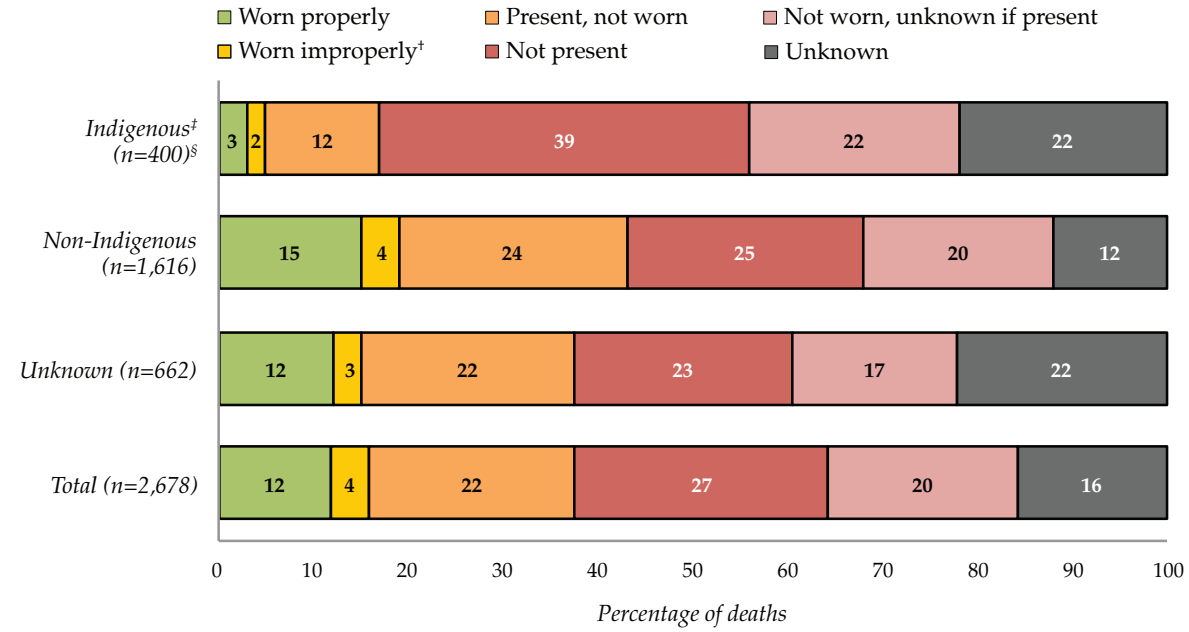
** Includes drownings and immersion hypothermia deaths † Not fastened or inappropriate size*
Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

Figure 14 **BOATING IMMERSION DEATHS* DURING RECREATION AND DAILY LIFE BY BOATING EXPERIENCE AND USE OF A PERSONAL FLOTATION DEVICE, CANADA 1991-2010 (n=2,678)**



** Includes drownings and immersion hypothermia deaths † Not fastened or inappropriate size*
‡ Inexperienced boaters had no or very little experience
Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

Figure 15 **BOATING IMMERSION DEATHS* DURING RECREATION AND DAILY LIFE BY INDIGENOUS ETHNICITY AND USE OF A PERSONAL FLOTATION DEVICE, CANADA 1991-2010 (n=2,678)**



** Includes drownings and immersion hypothermia deaths † Not fastened or inappropriate size*
‡ Indigenous peoples include First Nations, Inuit and Métis § Included those of definite and probable Indigenous ethnicity (368, 32)

Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

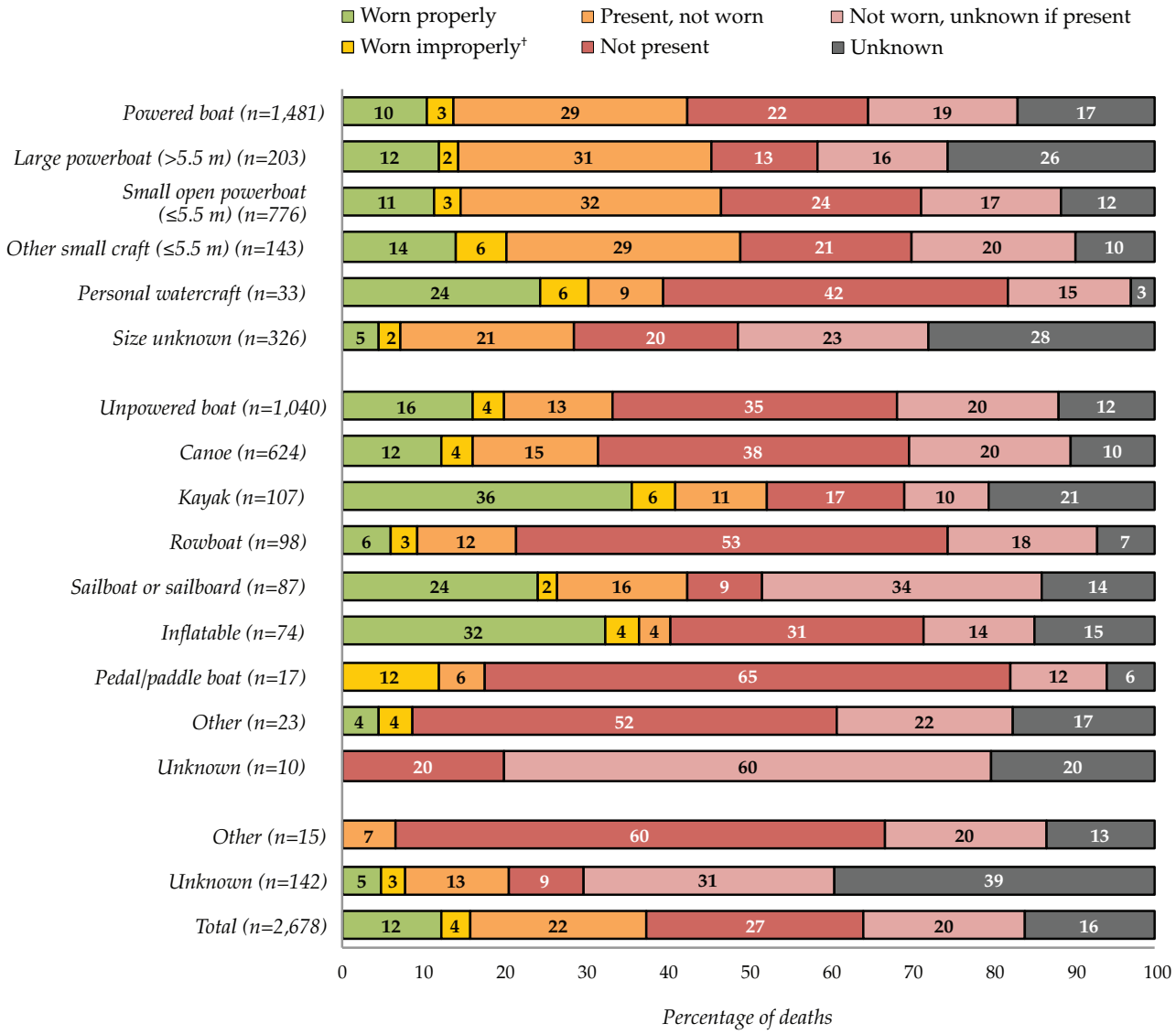
EQUIPMENT FACTORS

TYPE OF BOAT For immersion deaths involving powerboats, 10% of victims were properly wearing a PFD, compared to 16% for unpowered. On the other hand, compliance with the requirement to have a PFD in the boat was lower for unpowered than for powered boating victims. PFDs were most commonly properly worn with kayaks (36%), non-powered inflatables (32%), sailboats or sailboards (24%), and personal watercraft (24%), but considerably less so for the much more frequently used small and large powerboats and canoes (Figure 16, Table 18).

Life rafts can avert or shorten exposure to cold immersion in both recreational and occupational boating. Site of attachment must facilitate rapid and/or automatic launching (Transportation Safety Board of Canada) (Pacific Coast Liferaft at: http://www.liferaft.ca/index.html)

Figure 16

BOATING IMMERSION DEATHS* DURING RECREATION AND DAILY LIFE BY TYPE OF BOAT AND USE OF A PERSONAL FLOTATION DEVICE, CANADA 1991-2010 (n=2,678)



** Includes drownings and immersion hypothermia deaths † Not fastened or inappropriate size*
Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

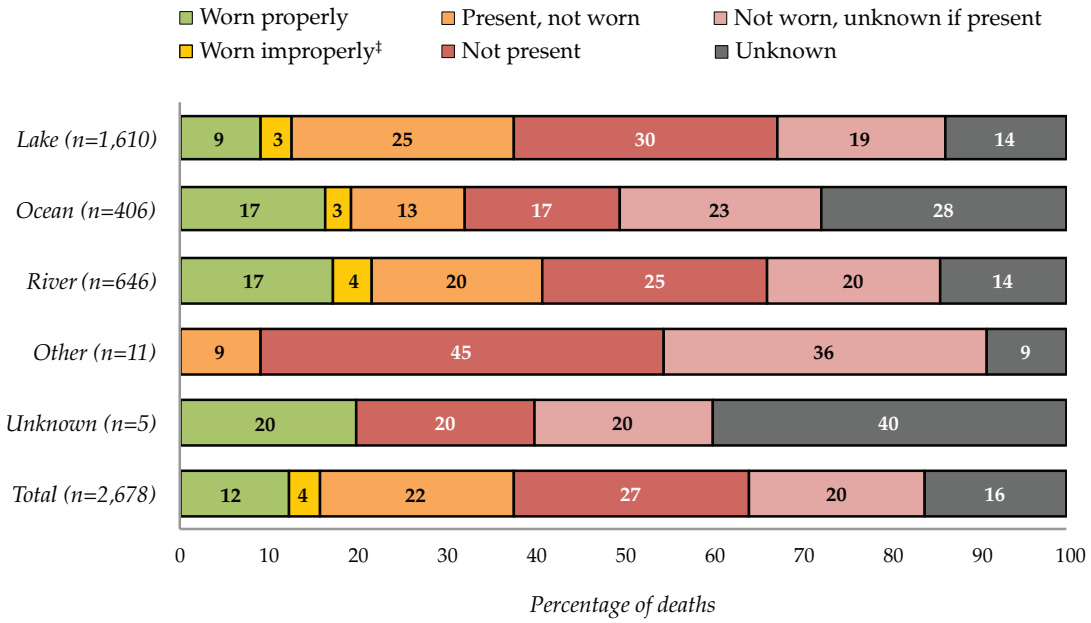
ENVIRONMENT FACTORS

BODY OF WATER 9% of victims boating on lakes or ponds were properly wearing a PFD, compared to 17% for rivers, streams, creeks or waterfalls, and 17% for oceans (Figure 17, Table 19).

CURRENT Moving river water, such as current, rapids or white water, waterfalls, hydraulic current and dams, and dam spillways, was associated with at least 58% of boating immersion deaths on rivers, probably more since current was unknown for 36%. 21% of victims boating in river current properly wore a PFD (Table 20).

WIND AND WAVES PFDs were most frequently worn in the presence of strong winds (19%) and breezy or windy conditions (16%). During calm, this was 8%. For wave conditions, proper wear of PFDs was 16% with storm/gale force wave conditions, 22% with rough/whitecaps, 17% for choppy/small waves, and 6% for calm (Figures 18 & 19, Tables 21 & 22).

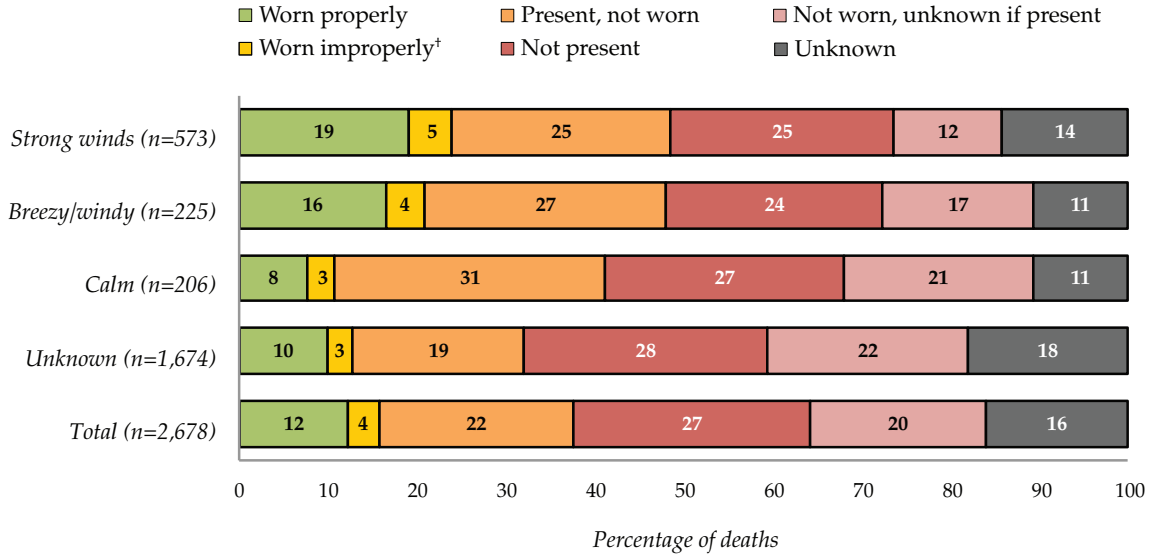
Figure 17 **BOATING IMMERSION DEATHS* DURING RECREATION AND DAILY LIFE BY BODY OF WATER† AND USE OF A PERSONAL FLOTATION DEVICE, CANADA 1991-2010 (n=2,678)**



** Includes drownings and immersion hypothermia deaths † Lake includes pond & reservoir; river includes creek, stream, waterfall & dam ‡ Not fastened or inappropriate size*

Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

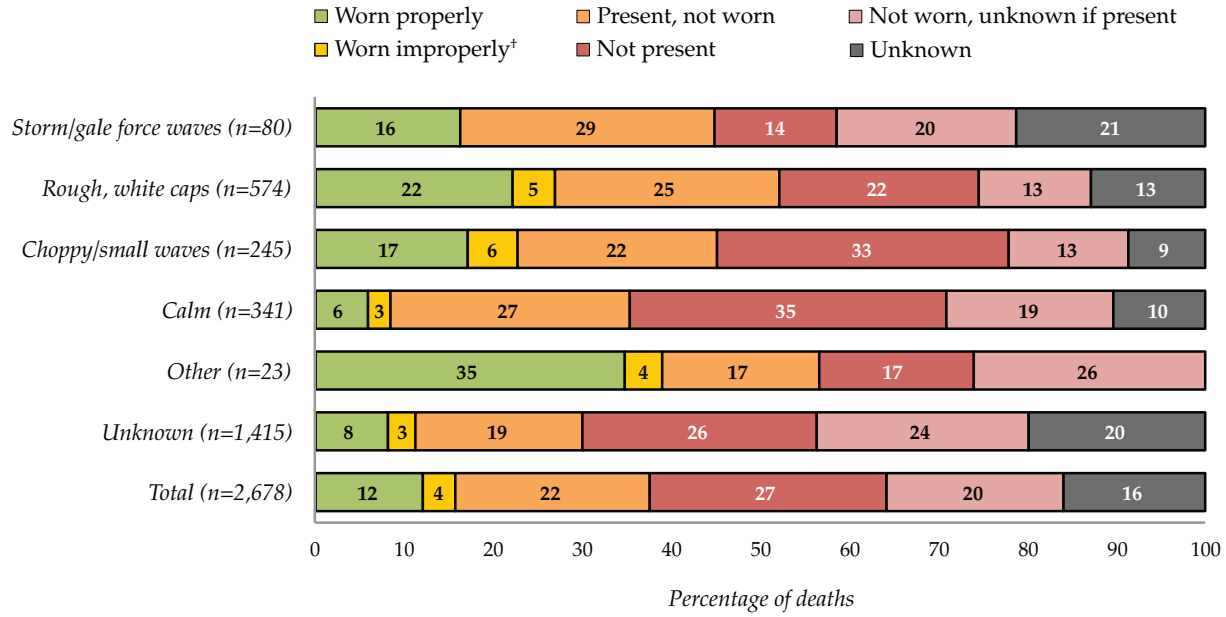
Figure 18 **BOATING IMMERSION DEATHS* DURING RECREATION AND DAILY LIFE BY WIND CONDITIONS AND USE OF A PERSONAL FLOTATION DEVICE, CANADA 1991-2010 (n=2,678)**



** Includes drownings and immersion hypothermia deaths † Not fastened or inappropriate size*

Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

Figure 19 **BOATING IMMERSION DEATHS* DURING RECREATION AND DAILY LIFE BY WAVE CONDITIONS AND USE OF A PERSONAL FLOTATION DEVICE, CANADA 1991-2010 (n=2,678)**



** Includes drownings and immersion hypothermia deaths † Not fastened or inappropriate size*
Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

WATER TEMPERATURE 20% of boating immersion victims had properly worn a PFD when boating on very cold or freezing waters (under 10°C), 15% on cool waters (10°C to 20°C), and 6% on warm or hot (21°C and above) (Figure 20, Table 23).

ICE CONDITIONS Boating immersion deaths by ice conditions were too few to assess (Table 24).

COLD WATER Based on the criteria[a] used in Module 2 of the Canadian Red Cross's 10-year series (Ice & Cold Water), it is probably that cold water played a role in at least 1,227 deaths (46%). Of these, 20% were properly wearing a PFD. For 19% a PFD was not present in the boat and for another 36% it was unknown whether flotation was present (Table 25).

LIGHT CONDITIONS At least 26% of boating immersion deaths occurred during reduced visibility. For incidents during daylight, 14% of victims were properly wearing a PFD, compared to 7% for dark (night) and 12% for dusk (Table 26).

DISTANCE FROM SHORE Many boating victims who died without a PFD were close to shore, where flotation could have made a difference (Table 27).

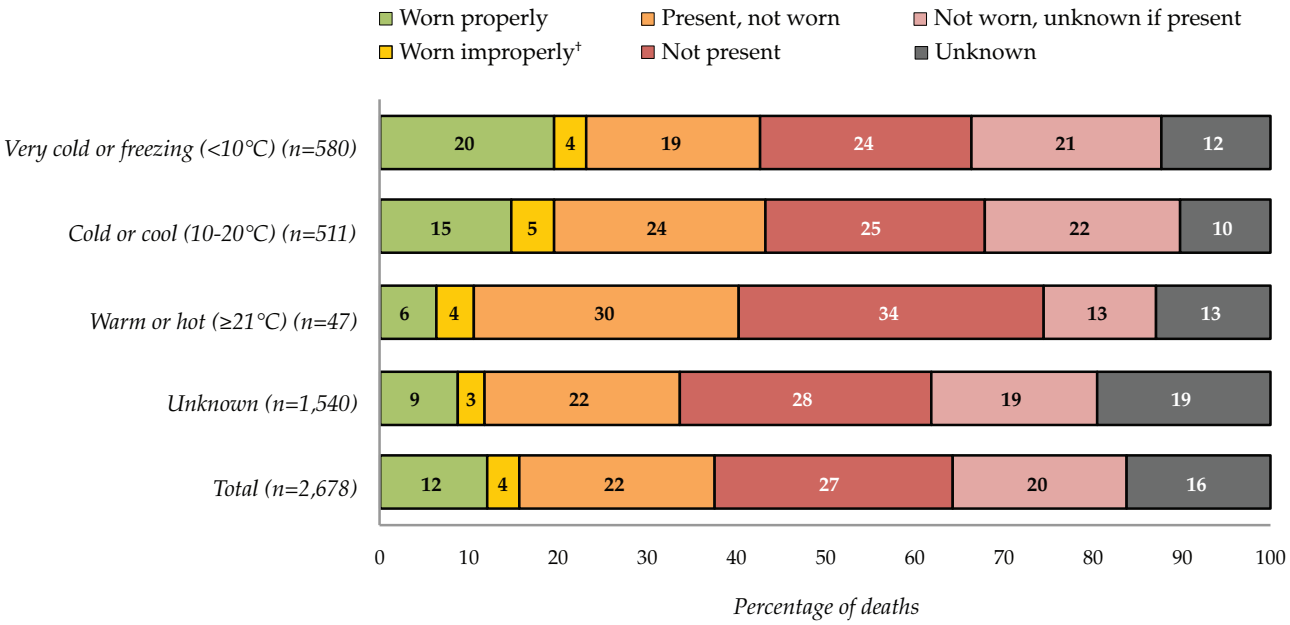
DEPTH OF WATER At least 35% of victims boating in water less than 2.5 metres deep did not even have a PFD on board, compared to 28% in more than 2.5 metres (Table 28).

RURAL/URBAN RESIDENCE & LOCATION OF INCIDENT 10% of victims in urban and 13% in rural incidents were properly wearing a PFD, while, 14% residing in urban and 8% in rural locations properly wore a PFD (Tables 29 & 30).

MONTH 87% of immersion deaths occurred between May and October. There was little difference in flotation wear throughout the year, although from April through September there were slightly higher proportions of PFDs not worn but present in the boat (Table 31).

[a] *These criteria include: hypothermia as reported by coroner, data collector, or autopsy; presence of ice or extremely cold water temperature (<10°C) as reported by coroner or police; and cold month of incident (November-April).*

Figure 20 **BOATING IMMERSION DEATHS* DURING RECREATION AND DAILY LIFE BY WATER TEMPERATURE AND USE OF A PERSONAL FLOTATION DEVICE, CANADA 1991-2010 (n=2,678)**



** Includes drownings and immersion hypothermia deaths † Not fastened or inappropriate size*
Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

DAY OF THE WEEK 24% of immersion deaths took place on Saturday and 20% on Sunday. The average for other days of the week was 11% (Table 32).

ACCOMPANIMENT For victims accompanied by at least one adult, 14% were properly wearing a PFD, and of those alone, 9% (Table 32). For children 0-14 years old accompanied by at least one adult, 31% were properly wearing a PFD, and for youth 15-19 years with at least one adult, 11% (Table 33).

MULTIPLE VICTIM INCIDENTS

PFDs were more frequently worn properly by victims involved in multiple victim incidents. While 11% of single victims were properly wearing a PFD, where there were 2 victims it was 15%, 3 victims 18%, and 4 or more victims 16% (Figure 21, Table 34).

AGE AND SEX 27% of male and 44% of female deaths occurred during incidents involving more than one victim (Table 35). 79% of multiple victim deaths involved boaters 15-54 years old (Table 36).

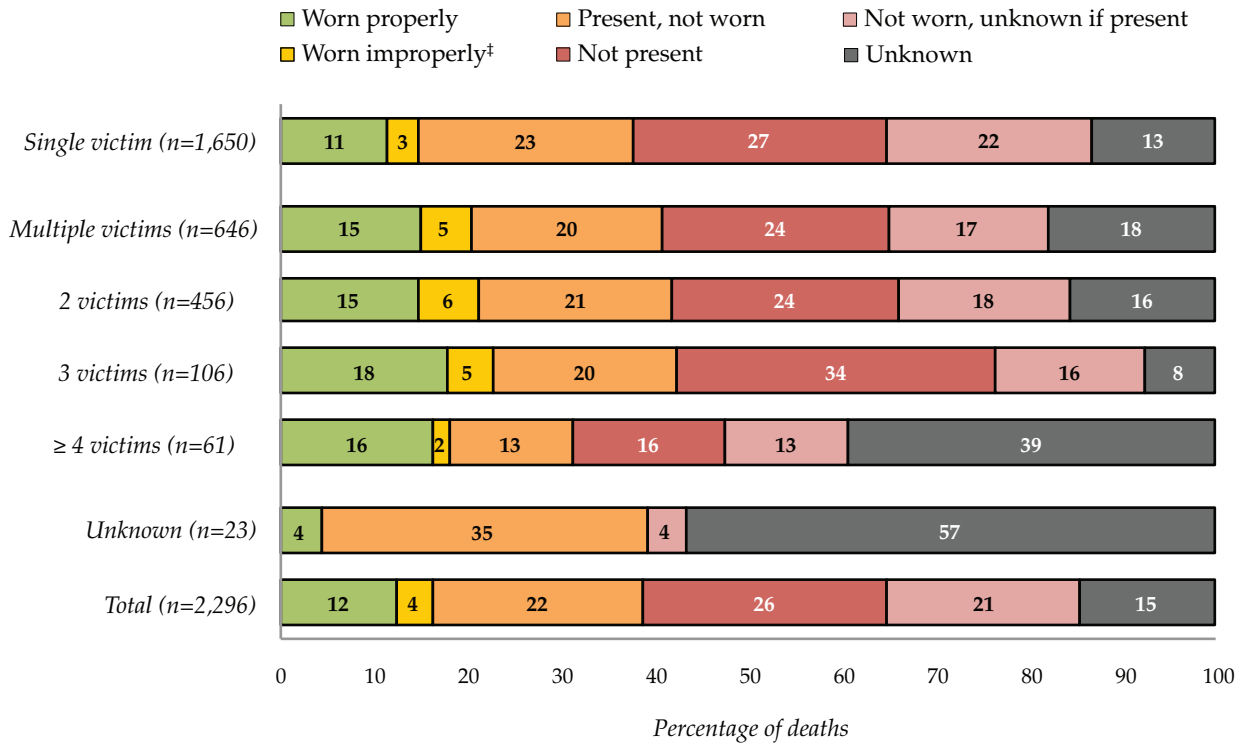
INDIGENOUS ETHNICITY 42% of deaths involving Indigenous people occurred during incidents claiming more than one victim, compared to 26% for other Canadians (Table 37).

TYPE OF BOAT 32% of powerboat deaths occurred during multiple victim incidents, compared to 23% for unpowered boats (Table 38).

BODY OF WATER 44% of ocean deaths occurred during multiple victim incidents, compared to 22% for rivers and 26% for lakes and ponds (Table 39).

ABOVE: River rafting in rapids – safety gear is essential, including activity specific PFDs, cold water suits, gloves, and helmets.
BELOW: Capsize in rapids – once clear of rapids, appropriate methods are needed to right a raft. This includes pulling from the bottom side with a rope or paddle handle. While still in the water, safety gear protects against cold from immersion and traumatic brain injury from rocks. Kangiqsualujjuaq (Georges River), Nunavik, Canada (Photos: Jean-Philippe Paiement, http://watercolorsimages.blogspot.ca/2012/09/georges-river-and-other-adventures.html)

Figure 21 **BOATING IMMERSION DEATHS* DURING RECREATION AND DAILY LIFE BY NUMBER OF VICTIMS AND USE OF A PERSONAL FLOTATION DEVICE, CANADA 1993-2010† (n=2,296)**



** Includes drownings and immersion hypothermia deaths † Data is not available for 1991-1992 ‡ Not fastened or inappropriate size*
Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

SURVIVORS

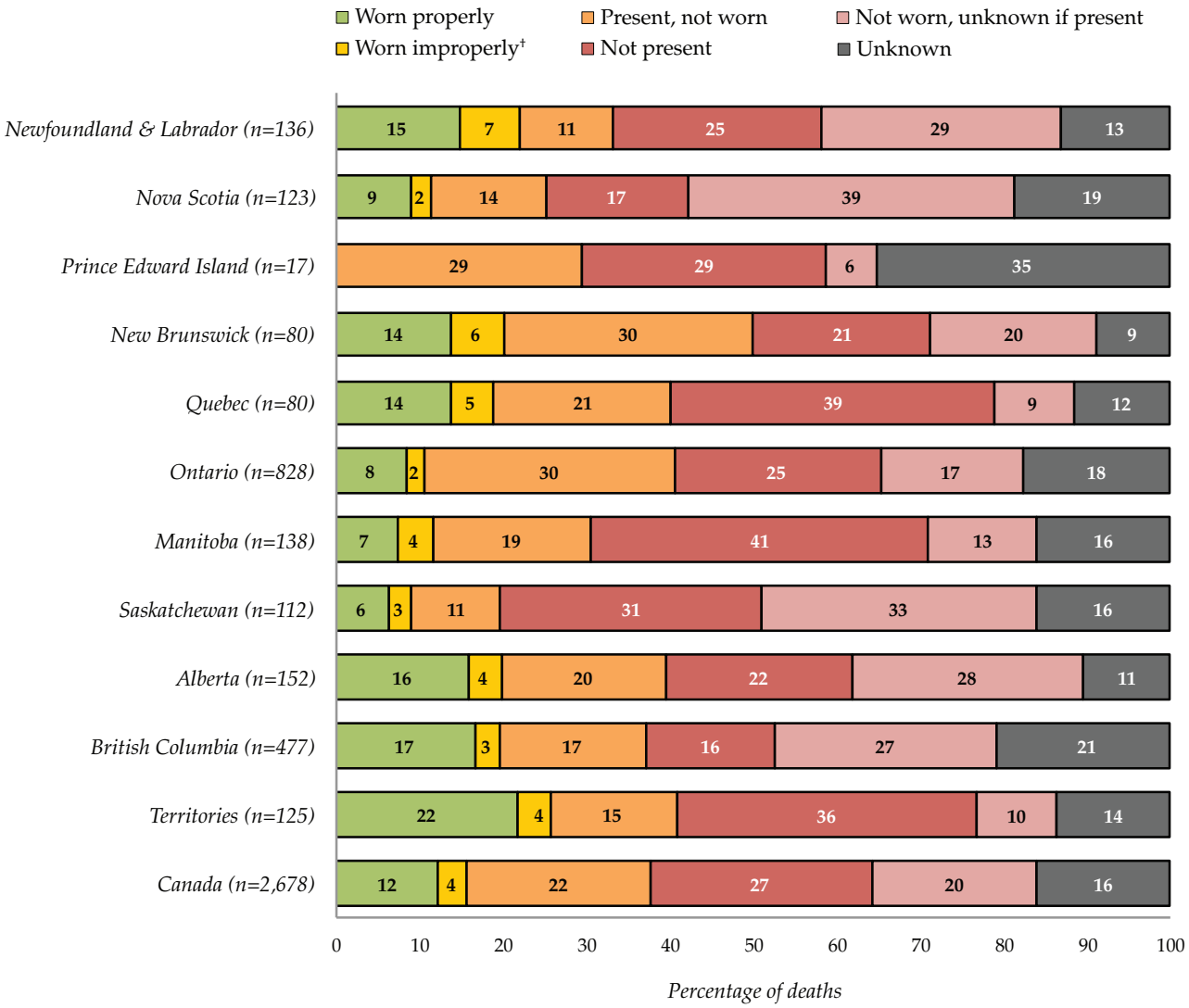
Survivor response was collected for capsizing and swamping incidents from 1996 onwards, so was not complete for the entire period and was not consistently recorded in coroner and police files. Of the 1,805 recreational and daily living boating immersion deaths during 1996-2010, there was one or more survivors for 673 deaths.

SURVIVOR RESPONSE Of the 673 deaths with one or more survivors, 27% of survivors swam for shore immediately, 12% swam to shore after a delay, 15% stayed with the boat, 12% had no choice to stay with boat or swim to shore due to the boat sinking, being swept away from the boat, or being trapped in the boat, and 6% had 'other' responses. Survivor response was unknown for 27% (Table 40). For victims involved in capsizing or swamping incidents, 11% swam for shore immediately, 6% swam for shore after a delay, 8% stayed with the boat, 30% had no choice to stay with the boat or swim to shore, 8% had 'other' responses, and victim response was unknown for 37% (Table 41).

REGION

Proper wearing of PFDs among victims was low in all provinces and territories. It was highest in the northern Territories and in Alberta and British Columbia. PFD wearing was lowest in Saskatchewan, Manitoba, Ontario and Nova Scotia. Although there were only 17 deaths in Prince Edward Island during the 20 year period, not one of these victims was reported to have been wearing a PFD (Figure 22, Table 42). As for completeness of reporting of PFD wearing among victims, this was highest in New Brunswick, Quebec, Alberta, and Newfoundland, and lowest in British Columbia and Ontario where there were many more unknowns.

Figure 22 **BOATING IMMERSION DEATHS* DURING RECREATION AND DAILY LIFE BY REGION AND USE OF A PERSONAL FLOTATION DEVICE, CANADA 1991-2010 (n=2,678)**



** Includes drownings and immersion hypothermia deaths † Not fastened or inappropriate size*
Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

TRENDS

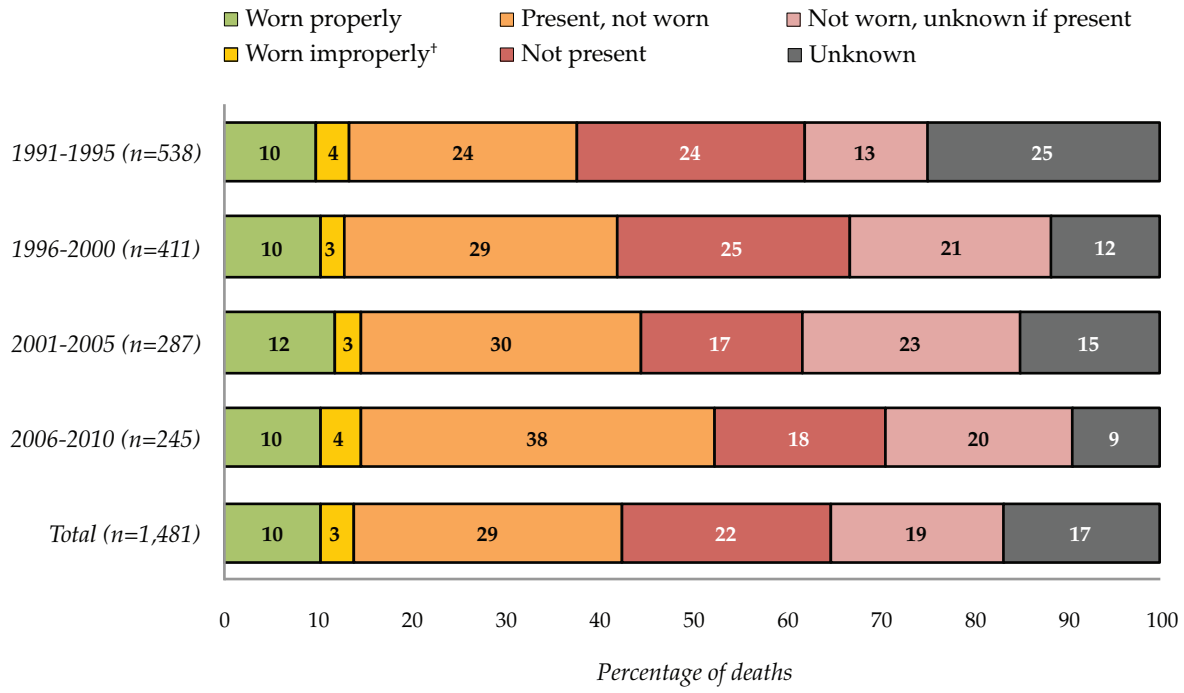
Among boating immersion victims, the proportion properly wearing PFDs remained low at 12% to 13% between 1991-1995 and 2005-2010 (Figure 23, Table 43). The proportion of deaths where a PFD was present but not worn rose from 19% to 25%. Hence while there was no increase in wearing among victims, there was some increase in compliance with current regulations requiring PFDs aboard. There may have been a slight decline in unknowns, perhaps attributable to greater awareness of police and coroners.

TYPE OF BOAT The proportion of victims reported properly wearing a PFD during powered boating incidents did not significantly change over the 20 year period. However, the proportion in compliance with current regulations requiring a flotation device(s) in the boat did increase. Unknowns also decreased (Figure 24, Table 43). For unpowered, the proportion properly wearing ranged from 13% to 18% during the 20 year period (Figure 25, Table 44).

Figure 23 **TRENDS IN BOATING IMMERSION DEATHS* DURING RECREATION AND DAILY LIFE BY USE OF A PERSONAL FLOTATION DEVICE, CANADA 1991-2010 (n=2,678)**

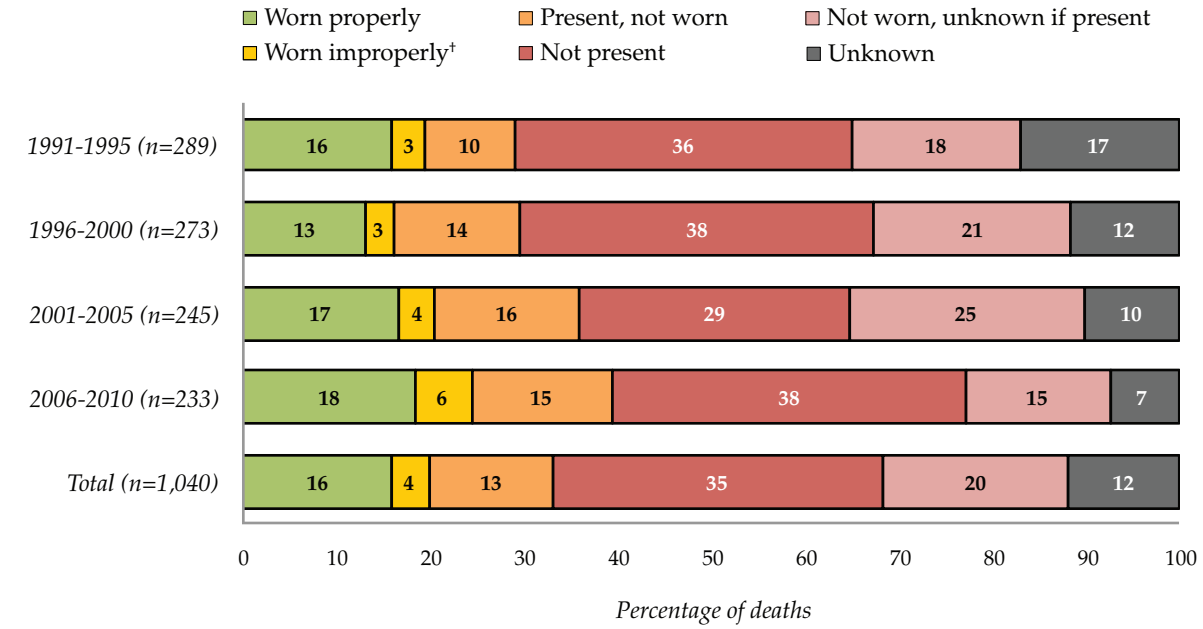
** Includes drownings and immersion hypothermia deaths † Not fastened or inappropriate size*
Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

Figure 24 **TRENDS IN POWERED BOATING IMMERSION DEATHS* DURING RECREATION AND DAILY LIFE BY USE OF A PERSONAL FLOTATION DEVICE, CANADA 1991-2010 (n=1,481)**



** Includes drownings and immersion hypothermia deaths † Not fastened or inappropriate size*
Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

Figure 25 **TRENDS IN UNPOWERED BOATING IMMERSION DEATHS* DURING RECREATION AND DAILY LIFE BY USE OF A PERSONAL FLOTATION DEVICE, CANADA 1991-2010 (n=1,040)**



** Includes drownings and immersion hypothermia deaths † Not fastened or inappropriate size*
Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

RECREATION AND DAILY LIFE: TRAUMA DEATHS

There were 167 recreational and daily living boating fatalities due to trauma during 1991-2010, accounting for 6% of all such deaths. 95% occurred during recreational activities and 5% during activities of daily life (Table 3).

FLOTATION 24% of victims were properly wearing a PFD, 2% improperly wearing, and at least 36% not wearing a PFD, possibly more since PFD involvement was unknown for 38% (Figure 26, Table 45).

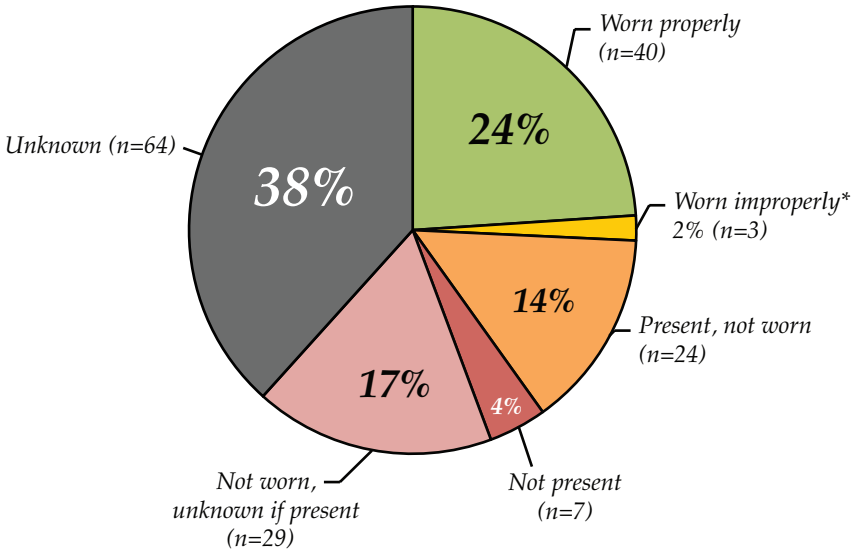
TYPE OF INCIDENT 72% of deaths resulted from various types of collision, 19% from falling overboard, 4% from capsizing and 5% from other types of incident. For collisions, 43% were between two boats, 43% were between a boat and a fixed object, and 7% between a boat and a victim. Of the 8 trauma deaths where the collision was between a boat and a victim, 4 of the victims were swimmers and 4 were being towed by a boat during waterskiing or tubing. Among the 31 trauma deaths involving falling overboard, 45% of victims were struck and injured by the boat propeller (Table 45).

NATURE OF INJURY Traumatic boating incidents frequently resulted in head injury, which accounted for at least 41% of boating trauma deaths. 21% of those who suffered a head injury were properly wearing a PFD, spinal injury 24%, bone fracture or dislocation 23%, and major lacerations 26% (Figure 27, Table 46). Use of helmets was generally not reported.

PERSONAL FACTORS

AGE AND SEX 76% of boating trauma victims were males and 24% females. 20% of males and 35% of females were properly wearing a PFD (Table 47). 79% of victims were between 15 and 54 years of age (Table 48).

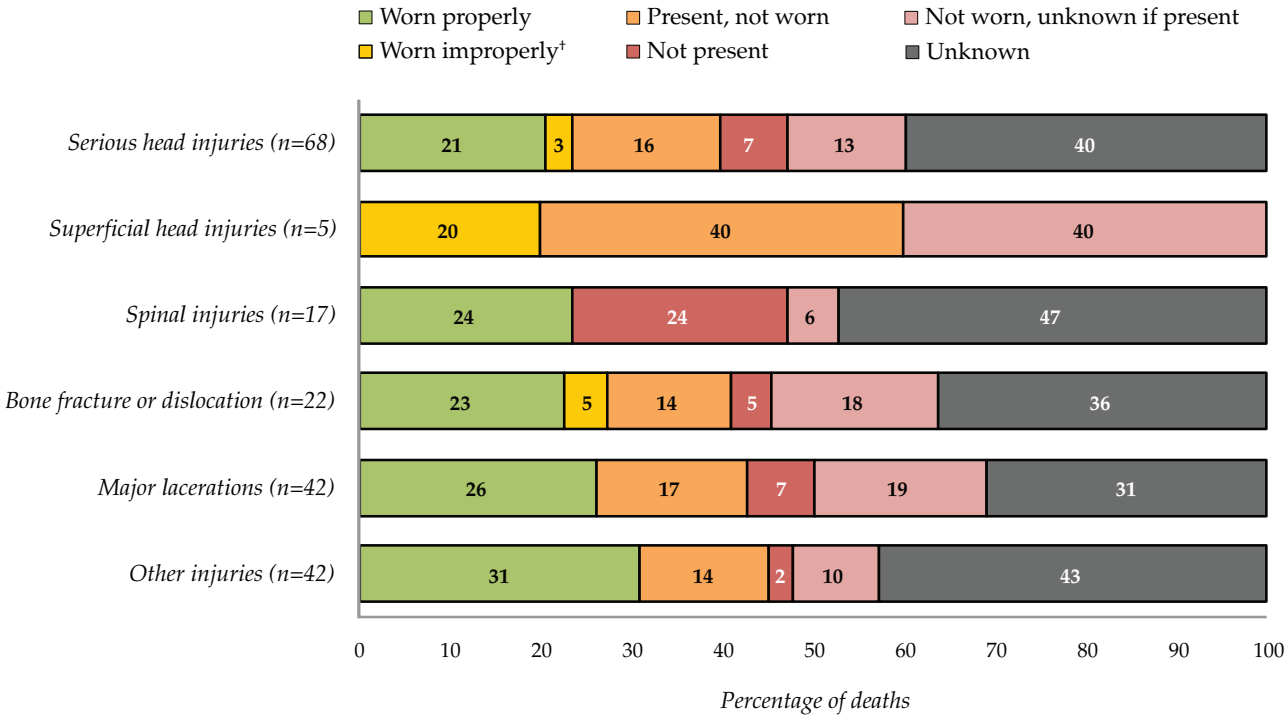
Figure 26 **BOATING TRAUMA DEATHS DURING RECREATION AND DAILY LIFE BY USE OF A PERSONAL FLOTATION DEVICE, CANADA 1991-2010 (n=167)**



* *Not fastened or inappropriate size*

Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

Figure 27 **BOATING TRAUMA DEATHS DURING RECREATION AND DAILY LIFE BY NATURE OF INJURY AND USE OF A PERSONAL FLOTATION DEVICE, CANADA 1991-2010 (n=167)***



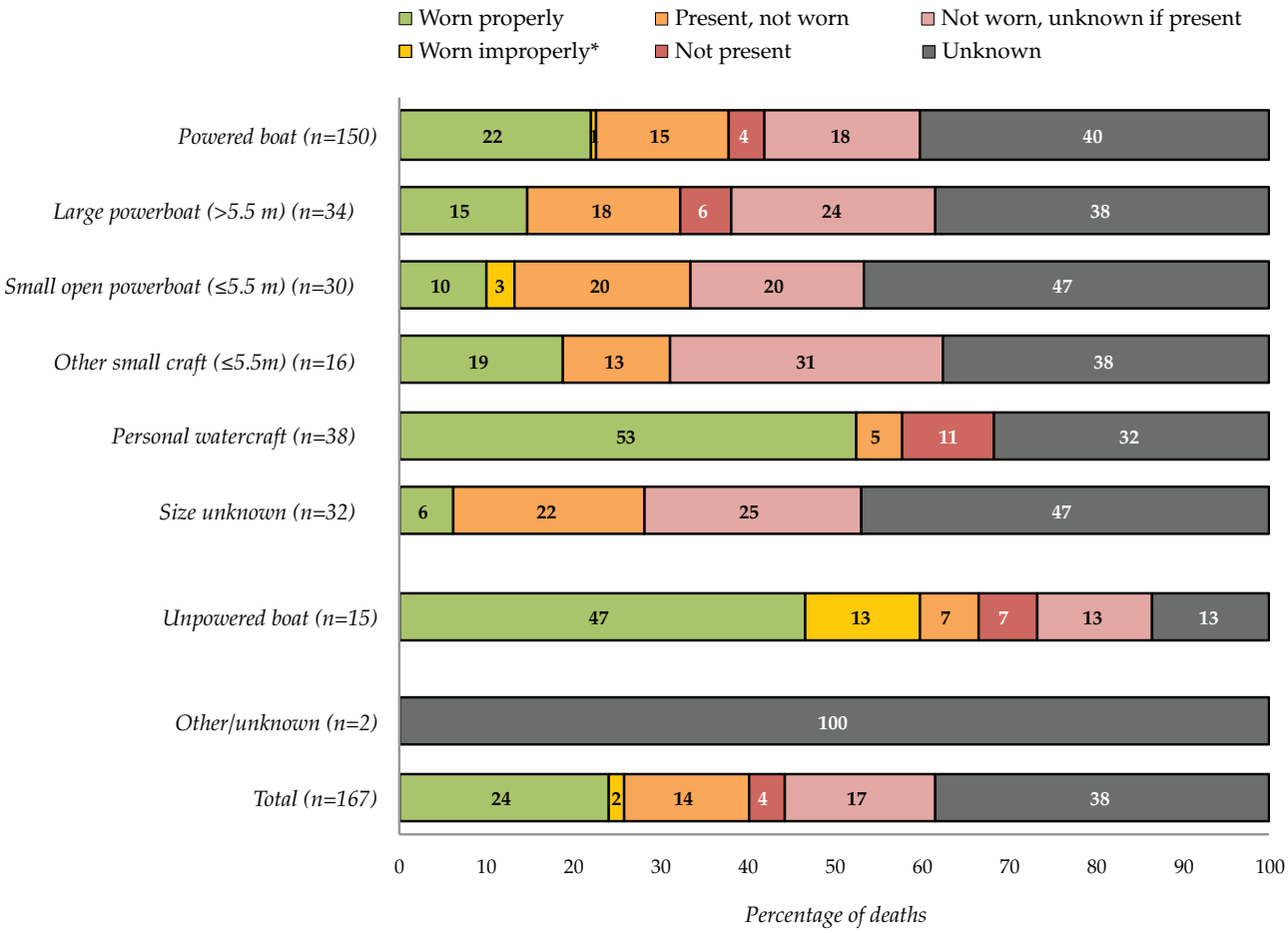
* *Victims may have incurred more than one type of injury* † *Not fastened or inappropriate size*

Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

EQUIPMENT FACTORS

TYPE OF BOAT 22% of trauma victims in powered boats were properly wearing a PFD, compared with 47% in unpowered (Figure 28, Table 49). About half of all trauma victims using personal watercraft were wearing a PFD, compared to just 10% of those in a small open powerboat.

Figure 28 **BOATING TRAUMA DEATHS DURING RECREATION AND DAILY LIFE BY TYPE OF BOAT AND USE OF A FLOTATION DEVICE, CANADA 1991-2010 (n=167)**



** Not fastened or inappropriate size*

Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

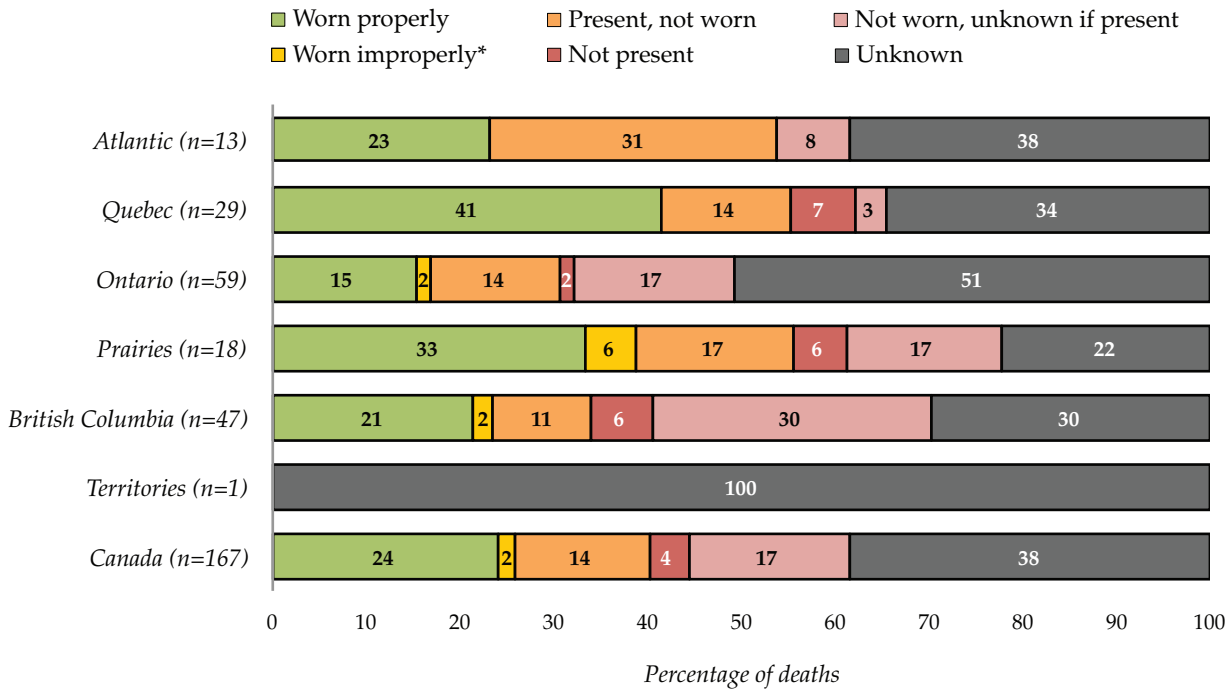
REGION

Proper wearing of a PFD among boating trauma victims was highest in Quebec and the Prairies, and lowest in Ontario (Figure 29, Table 50).

Specialised PFDs are available for PWCs. Some are made to protect the torso in the event of a collision. (From http://www.discoverboating.ca/buying/boat/personal-watercrafts?gclid=CLmj3_L8s8oCFYQ1aQodsd8BaA)

Figure 29

BOATING TRAUMA DEATHS DURING RECREATION AND DAILY LIFE BY REGION AND USE OF A PERSONAL FLOTATION DEVICE, CANADA 1991-2010 (n=167)



** Not fastened or inappropriate size*

Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

BOATERS WHO DIED DESPITE WEARING A PFD

Of 2,678 recreational and daily living boating immersion deaths during 1991-2010, 327 victims were reported to be properly wearing a PFD.

TYPE OF INCIDENT 49% of victims who died despite properly wearing a PFD had been immersed from capsizing, 20% swamping, 9% falling overboard, and 4% from collision including boat with boat, boat with fixed object, or swimmer being hit by a boat. For those victims not wearing a PFD, 41% ended up in the water due to capsizing, 29% falling overboard, 12% swamping, and 3% collision (Figure 30, Table 11).

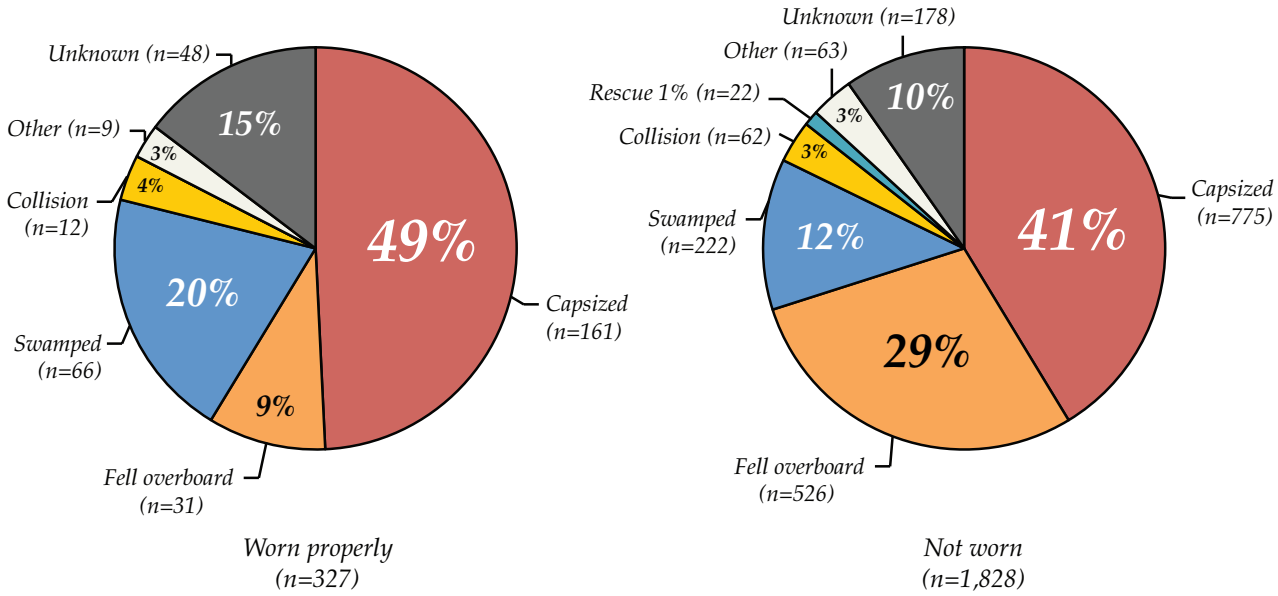
AGE & SEX 72% of victims who died despite properly wearing a PFD were between 25 and 64 years, and 89% were males (Table 12).

ALCOHOL Alcohol was known or suspected for 17% of victims properly wearing a PFD, compared to 49% for those not wearing (Figure 31, Table 13).

SWIMMING ABILITY For boating immersion victims 5 years of age and older properly wearing a PFD, 4% were non-swimmers, 5% were weak swimmers, 4% were of average swimming ability, 4% were strong swimmers and another 10% were swimmers but skill level was not further defined. Swimming ability was unknown for 73% of victims properly wearing a PFD (Table 15).

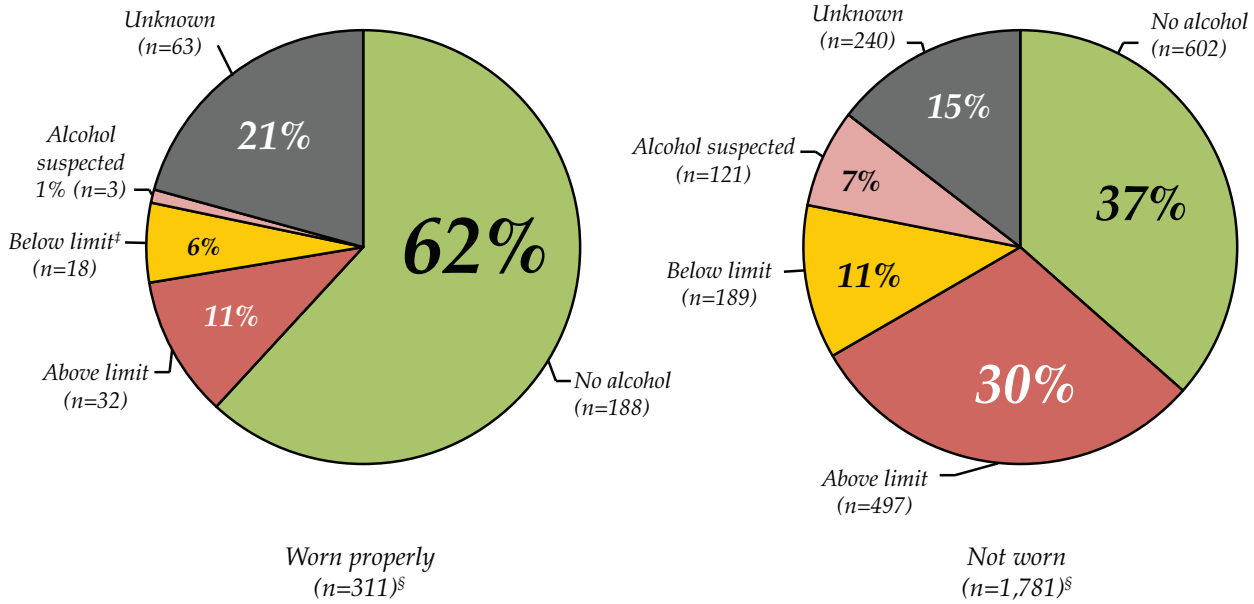
This PFD is short for use in a kayak with spray skirts, and has armholes cut low to allow for shoulder rotation when paddling. Helmets are essential for brain injury prevention when white water paddling. (Oleg Zabielin, Shutterstock.com)

Figure 30 **BOATING IMMERSION DEATHS* DURING RECREATION AND DAILY LIFE BY TYPE OF INCIDENT AND USE OF A PERSONAL FLOTATION DEVICE, CANADA 1991-2010 (VICTIMS WHO PROPERLY WORE OR WHO DID NOT WEAR† A PFD; n=2,155)**



* Includes drownings and immersion hypothermia deaths † Includes PFD present, not worn; not worn, unknown if present; and not present
Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

Figure 31 **BLOOD ALCOHOL LEVELS FOR BOATING IMMERSION DEATHS* DURING RECREATION AND DAILY LIFE BY USE OF A PERSONAL FLOTATION DEVICE, CANADA 1991-2010 (VICTIMS ≥ 15 YEARS OF AGE WHO PROPERLY WORE OR WHO DID NOT WEAR† A PFD; n=2,092)**



* Includes drownings and immersion hypothermia deaths † Includes PFD present, not worn; not worn, unknown if present; and not present
‡ Limit refers to federal legal limit of 80 mg %; some provinces have lower limits
§ Charts exclude 139 victims for whom decomposition rendered blood alcohol unreliable (worn properly 7, not worn 132)
Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

COLD WATER Based on the criteria[a] used in Module 2 of the Canadian Red Cross's 10-year series (Ice & Cold Water), exposure to cold water was a probable factor for 73% of victims properly wearing a PFD. Cold water was a factor for 51% of victims improperly wearing a PFD, 41% of those who had a PFD present but not worn, 32% of those with no PFD present, and 47% of those where a PFD was not worn but it was uncertain if one was present (Table 25).

CURRENT Moving river water, including current, rapids, white water, waterfalls, hydraulic current, dams and dam spillways, was associated with at least 30% of deaths where the victim was properly wearing a PFD, likely more as PFD involvement was unknown for 34%. Ocean current including undertow and tide was associated with 11% of deaths where the victim was properly wearing a PFD (Table 20).

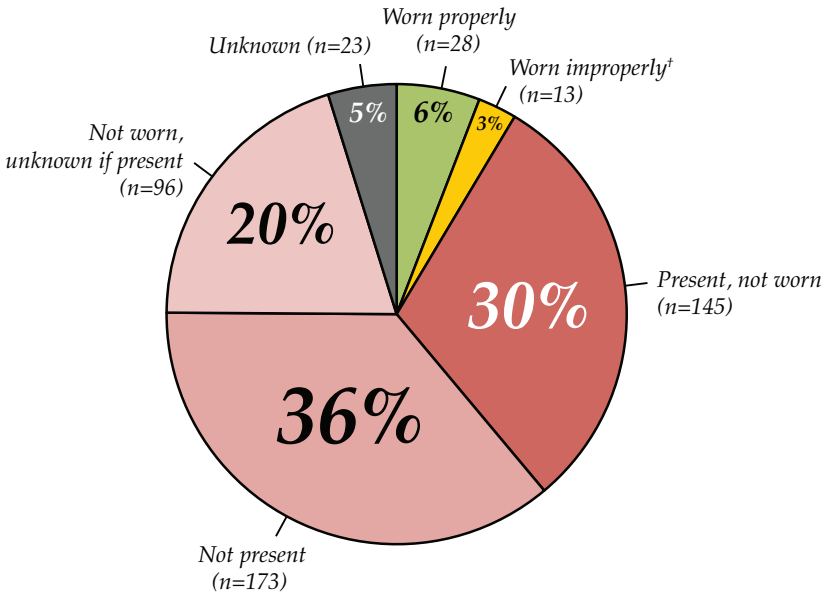
WEAK AND NON-SWIMMERS

Victims 5 years of age and older reported by swimming ability included 303 non-swimmers, 175 weak, 106 average, 105 strong, swimmer of unknown level 225, and unknown 1,742. For average and strong swimmers, 12% were properly wearing a PFD, and for victims who were swimmers but skill level was not identified, 14% were properly wearing one (Table 15). However, for the 478 immersion victims identified as weak or non-swimmers, only 6% were reported to be properly wearing a PFD (Figure 32, Table 51). There were even differences between non-swimmers and weak swimmers, with only 4% of non-swimmers properly wearing a PFD, compared to 9% for weak swimmers.

TYPE OF INCIDENT 43% of weak and non-swimmers died in capsizes, 31% by falling or being thrown overboard, 13% swamping, 3% collisions, 1% rescues, and 8% other or unknown (Table 51). This differed only slightly from other boaters with 40% capsizing, 25% falling overboard, 12% swamping, 4% collisions, 1% rescues, and 17% other or unknown.

Figure 32

BOATING IMMERSION DEATHS* OF WEAK AND NON-SWIMMERS DURING RECREATION AND DAILY LIFE BY USE OF A PERSONAL FLOTATION DEVICE, CANADA 1991-2010 (VICTIMS ≥ 5 YEARS OF AGE; n=478)†



** Includes drownings and immersion hypothermia deaths † Not fastened or inappropriate size*

Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

[a] *These criteria include: hypothermia as reported by coroner, data collector, or autopsy; presence of ice or extremely cold water temperature (<10°C) as reported by coroner or police; and cold month of incident (November-April).*

AGE AND SEX 96% of weak and non-swimmers were males, and 87% were between 15 and 64 years of age. Only 8% of weak and non-swimmers between the ages of 5 and 14 years were wearing a PFD, and for 15-19 years, 3% (Table 52).

TYPE OF BOAT Powered boats were associated with 56% of deaths involving weak and non-swimmers, and unpowered with 42%. Small open fishing type craft were the most numerous powerboats, representing 33% of all deaths among weak and non-swimmers. Canoes were the most common unpowered boat, representing 27% of deaths (Table 53). Type of boat was relatively similar to other boaters, with the exception of kayaks, which represented only 1% for weak and non-swimmers compared with 5% for all others.

URBAN/RURAL RESIDENCE & LOCATION 66% of weak and non-swimmers resided in urban locations and 30% in rural, unknowns 4% (Table 54). 75% of deaths among weak and non-swimmers occurred in rural locations, and 23% in urban ones, unknowns 2% (Table 55).

DISTANCE FROM SHORE For weak and non-swimmers who drowned at 0 to 2 metres from shore, 8% were properly wearing a PFD, 2.1 to 15 metres 5%, 16 to 50 metres 0%, and greater than 50 metres 9% (Table 56).

DEPTH OF WATER For weak and non-swimmers who drowned in 0 to 1 metres of water, none was properly wearing a PFD, 1.1 to 2.5 metres 3%, and more than 2.5 metres 6% (Table 57).

CHILD AND YOUTH BOATERS

20% of 0-14-year-old victims were properly wearing a PFD, compared with 11% for youth 15-19 years (Figures 33 and 34, Table 58). For 35% of child boaters, there was reportedly no PFD present, representing a violation of current legislation, and for another 27% it was unknown whether a PFD was present. Hence as many as 62% were in violation.

Young paddler with small boating PFD providing head support for child, North Central British Columbia.
(From PictureBC.ca, photo by Shannon Himmelright)

AGE AND SEX Among 2,678 recreational and daily living boating victims during 1991-2010, included were 4 infants less than 1 year old, 18 toddlers 1-4 years old, 57 5-14 year olds, and 219 youths 15-19 years old. By sex, all 4 infants were male, there were 13 male and 5 female toddlers, 40 male and 17 female 5-14 year olds, and 198 male and 21 female youths.

ACTIVITY The most frequent recreational boating activity for 0-14-year-old victims was power boating, and for 15-19-year-old youths canoeing. 33% of 0-14 year olds had been properly wearing a PFD while power boating and 18% while fishing from a boat. Only 8% of 15-19 year olds had been properly wearing a PFD while canoeing, 12% fishing from a boat, and 10% for power boating (Table 58).

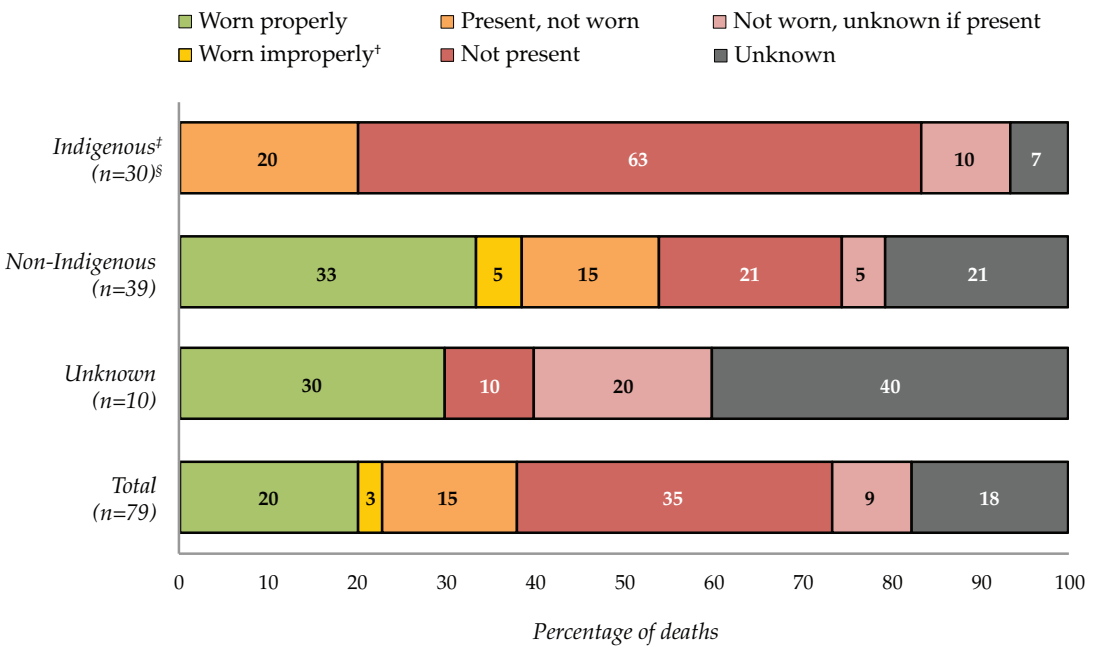
SUPERVISION & ACCOMPANIMENT 25% of victims 0-14 years were alone or with minors only at the time of the incident. For the remaining 75%, there was at least one adult present. For 15-19 year olds, 20% were alone or with minors only, 65% with at least one adult and 13% with others. Of the 17 victims 0-19 years who were alone at the time of the incident, only one was wearing a PFD. For 0-14 year olds with an adult, 25% were properly wearing a PFD, and for 15-19 year olds, 13% (Table 60).

INDIGENOUS ETHNICITY

18% of non-Indigenous children and youth were properly wearing a PFD (0-14 years 33%, 15-19 years 13%). However, not a single Indigenous victim 0-19 years old was reported to have properly worn a PFD during the 20-year period (Figures 33 & 34, Table 59).

Figure 33

BOATING IMMERSION DEATHS* OF CHILDREN DURING RECREATION AND DAILY LIFE BY INDIGENOUS ETHNICITY AND USE OF A PERSONAL FLOTATION DEVICE, CANADA 1991-2010 (VICTIMS < 15 YEARS OF AGE; n=79)

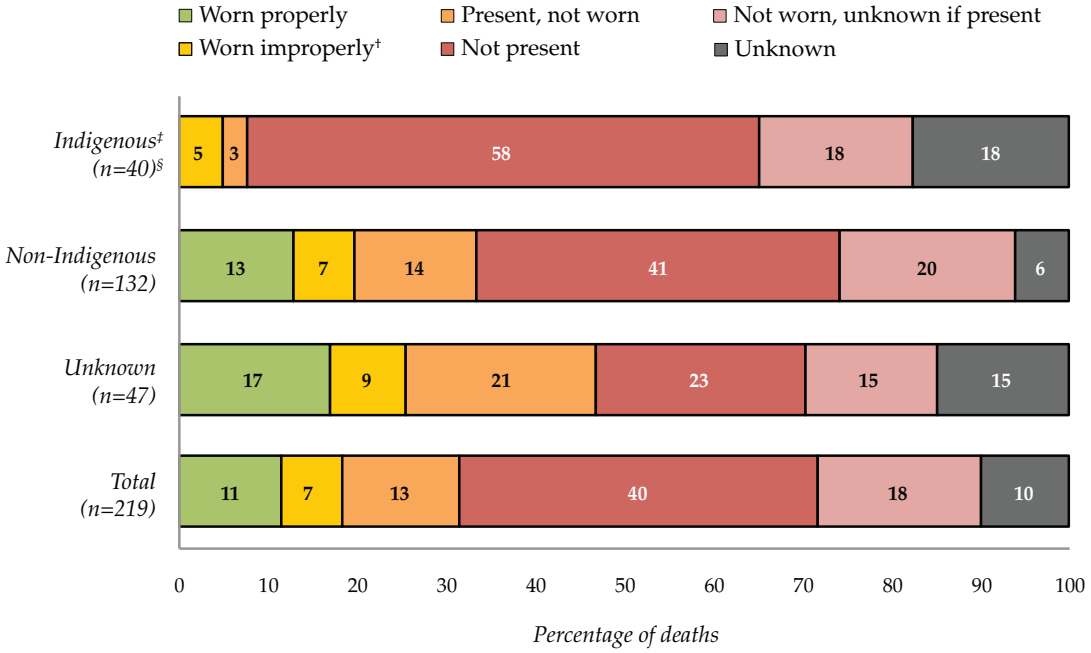


** Includes drownings and immersion hypothermia deaths † Not fastened or inappropriate size*
‡ Indigenous peoples include First Nations, Inuit and Métis § Included those of definite and probable Indigenous ethnicity (27, 3)

Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

Figure 34

BOATING IMMERSION DEATHS* OF YOUTHS DURING RECREATION AND DAILY LIFE BY INDIGENOUS ETHNICITY AND USE OF A PERSONAL FLOTATION DEVICE, CANADA 1991-2010 (VICTIMS 15-19 YEARS OF AGE; n=219)



** Includes drownings and immersion hypothermia deaths † Not fastened or inappropriate size*
‡ Indigenous peoples include First Nations, Inuit and Métis § Included those of definite and probable Indigenous ethnicity (40, 0)

Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

For Indigenous children, in 63% no PFD was present, and for 17% PFD involvement was unknown, i.e., as many as 80% were in violation, compared with other ethnicities where PFDs were not present in 21% and unknown in 26%. Concerning youth, for 40% no PFD was present, and for 28% involvement was unknown. Hence, up to as 68% were in violation. In the case of Indigenous youth, 58% had no PFD present and for 35% involvement was unknown, i.e., as many as 93% were in violation. For other ethnicities, 41% had no PFD present and 26% unknown.

There were 366 occupational boating immersion deaths during 1991-2010, including 297 drownings, 53 drownings with hypothermia, 5 deaths due to hypothermia complicated by drowning, and 11 hypothermia deaths (Table 61). Detailed information for this section can be found in Tables 61-76.

11% of victims were properly wearing a PFD, 2% improperly wearing, and at least 54% not wearing a PFD, possibly more since PFD involvement was unknown for 33% (Figure 35, Table 61). For 9% a PFD was not present in the boat, and for another 55% this was unknown. Hence as many as 64% could have been without the presence of a flotation device.

ACTIVITY 62% of victims were commercial fishing, 14% marine shipping, 3% fishing guiding or charter, and 2% aquaculture. 9% of commercial fishers and 12% of marine shipping victims were properly wearing a PFD (Table 62).

TYPE OF INCIDENT Capsizing was the most frequent boating incident, followed by falling overboard and swamping. PFDs were properly worn by 17% of victims whose boat was swamped, but only 5% of those who fell overboard (Figure 35, Table 63).

PERSONAL FACTORS

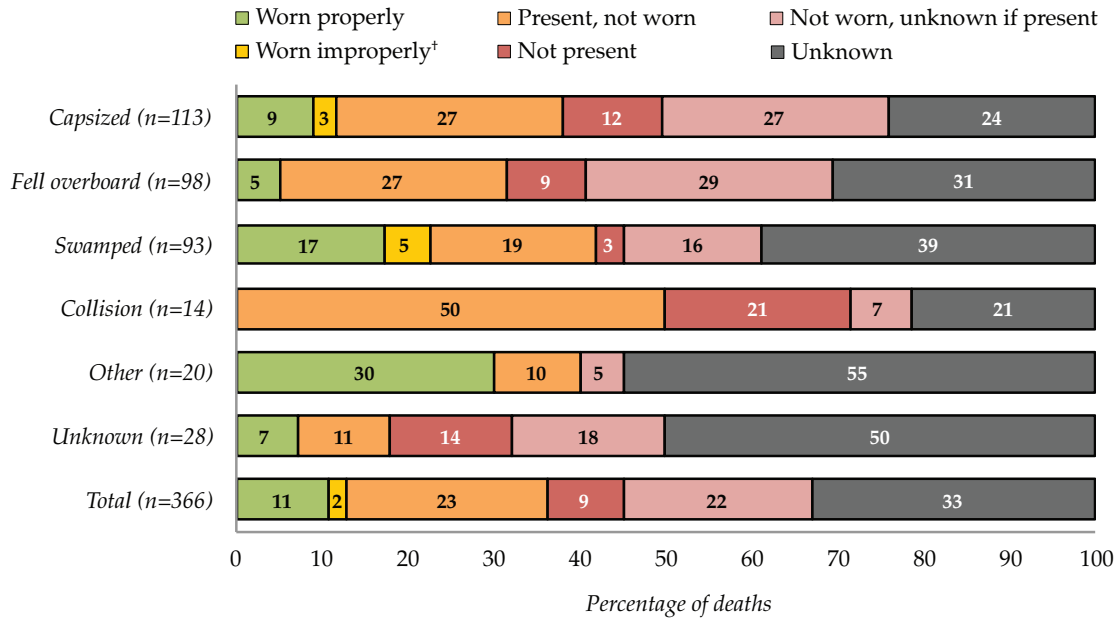
AGE & SEX 98% of occupational boating immersion victims were males (Table 64). 79% were between 20 and 64 years of age (Table 65).

SWIMMING ABILITY 11% of victims were weak or non-swimmers, 2% average or strong swimmers, and 4% swimmers of unidentified level. Swimming ability was unknown for 83% of occupational immersion victims (Table 66).

BOATING EXPERIENCE At least 64% of victims were experienced boaters, and 1% occasional or inexperienced boaters. Boating experience was unknown for the remaining 34% (Table 67).

A Newfoundland Crab trawler from Port de Grave in stormy weather on the Grand Banks. In such seas, appropriate rescue rafts are needed in the event of swamping and capsizing. Life rafts can avert or minimise exposure to cold immersion. However, unless a PFD is worn, it may not be feasible to survive to get to the life raft. Rafts are available in various sizes, such as four person capacity or larger, and can be used on larger recreational as well as occupational vessels. Life rafts should be readily launchable and float free in the event of a vessel sinking. (Photo: Pinterest.com)

Figure 35 **BOATING IMMERSION DEATHS* DURING OCCUPATIONAL ACTIVITIES BY TYPE OF INCIDENT AND USE OF A PERSONAL FLOTATION DEVICE, CANADA 1991-2010 (n=366)**



** Includes drownings and immersion hypothermia deaths † Not fastened or inappropriate size*
Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

Fishers aboard the *Marion Michelle*, 12 metre Okanagan Nation Alliance purse seiner on Osoyoos Lake set nets for sockeye salmon (Photo: Bruce Kemp) *Canadian Geographic* July / August 2013)

EQUIPMENT FACTORS

TYPE OF BOAT Powerboats were associated with 94% of deaths and unpowered boats with 3%. Large powerboats more than 5.5 metres in length accounted for 66% of occupational immersion deaths, small open type fishing boats for 15%, powerboats of unknown size for 10%, and other small open craft such as inflatables for 3% (Figure 36, Table 68).

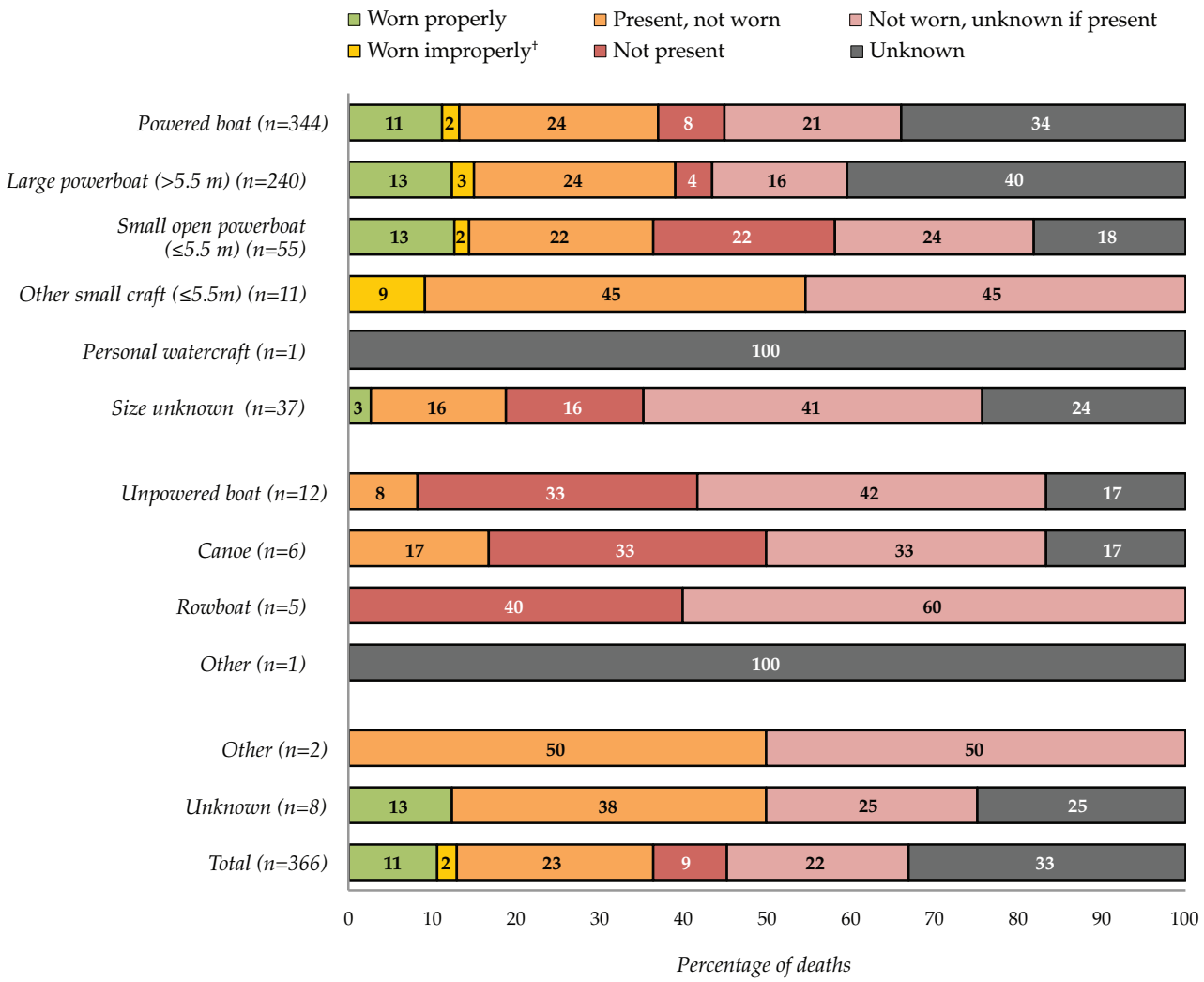
ENVIRONMENT FACTORS

BODY OF WATER 78% of deaths took place in oceans, 14% lakes and ponds, and 8% rivers, creeks, streams and waterfalls. For oceans, 12% of victims were properly wearing a PFD, compared to 6% for lakes and ponds (Table 69).

WIND AND WAVES PFDs were most frequently worn in the presence of strong winds and breezy or windy conditions. No victim was reported properly wearing a PFD during calm conditions. For wave conditions proper wear of PFDs was 18% for storm or gale force conditions, 13% for rough seas with whitecaps, 9% for choppy/small waves, and 7% for calm (Tables 70 -71).

Figure 36

BOATING IMMERSION DEATHS* DURING OCCUPATIONAL ACTIVITIES BY TYPE OF BOAT AND USE OF A PERSONAL FLOTATION DEVICE, CANADA 1991-2010 (n=366)



** Includes drownings and immersion hypothermia deaths † Not fastened or inappropriate size*

Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

WATER TEMPERATURE Very cold or extremely cold water temperature (below 10°C) was associated with at least 55% of occupational immersions, likely more as water temperature was unknown for 32%. 14% of victims properly wore a PFD when boating in extremely cold or freezing water (under 10°C), compared to 9% for cold or cool water (10°C to 20°C) (Table 72).

DISTANCE FROM SHORE At least 57% of victims died more than 50 metres from shore, compared to 23% for recreational and daily living immersion deaths. 11% of occupational victims 50 metres or more from shore were properly wearing a PFD (Table 73).

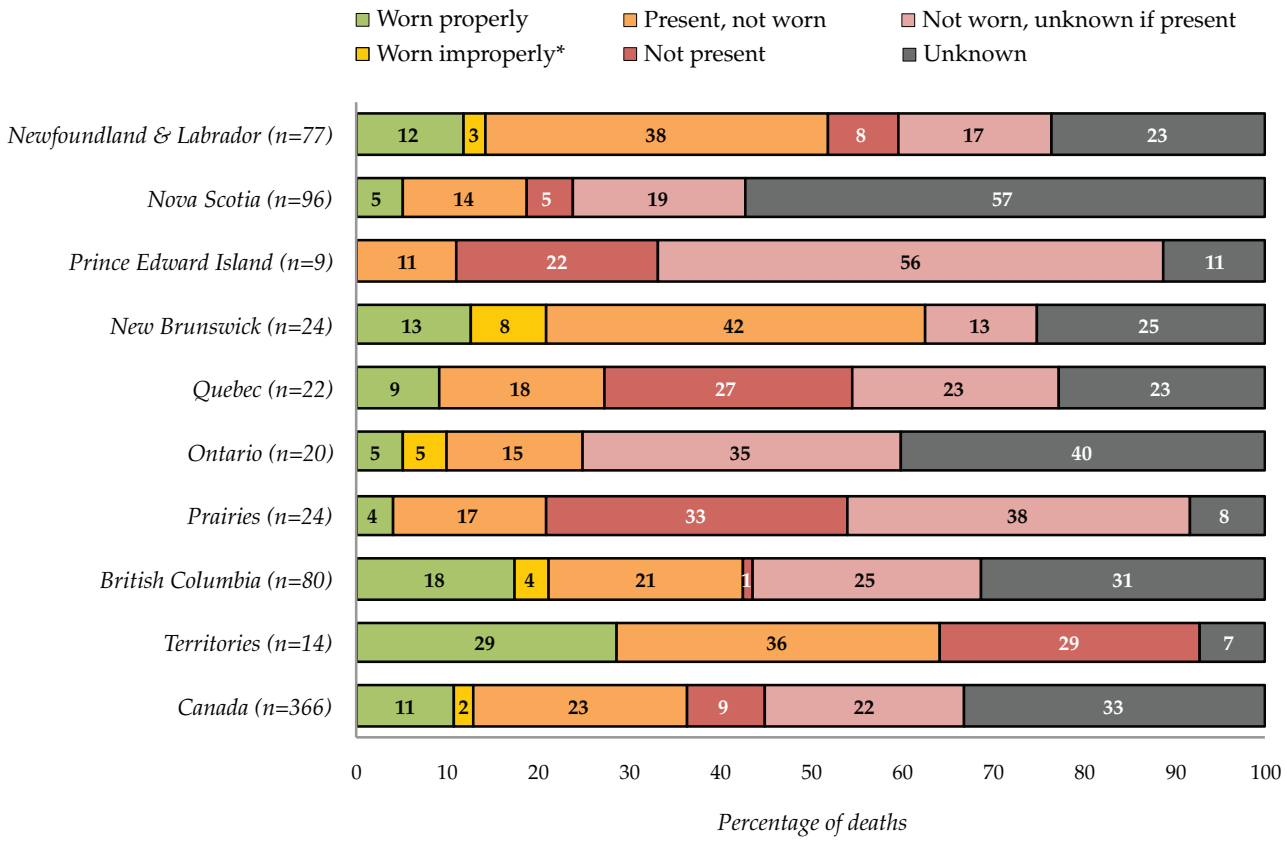
DEPTH OF WATER At least 64% of victims died boating in water more than 2.5 metres deep, compared to 28% for recreational and daily living immersion deaths. Only 12% of occupational victims in water more than 2.5 metres deep were properly wearing a PFD (Table 74).

REGION

Proper wearing of PFDs among occupational immersion victims was low in all provinces and territories. It was highest in the northern territories and British Columbia, and lowest in the Prairies, Ontario and Nova Scotia (Figure 37, Table 75). The proportion with no flotation device in the boat ranged from 5% to 33%, the unknowns from 7% to 76%; reporting on this was very low in Ontario and Nova Scotia and highest in the northern territories.

Figure 37

BOATING IMMERSION DEATHS* DURING OCCUPATIONAL ACTIVITIES BY REGION AND USE OF A PERSONAL FLOTATION DEVICE, CANADA 1991-2010 (n=366)



* *Includes drownings and immersion hypothermia deaths* † *Not fastened or inappropriate size*

Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

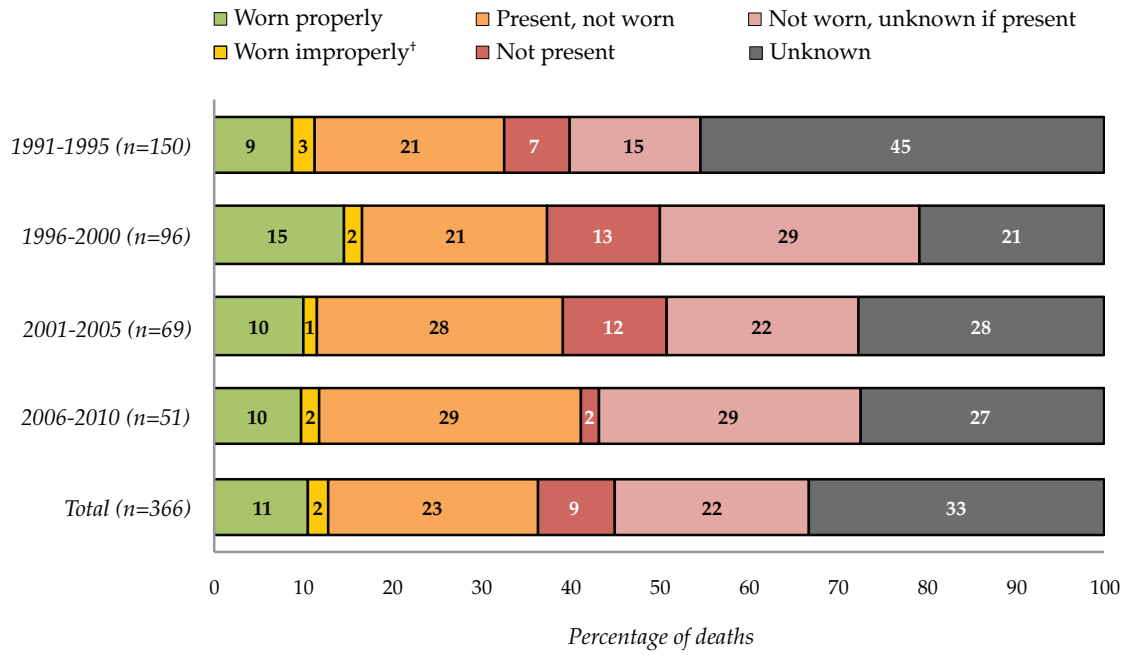
OCCUPATIONAL: IMMERSION

TRENDS

Among occupational boating immersion victims, the proportion properly wearing PFDs remained low between 1991-1995 and 2006-2010. The proportion of deaths where no flotation devices were reported in the boat ranged from 2 to 13%, with no significant trends; however, unknowns were high at 50% to 60%. There was a major decline in the number of deaths, which could be attributable in part to decreased exposure especially in the Atlantic fishery (Figure 38, Table 76).

Figure 38

TRENDS IN BOATING IMMERSION DEATHS* DURING OCCUPATIONAL ACTIVITIES BY USE OF A PERSONAL FLOTATION DEVICE, CANADA 1991-2010 (n=366)



** Includes drownings and immersion hypothermia deaths † Not fastened or inappropriate size*
Source: The Canadian Red Cross Society & the Canadian Surveillance System for Water-Related Fatalities, 2015

OCCUPATIONAL ACTIVITIES: TRAUMA DEATHS

There were 10 occupational boating trauma deaths during 1991-2010 (Table 61). 9 victims were males; 9 were between 25 and 54 years and 1 was 65+ years. Occupation included commercial fishing 3 and marine shipping 3; it was unspecified for the remaining victims. Only 2 were properly wearing a PFD.

Snowmobile, sled and ATV crossing a bay. Travellers have to choose their way carefully, avoiding the cracks. Cold immersion protective clothing, PFDs, and ice picks would be advisable. Taloyoak, Nunavut, 1988-1990. (From John Tyman's INUIT People of the Arctic Unit 1: INUIT: POLAR ENVIRONMENTS Part 2: Ice & Snow and Soils. © Pitt Rivers Museum, Oxford University, 2010.)

RECREATION AND DAILY LIFE

SCUBA DIVING There were 121 deaths involving scuba diving during 1991-2010. The causes were immersion for 57%, air embolism 36%, trauma of diving into water or boating collision 2%, and other causes 5%. 35% were properly wearing a PFD, 3% improperly wearing, and 2% not wearing (Table 77).

FISHING IN WATER There were 52 deaths during 1991-2010 of fishers wading in water; 33% wore hip waders. 98% of deaths were due to drowning and 2% to other causes. Only 1 victim was wearing a PFD (Table 77). Another 129 immersion victims were fishing from land. Since slipping on rocks or from a height and falling in could have been a factor in such deaths, wearing of flotation could have averted some, perhaps many, such deaths. No information was reported regarding PFD wearing for such deaths.

SNOWMOBILES There were 379 recreational or daily living snowmobile deaths involving ice and/or water during 1991-2010. 99% were due to immersion and 1% to trauma or other causes. 9% of victims on snowmobiles were properly wearing a flotation device, 3% improperly wearing and 36% not wearing. For the remaining 51%, flotation use was unknown (Table 77).

ALL TERRAIN VEHICLES There were 29 deaths involving ATVs on ice during 1991-2010. 28 deaths were due to immersion and 1 to trauma from a vehicle crash. Only 1 victim was properly wearing a PFD (Table 77).

OCCUPATIONAL ACTIVITIES

MOTOR VEHICLES ON ICE There were 39 occupational deaths involving motor vehicles driving on ice during 1991-2010. These included 10 snowmobiles, 23 heavy machines such as bulldozers, tractors, and excavators, 3 cars or pickup trucks, 2 transport trucks and 1 unknown vehicle. Only 1 victim was reported properly wearing a PFD (Table 77).

OVERVIEW: ASSESSING MULTIPLE RISK FACTORS SIMULTANEOUSLY

The purpose of multiple regression is to learn more about the relationship between a dependent variable (e.g. whether an immersion victim was wearing or not wearing a PFD) and several independent variables (e.g. age, sex, alcohol consumption, presence of waves). The 'logistic' part of multiple logistic regression refers to the dependent variable having two categories (properly wearing a PFD and not wearing a PFD). A two category variable is commonly referred to as a binary variable.

For this research, multiple logistic regression was used to examine whether different personal, environmental and equipment factors contributed to properly wearing a PFD among drowning immersion victims. The regression analyses were helpful in generating information about what factors are the best predictors of an immersion victim wearing a PFD, taking into consideration the various relationships that may exist between the independent variables.

For logistic regression, measures of association are reported as an odds ratio. The odds of a victim properly wearing a PFD differs from the probability of a victim properly wearing a PFD. The probability would be the number of victims properly wearing a PFD divided by the total number of victims, whereas the odds of a victim properly wearing a PFD represents the number of victims properly wearing divided by the number of victims who were not wearing a PFD. The interpretation of odds and probabilities are not interchangeable except in specific circumstances.

The confidence interval provides the range within which the true effect is likely to lie with a specified degree of certainly, usually 95%, i.e., there is only a 5% or 1 in 20 probability the true number lies outside the range. In other words, confidence intervals tell us the range of possible effect sizes personal, environmental and equipment factors have on properly wearing a PFD. The confidence interval also tells us whether the relationship between the dependent variable and the independent variable is statistically significant; confidence intervals that do not include 1.0 are considered to be statistically significant. Confidence intervals not including 1.0 tell us the likelihood that the relationship is caused by something other than random chance. For easy viewing, all statistically significant associations have been highlighted in red in Tables 78-80.

BOATING IMMERSION DEATHS

Multiple logistic regression modeling indicates that for boating immersion deaths, ages of victim 5-14 and 45-54, average swimming ability, rural location of incident, presence of waves, and very cold water temperatures all significantly increase the odds that the victim was properly wearing a PFD, whereas ages of victim 20-24, Indigenous ethnicity, alcohol involvement, boating on a lake, and using a power boat significantly decreased the odds that the victim was properly wearing a PFD. Significant associations are mentioned in the text below. Complete results of multiple logistic regression for all boating immersion deaths results can be found in Table 78. Note: In the following sections, for brevity, "adjusted odds"means the odds controlling for all other variables in the model; all odds ratios in this section are adjusted. "Odds of wearing" means "odds of properly wearing a PFD".

PERSONAL FACTORS

AGE Victims 5-14 years of age had 2.60 times the adjusted odds of properly wearing a PFD compared to victims 25-44 years, controlling for all other variables in the model (95% CI: 1.21-5.57). Victims 20-24 years had 0.58 times the odds (42% reduced odds) of wearing compared to those 25-44 years of age (95% CI: 0.34-0.98). Victims 45-54 years old had 1.46 times the odds of wearing compared to those 25-44 years of age (95% CI: 1.02-2.09).

INDIGENOUS ETHNICITY Indigenous victims had 0.34 times the adjusted odds (66% reduced odds) of wearing compared to non-Indigenous victims (95% CI: 0.20-0.57).

ALCOHOL INVOLVEMENT Victims with blood alcohol equal or below 80 mg% had 0.35 times the odds (65% reduced odds) of wearing compared to those with zero alcohol (95% CI: 0.22-0.57). Victims with alcohol above 80 mg% had 0.27 times the odds (73% reduced odds) of wearing compared to those with zero alcohol (95% CI: 0.18-0.41). Victims suspected to have consumed alcohol but without a blood alcohol reading had 0.14 times the odds (86% reduced odds) of wearing compared to those with zero alcohol (95% CI: 0.05-0.41).

SWIMMING ABILITY Victims with average swimming ability had 2.23 times the odds of wearing compared to non-swimmers/weak swimmers (95% CI: 1.23-4.05).

EQUIPMENT FACTORS

BOAT TYPE Victims on powerboats had 0.63 times the adjusted odds (37% reduced odds) of wearing compared to those on unpowered boats (95% CI: 0.48-0.83).

ENVIRONMENT FACTORS

RURAL/URBAN LOCATION OF INCIDENT Victims dying in rural locations had 1.69 times the adjusted odds of wearing compared to those in urban location (95% CI: 1.20-2.37).

WAVES Victims in the presence of storm waves or whitecaps had 1.86 times the odds of wearing compared to calm water or no waves (95% CI: 1.31-2.63).

WATER TEMPERATURE Victims boating on very cold water (<10^{0}C) had 1.40 times the odds of wearing compared to those victims on warm or cool water (95% CI: 1.07-1.84).

BODY OF WATER Victims boating on lakes or ponds had 0.39 times the odds (61% reduced odds) of wearing compared to those on the ocean (95% CI: 0.21-0.74).

RECREATION AND DAILY LIFE

Multiple logistic regression modeling indicates that for recreational and daily life immersion deaths, age of victim 5-14 years, average swimming ability, presence of storm waves or whitecaps, and rural location of incident significantly increased the odds that the victim was properly wearing a PFD, whereas age of victim 20-24 and 65+ years, Indigenous ethnicity, alcohol involvement, boating on a lake, and using a powered boat significantly decreased the odds of wearing. The complete multiple logistic regression results for recreational and daily living immersion deaths are in Table 79.

PERSONAL FACTORS

AGE Victims 5-14 years of age had 2.50 times the adjusted odds of wearing compared to those 25-44 years (95% CI: 1.14-5.51). Victims 20-24 years had 0.51 times the odds (49% reduced odds) of wearing compared to those 25-44 years of age (95% CI: 0.29-0.91). Victims 65+ years had 0.57 times the odds (43% reduced odds) of wearing compared to 25-44 years of age (95% CI: 0.35-0.92).

INDIGENOUS ETHNICITY Indigenous victims had 0.22 times the odds (78% reduced odds) of wearing compared to non-Indigenous victims (95% CI: 0.09-0.49).

ALCOHOL INVOLVEMENT Victims with blood alcohol ≤ 80 mg% had 0.36 times the odds (67% reduced odds) of wearing compared to those victims with zero alcohol (95% CI: 0.19-0.57). Victims with alcohol > 80mg% had 0.23 times the odds (77% reduced odds) of wearing compared to those with zero alcohol (95% CI: 0.16-0.36). Victims suspected to have consumed alcohol but with no reading available had 0.11 times the odds (89% reduced odds) of wearing compared to those with zero alcohol (95% CI: 0.03-0.43)

EQUIPMENT FACTORS

BOAT TYPE Victims on powerboats had 0.69 times the adjusted odds (31% reduced odds) of wearing compared to those on unpowered boats (95% CI: 0.51-0.93).

ENVIRONMENT FACTORS

RURAL/URBAN LOCATION OF INCIDENT Victims dying in rural locations had 1.86 times the adjusted odds of wearing compared to those in urban locations (95% CI: 1.32-2.62).

WAVES Victims boating in the presence of storm waves or whitecaps had 1.84 times the odds of wearing compared to those on calm waters (95% CI: 1.19-2.85).

BODY OF WATER Victims boating on lakes or ponds had 0.36 times the odds (64% reduced odds) of wearing compared to those on the ocean (95% CI: 0.18-0.73).

OCCUPATIONAL ACTIVITIES

Multiple logistic regression modeling indicated that no independent variables considered for the model were statistically significant. Complete results are in Table 80.

OVERVIEW OF MAIN SURVEILLANCE AND RESEARCH FINDINGS

Boating represented 32% of all water-related injury fatalities during 1991-2010, and 37% when land and air transport deaths were excluded. Boating deaths occurred mainly during recreational activities such as fishing from a boat, powerboating and canoeing. Overall, recreational activities accounted for 77% of boating deaths, occupational activities for 11%, activities of daily life for 9% and attempting rescue for 2%. For the remaining 2%, the purpose was other or unknown. Powerboats were involved in two-thirds of all fatalities and unpowered boats one-third. 94% of deaths resulted from immersion including drowning with or without cold exposure, and 6% from trauma including head injury and lacerations from incidents such as collisions and propeller injuries.

Overall, only 12% of boating victims were reported properly wearing a PFD and another 3% improperly wearing one. A PFD was present but not worn for 21%, not present for 24%, and not worn but unknown if present for 20%. For the remaining 19%, PFD involvement was unknown.

The following two sections summarise findings for recreational and daily living deaths combined, and for occupational deaths.

A. RECREATIONAL AND DAILY LIVING DEATHS

Recreational and daily living boating immersion deaths represented 85% of boating immersion deaths during the 20 year period. For recreational immersion deaths, fishing from the boat and powerboating were the most frequent activities. For daily living, traveling by boat and fishing for food were most frequent.

Overall wearing of PFDs was extremely low, and for many victims even the minimal legal requirement of having a PFD in the boat was not met. In regard to compliance with current regulations requiring presence in the boat but not wearing of a flotation device, in 27% of deaths a flotation device was reported not to be present, and in another 36% unknown if present. Hence in as many as 62%, there was violation of regulations. There were certain differences in proper wear of PFDs by various risk factors, including personal factors such as age, sex, alcohol and drugs, swimming ability, boating experience, and ethnicity.

While 11% of males 15 years of age and older were properly wearing a PFD, 21% of boys less than 15 years of age were properly wearing flotation. Males 15 years of age and older accounted for 91% of recreational and daily living immersion deaths and only 11% were properly wearing a PFD. 12% of males were properly wearing a PFD compared to 19% of females.

20% of victims with no blood alcohol were properly wearing a PFD, compared with 5% at blood alcohol 80 milligram percent or greater. Victims using illegal drugs were also less likely to wear a PFD; 15% without illegal drugs properly wore a PFD, compared to 11% with drugs.

Non-swimmers had the lowest prevalence of proper PFD wear at just 4%, compared with 9% for weak, 11% for average, and 13% for strong swimmers. Where boating experience was known, 23% of inexperienced boaters wore a flotation device compared to 15% of experienced boaters. Proper PFD wearing also differed by ethnicity; while 15% of non-Indigenous victims were properly wearing a PFD, only 3% of Indigenous victims were.

For equipment factors such as type of boat, 10% of immersion victims of powered boats were properly wearing a PFD compared to 16% for unpowered. PFDs were properly worn for 36% of immersion deaths involving kayaks, 32% for non-powered inflatables, 24% for sailboats and sailboards, and 24% for personal watercraft. PFDs were least often properly worn for victims of large powerboats (12%), small powerboats (11%), rowboats (6%) and paddleboats (0%).

As for environmental risk factors, victims were somewhat more likely to have been wearing a PFD in adverse conditions. During the presence of strong winds, 19% of victims properly wore a PFD, compared to 8% for calm wind conditions. Similarly, 22% of victims properly wore a PFD during whitecap wave conditions, while only 6% did so during calm conditions. For very cold or freezing water temperatures less than 10°C, 20% of victims properly wore a PFD, while only 6% of victims were properly wearing one when boating on warm waters above 20°C.

The provinces/regions that had the highest proper PFD wearing among victims were the northern territories at 22%, British Columbia at 17%, and Alberta 16%. PFD wearing was lowest in Prince Edward Island at 0%, Saskatchewan 6%, Manitoba 7%, and Ontario 8%.

There was no positive trend in PFD wearing among boating victims during the 20-year period. However, the rate of boating immersion fatalities has declined, suggesting that safety practices among the general boating population, including PFD wearing, may have improved, or that exposure to boating may have declined.

In summary, failure to wear a PFD was a factor for up to 88% of victims, and for an even higher proportion of weak and non-swimmers, Indigenous people, and those who had consumed alcohol or other drugs. The key target group for intervention is males 15 years of age and older, especially 25-64 year olds, where the numbers of victims are greatest and human capital costs of lost wages are highest.

What do the multiple regression results add to the above? Regression helps control for confounding of the effects of multiple "predictor" variables on the "outcome" variable, namely whether a PFD was worn or not. Some might say non-wearing is a process leading to the outcome of death by immersion. Confounding derives from the ancient Latin word "confundere", to mix up. Many of the regression results make intuitive sense, such as the fact that in the presence of hazards such as waves, very cold water, and remote locations, boaters tended to wear a PFD. While the hazards of oceans are apparent to most boaters, people may underestimate how quickly a seemingly inviting rural lake can transform to a dangerous "inland sea".

What are the practical implications of the regression findings? In conditions just described, boaters should have been off the water or protected by more than a PFD, including equipment such as wet suits, survival suits, and/or life rafts. More than ever, certain populations clearly need targeting for education and regulation on the crucial need for PFD wearing, such as young adult male boaters, boaters consuming alcohol, lake boaters, and powerboat users. For many Indigenous peoples, supplementary safety and communications equipment to prolong cold survival and hasten rescue are essential beyond wearing a PFD.

Perhaps the most surprising, important, and not necessarily intuitive regression finding is that non-swimmers and weak swimmers were significantly less likely to have worn a PFD than average or strong swimmers. This finding suggests, but does not prove, that persons with limited swimming skills also have deficient boating safety knowledge and practices with regard to the key indicator for use of safety equipment, i.e., flotation wearing. A related policy recommendation would be that swimming competency should be widely supported and required for all, but only if it includes as an integral component not only technical survival skills but also preventive water safety knowledge, attitudes, and behaviours for boating, as well as aquatic activities. At a minimum, this would emphasise that wearing of a flotation device at all times in/on a boat is no less fundamental than wearing a safety belt in a motor vehicle, since per hour of exposure the boat is equally or more dangerous (Mitchell et al., 2010; Maxim, 2015).

B. OCCUPATIONAL DEATHS

> *"Three men are dead after a commercial fishing boat capsized when hauling in a net. The boat was fishing in a remote area 55 kilometres off the west coast of Vancouver Island. A fourth man was rescued from a life raft – early reports indicate the survivor was the only crew member wearing a life jacket."*
>
> – News bulletin, Canadian Press, Canada, 6 September 2015

There were 376 occupational boating deaths during 1991-2010, 97% of which were due to drowning with or without cold exposure. Overall, 11% of occupational boating victims were properly wearing a PFD, while another 2% were improperly wearing one. In 9% of deaths, it was reported that no flotation device was present in the boat, and for 55% it was unknown whether flotation was available.

For occupational immersions, 62% of victims were commercial fishing and 14% in marine shipping. The majority (98%) were males, and, where age was known, 90% were 20-64 years old.

64% of occupational immersion victims were experienced boaters, only 1% occasional or inexperienced. 94% of occupational immersions involved powerboats and 3% unpowered boats. 13% of victims on large powerboats more than 5.5 metres in length properly wore a PFD, and 13% on smaller powerboats 5.5 metres or less.

As with daily living and recreational deaths, victims were more likely to have been wearing a PFD in adverse environmental conditions. While 16% of victims properly wore a PFD during strong wind conditions, not one wore a PFD during calm. For waves, 18% of victims properly wore a PFD in strong wave conditions compared to 7% during calm. For very cold or freezing water temperatures less than 10°C, 14% of victims properly wore a PFD,

Commercial foam personal flotation device, with reflective shoulder strips, as worn for organic aquaculture in Clayoquot Sound, near Tofino, BC (Photo: Creative Salmon Co. Ltd, www.creativesalmon.com)

while 9% of victims were properly wearing one when boating in cool water 10-20°C. There were no occupational immersion deaths on waters 21°C and above. A higher proportion of occupational immersions occurred more than 50 metres from shore, compared to recreational and daily living immersions. Similarly, occupational immersions more frequently involved water more than 2.5 metres deep.

By region, the northern territories had the highest proportion of proper PFD wear at 29%, followed by British Columbia at 18%. The prairies were the lowest with just 4% of occupational immersion victims properly wearing a PFD, followed by Ontario and Nova Scotia at 5% each.

There has not been a positive trend in PFD wearing among occupational immersion boating victims during the 20-year study period. However, the number of occupational boating deaths has declined, perhaps as a result of decreased exposure to fishing due to collapse of the cod fishery on the Atlantic coast, possibly as a result of improved occupational safety equipment, and/or other measures.

PERCEPTIONS AND BARRIERS TO PFD WEAR

Twenty years of research across Canada show that the majority of boaters who die have neglected to wear a personal flotation device. Without regulations requiring wearing of PFDs by all boaters in Canada, the decision is left to the individual as to whether to don a PFD before embarking on the water. Research shows boaters make conscious decisions about whether or not to wear a PFD. Such decisions are based on a wide range of factors, including perceived risk, perceptions of skills, views on personal responsibility, social and familial pressures, and comfort and aesthetics.

a) PERCEIVED RISKS

Recreational boaters may make decisions about wearing a PFD based on their evaluation of perceived risks. The true risk of drowning may be exacerbated by cold water temperatures, strong winds and waves, alcohol and/or drug involvement, and activity. Among a survey of 300 boaters in Florida, 45% reported they would most likely wear a PFD when the weather was bad, 47% when the water was rough, 20% at nighttime, 19% when in deep water and 23% when alone (USF Center for Social Marketing, 2010).

The belief that PFDs are only required if the water is cold was held by 8% of the Canadian recreational boating population and by 12% if the weather is poor, including strong winds and waves, as estimated from a survey of 4,021 men and women across Canada (Environics, 2002). However, 69% strongly agreed that boating incidents or mishaps cannot be predicted, with females more likely than males to hold this belief. Hence, future campaigns should address the unpredictability of boating mishaps. 69% of respondents strongly agreed it is necessary to wear a PFD if the boat is overloaded, and 68% agreed with PFD wearing if anyone on board had consumed alcohol. On the other hand, 14% of respondents strongly disagreed that it was necessary to wear a PFD when the boat is overloaded and 13% when another person aboard had consumed alcohol.

A separate telephone survey of 501 male boaters in Western Canada found that 64% of respondents felt safe as long as a PFD was within reach (Mark Trend, 2001). 30% agreed they didn't need to wear a PFD if it was close by. 0% of respondents also felt safe without a PFD as long as the shore line was within sight, and 29% felt that a PFD was only necessary when the boat was moving. Even boaters with formal training tended to feel that having a PFD within reach was sufficient.

The perceived importance of wearing PFDs is associated with the type of boating activity. In boats with high risk of capsizing such as PWCs and kayaks, PFD wearing is higher. When Canadian recreational boaters were asked if using a PFD would make a boat activity safer, 94% said yes in relation to PWCs/jet skis while only 69% said yes for fishing from a non-motorised boat and 64% for rowing (Environics, 2002).

b) PERCEIVED SKILLS

Attitudes towards PFD usage are also based on perception of personal skills. According to the Environics 2002 survey, 5% of Canadian boaters strongly agreed that they did not need a PFD because they were experienced enough, 3% indicated that they were a safe enough boater to not need to wear a PFD, and 4% felt that they were a strong enough swimmer to not need to wear one. More younger than older boaters were likely to think that their skills were an adequate substitute for a PFD.

The same survey also showed that 85% of recreational boaters strongly disagreed that only weak swimmers need PFDs, and 83% strongly disagreed that people who wear lifejackets lack confidence. However, a focus group of 16 boaters in the Northwest USA agreed that the typical person who wore a PFD was an inexperienced boater; however, this is a large number for a focus group but a small number for a sample, and the study would need to be replicated elsewhere on a random sample (Quistberg et al., 2014).

c) PERSONAL RESPONSIBILITY, SOCIAL PRESSURES AND ADULT ROLE MODELING

Boat operators are in a unique position to promote safety behaviours. An observational study of Canadian male recreational boaters in 2000 found the most significant factor associated with passengers wearing a PFD was whether the operator was wearing a PFD. Conversely, if the operator was observed not wearing a PFD, then it was likely that any passenger observed was also not wearing a PFD (Starr Group Inc., 2001). 89% of Canadian recreational boaters indicated they would wear a PFD if asked to by the boat operator, while 75% strongly or somewhat agreed that they would always wear a PFD if the boat operator wore one (Environics, 2002). Only 20% of Canadians strongly or somewhat agreed that they would feel uncomfortable wearing a PFD if no one else was (Environics, 2002).

This boat operator models safe boating practice for his young passenger by wearing his PFD. An additional safety measure would be a dead man engine lanyard switch (absent here) to cut the motor if the operator falls overboard. (Photo: David Beattie)

Children are also much more likely to wear a PFD if adult(s) on board are doing so (Treser et al., 1997). In Washington State, USA, PFD wearing by 13-17 years olds was 20 times higher when at least one adult in the boat was wearing one (Chung et al., 2014). Among Canadians, 68% reported always wearing a PFD if a child was aboard (Environics, 2002).

d) COMFORT AND AESTHETICS

One of the most common reported barriers to consistent PFD wearing is discomfort. 28% of Canadian boaters strongly or somewhat agree that PFDs restrict movement too much or are too hot. Younger boaters were more likely than older boaters to hold this belief (Environics, 2002). In Florida, 70% of a sample of boaters felt discomfort was the greatest barrier to wearing a PFD (USF Center for Social Marketing, 2010). In a survey of 501 male boaters in Western Canada, 10% of respondents agreed that having a more comfortable PFD would encourage them to wear one in all circumstances (Mark Trend, 2001).

Aesthetic qualities of PFDs appear to be less of an issue for the majority of boaters. 18% of Canadian boaters strongly or somewhat agreed they don't look good in a PFD, and only 5% strongly or somewhat agreed that they do not wear a PFD because it prevents getting a tan (Environics, 2002). An unpublished field interview survey of boaters in Quebec in the mid-1990s found that comfort and coolness (not overheating) were key considerations and that the "look", style, and colour were not considered important (Masson & Barss, 1996).

METHODS OF ENCOURAGING PFD WEARING

a) EDUCATIONAL PROGRAMMES

Educational programmes have been a frequent approach to encouraging PFD wearing. They aim to teach boaters the risks of not using a PFD. In Canada, operators of pleasure craft fitted with any type of motor must have a basic level of boating safety knowledge. The operator should provide proof of competency either with a Pleasure Craft Operator Card or proof of having passed a boating safety course in Canada before April 1, 1999. The Pleasure Craft Operator Card can be obtained by taking a boating safety course in-person or online, and passing a test at the end of the course. There are 25 course providers accredited by Transport Canada to deliver boating safety courses and administer tests for the issuance of Pleasure Craft Operator Cards. Boating safety courses and examination cover rules and regulations in Canada, equipment, navigation and right-of-way rules, markers and buoys and responding to emergencies. These regulations have been in place since 2009.

However, of concern, evidence from the 2001 national telephone survey of more than 4,021 Canadians found that respondents completing or not a training course on boat safety generally had the same frequency of PFD wearing (Environics, 2002). Furthermore, after the course, the only categories of boaters reporting higher wearing were those using personal watercraft/jet skis or participating in powerboat racing, which represent only a small proportion of all victims. Moreover, current regulations already require wearing aboard PWCs.

b) PROMOTIONAL CAMPAIGNS

Promotional campaigns have also been a popular method of encouraging PFD usage. Only a few studies have evaluated effectiveness (Treser et al., 1997; Mangione & Chow, 2014). An example is the *Wear It California* campaign, a collaborative effort of the United States Coast Guard, the California Department of Boating and Waterways, and two non-government groups in the California Delta during 2006-2011. The campaign included mass media productions, marina events, radio advertising, signing of pledge cards, and a campaign tour boat staff with ambassadors that cruised the Delta educating the public and giving away free personal PFDs. The campaign was estimated to reach about 10,000 boaters in the first year. Before the campaign, adult PFD wearing in the Delta was 9%, increasing to 12% in year 1, and dipping to 11% at year 3. Wear among youth was 16% at baseline, 15% at 1 year, and 27% at year 3. For children younger than 13 years, wear was 81% at baseline, 77% at year 1, and 91% at year 3 (Mangione & Chow, 2014).

During the early 1990s, the Seattle-King County Drowning Prevention Coalition, Seattle Children's Hospital and Medical Center, and the Washington State Department of Parks and Recreation initiated a two-year educational campaign to increase PFD usage and safe boating practices in King County, Washington (Treser et al., 1997). The campaign included production of a boating safety video for use in elementary schools, a life jacket loaner programme, community events, fliers, brochures and other promotional materials, all of which focused on drowning prevention. At baseline, observed PFD usage was 20% for all boaters (including those of undetermined sex), while two years post-intervention it increased to 31%; for males, the increase was from 18% to 30%, for females 20% to 30%, and for adults 14% to 25%. All changes were significant ($p<0.05$). For children <14 years of age the change of 68% to 71% was not significant ($p>0.05$). It was also noted that PFD usage among children 5-14 years was much higher when an adult on board was wearing a PFD; post-intervention, 70% of children wore a PFD when the adult on board was not wearing a one, compared to 96% if the adult was wearing a PFD.

By boat type, PFD wearing increased significantly ($p<0.05$) over the two years post-intervention for the following boat types: powerboats from 10% to 17%, row boats 8% to 31%, kayaks 79% to 90%, and rafts 10% to 24%. It was noted that the largest increase was among people in row boats, many of whom were fishing; this had been one of the target populations for the educational campaign. Non-significant increases in PFD usage were observed for sailboats, canoes, and other types of boats.

The source and messenger for delivery of information should be considered for promotional campaigns. In Florida, a survey among 300 boaters showed that 70% trust authority figures such as the Coast Guard the most for information on PFDs, while 17% trust professional boating associations, 10% other boaters, 1% family members and 1% professional fishermen (USF Center for Social Marketing, 2010). On the other hand, when it comes to sources of information, people may more frequently encounter other boaters than authority figures.

c) LEGISLATION

Legislation mandating wearing of a PFD while aboard a recreational watercraft is another approach to increasing wearing. Focus group discussions among boaters in Washington State, on the west coast of the USA, indicated that laws requiring PFD usage would change boaters' behaviour (Quistberg, 2014). However, among male boaters in Western Canada, only 11% of respondents said they would always wear a PFD if it was mandatory by law (Mark Trend, 2001). An unpublished survey, conducted by the Red Cross in collaboration with First Nations in Northern Saskatchewan and public health researchers, found that most adults supported a law mandating wearing, because they believed passengers would then obey the operator's request to wear a PFD (Sawyer & Barss, 1995).

EFFECTS OF LEGISLATION ON PFD WEARING

In the state of Victoria, Australia, wearing of a PFD was made mandatory for all boaters in small recreational vessels of ≤4.8 metres length (Cassel & Newstead, 2014). Wearing increased from 22% to 63% between the pre-intervention year of 2005 and the post-intervention year of 2007; for larger vessels not covered by the legislation, wearing was 12% and 13% during pre- and post-intervention periods. Increases in the small vessel group were significant in all age groups and both sexes, all boat types, and all activities except water sports involving towing.

During 2009-2011 in a pilot program in the Northwestern region of the state of Mississippi in the USA, regulations were introduced mandating wear of PFDs on certain recreational watercraft. All boaters were required to wear a PFD at all times on boats less than 16 feet long (4.9 metres) and while the vessel was underway on boats 16-26 feet (4.9-7.9 metres). Wearing increased among adults from 14% at pre-intervention baseline in 2008 to 68% post-intervention in 2011, and for teenagers from 38% to 88%. It was noted that campaign visibility was important: when the number of patrols decreased due to budget cuts, so did wearing (Mangione & Chow, 2014). In nearby control lakes where no such policy was adopted, wearing was observed at less than 10% during those same test years (US Army Corps of Engineers, 2010).

Field survey data found that First Nations peoples in northern Saskatchewan supported regulations requiring wearing of a PFD, because it facilitates a boat operator requesting passengers to do so. In this photo a PFD is worn, but not securely fastened. Victoria Island, near Cambridge Bay, Nunavut. (Photo: High Arctic Lodge)

An observational study of 5,200 boaters in Washington state noted that 31% of boaters wore a PFD (Chung et al., 2014). However, PFD wearing was highest among groups required by state law, such as personal watercraft users (97%), people being towed by boat (95%), and children 0-12 years of age (82%). Children and youth were more likely to wear a PFD if there was an adult in the boat who was also wearing a PFD.

EFFECTS OF LEGISLATION ON BOATING DEATHS

In Victoria, Australia, mandatory PFD wearing regulations began in 2005. According to coroners' data, in the six years prior to legislation there were 59 recreational boater deaths from drowning, and in the five years post-intervention only 16 ($p=0.01$), representing a statistically significant change from an average of 9.8 per year to 3.2 (Bugeja et al., 2014). In the United States it was estimated that about half of recreational boating drowning deaths could be prevented by wearing a PFD (OR 0.51; 95% CI 0.35 to 0.74) (Cummings et al., 2011). Based on the data from Australia and the US, it appears that somewhere between half and two thirds of boaters might be saved by mandatory wearing. Moreover, in a colder country such as Canada, where wearing could be more comfortable and compliance is high for vehicle safety belts, and where the risk per hour of boating activity is much greater than for road travel, it should be feasible to raise PFD wearing above the 63% observed in Australia. If wearing were to increase to the current level of safety belt wearing in motor vehicles, about 95%, then the proportion of deaths averted could rise to 80-90%.

PFD EFFECTIVENESS

The theory behind PFDs as a method of drowning prevention is relatively straightforward; the device helps to keep one afloat with the airways above water until help arrives or the individual can swim to shore. Certain designs of PFD also slow heat loss from the body to the surrounding water. The data in this report show that only about 12% of boating victims were wearing a PFD, while other survey data show wearing to be higher among the general population of boaters than among victims. However, one cannot necessarily assume that if all victims had worn a PFD they would have survived. On the other hand, although injury incidents are frequently multifactorial, a positive change in a single risk factor may avert a fatal outcome. While certain personal factors such as age and environmental factors like wind, waves, and cold water-temperature are not modifiable, putting on a PFD when boarding a boat is. A few studies have examined the effectiveness of PFDs, including the avertable proportion of immersion deaths if the victims had been wearing a PFD.

One study used U.S. recreational boating data to estimate the association between wearing a PFD and death by drowning by comparing victims and survivors of the same incident. Risk of drowning was reduced by 50% when a PFD was worn, taking into account age, sex and all environmental factors such as water temperature, wind, waves, and distance from shore (Cummings et al., 2011). However, investigators were unable to account for alcohol involvement and swimming ability due to lack of data, which could have biased results and exaggerated benefits of wearing a PFD. Indeed, when additional variables were controlled for, risk of drowning was reduced by 36% rather than 50%.

Nevertheless, a study from Australia found the odds of drowning were reduced by 53% when the boater was wearing a PFD (O'Connor & O'Connor, 2005). Improved completeness of reporting on existing variables in data sources for boating fatalities, as well as collection of additional variables such as alcohol use and swimming ability, have potential for facilitating future injury prevention studies. Effectiveness of PFDs has also been examined for non-boating situations. In China, children 1-4 years of age wearing a PFD were less likely to drown when playing near water, compared to non-wearers the same age (OR: 0.43, 95% CI: 0.22-0.71) (Yang et al., 2007). A UK review indicated that about half of 148 water-related deaths during 2007-2013 would definitely have been averted if they had been wearing flotation, and the other half possibly averted; activities included mainly fishing from shore and boating (Maritime and Coastguard Agency, 2014).

PFD WEAR AMONG GENERAL BOATING POPULATION

Red Cross surveillance data show that only 12% of boating victims in Canada were wearing a PFD. Similar findings of 15% have been found in the USA (Mangione et al., 2012; Gungor & Viauroux, 2014). Among boating drowning victims in New York State during the late 1980s and early 1990s, 9% of victims were wearing a PFD. For the small proportion of victims who died despite wearing a PFD, blunt force injury, hypothermia, strong currents, and being trapped under a partially sunken boat were determined to be contributing causes (Browne et al., 1994). In Canada during 1991-2010, 13% (n=368) of recreational and daily living boating victims died despite wearing a PFD. Of these, 11% resulted from trauma as a primary cause. Cold was frequently a factor in deaths where a PFD was worn, and additional protective equipment would have been indicated.

PFD wearing from observational surveys of boaters on the water and self-reported wearing are generally somewhat higher than among victims. Observed PFD usage among boaters on the water differs significantly by age and type of boat. Usage among adults is considerably lower than for children. Observational studies of U.S. boaters have reported wear of 80-95% among children younger than 5 years of age. For children and youth 5 to 18 years, usage fell to about 60-70%. Among adults, observed flotation wear ranges from 13% to 25% (Mangione et al., 2012; Quan et al., 1998; Treser et al., 1997). The largest study, covering the entire USA, included more than 480,000 boaters in 175,000 boats between 1999 and 2010 and found average wearing of 22% (Mangione et al., 2012).

It is not clear whether PFD usage differs between males and females. Among 4,000 boaters in Washington and Oregon states during 1995, 31% of females and 21% of males were observed wearing PFDs (Quan et al., 1998). However, another study in Washington state during 1992-1994 found no difference between the sexes at 18% and 20% pre-intervention for males and females respectively, and 30% for both males and females post-intervention (Treser et al., 1997). As reported in the results section of this report, among victims the proportion of females wearing a PFD did differ from males (19% vs 12% for recreational and daily living immersion deaths).

Examining flotation wearing by type of boat, personal watercraft (PWC) boaters have the highest wearing of PFDs, 89-96% (Environics, 2002; Mangione et al., 2012). This is probably attributable to laws in Canada and the U.S. requiring PFDs for PWCs. For kayaks, wearing has been observed at around 80% and canoes around 70% (Mangione et al., 2012; Quan et al., 1998; Treser et al., 1997). Speedboats and houseboats were among the lowest at 20% and 17% respectively. In Canada, self-reported, not observed, life-jacket wear for cruising in small powerboats was 51% (Environics, 2002).

In Canada, observational studies indicate PFD wearing differs by region. Newfoundland and Labrador have the highest percentage of boaters observed wearing a PFD (60%), followed by the Northern Territories at 45%, the Prairies at 27%, BC at 20%, Ontario at 19%, Quebec at 17% and Maritimes at 15% (Starr Group Inc., 2001). Such differences could in part be attributable to factors other than region, such as perceptions of greater environmental hazards in certain regions, such as oceans and cold. It is clear that wearing of a PFD is a key factor in survival of immersion. In cold conditions, however, it may not be enough and additional protection of hypothermia protective garments is required (Canadian Red Cross 1994, 2006a, 2009a, 2009b, 2009c, 2011, 2013).

TRENDS IN PFD WEARING

According to U.S. data, PFD wearing has increased in certain subgroups of boaters since the early 1990s. During 1999-2010, for adults there was no positive change, while for children and youth 0-17 years wearing rose from 51% to 65% and for children 0-5 years, 81% to 95% (Mangione et al., 2012). Wearing among youth boating in speedboats, skiff/utility boat, and all powerboats combined increased. Between 1992 and 1994 in King County, Washington, wearing for all boaters increased from 20% to 31%. This short-term increase was largely due to increased wear by adults and children 0-4 years, and attributable to educational campaigns promoting PFDs (Treser et al., 1997). However, in Canada there are few victims in the 0-4 group, but many among youth 15-19 years of age.

ECONOMIC COSTS DUE TO NON-WEARING OF PFDS IN CANADA

To assess benefits from injury prevention interventions, various types of costs should be considered. To quantify losses for a death, it is essential to know the number, age, and sex of victims. This makes it feasible to calculate lost future earnings and benefits for each victim, known as human capital costs. With expert advice, we have done this for the two decades of deaths included in this report, and the result as shown in Appendix 4 was an average loss of about C$1 million per victim for lost wages and benefits.

However, this amount does not include the total costs of such deaths to family and society. In illustration, if a man with young children drowns, the total impact on his family and community is much greater than the loss of his own wages. A mother with a demanding job involving travel or shift work might need to change to a lower paying job or even not work at all, or pay for costly child care during evenings, nights, and weekends when there is no other parent. Such expenses can easily exceed the lost wages, leading to poverty and high stress for all, and costs of welfare and employment insurance for society. Furthermore, the victim's community has lost the societal investment in such a victim, with the cost of education day care, opportunity costs of lost wages, and all other expenses for some families mounting to as high as a million dollars for a child (McMahon, 2015; Taylor, 2013; Barss, 1991). Other expenses include search and rescues, police and coroner investigations,

ambulances and hospital costs for those who survive long enough to reach hospital, and funerals. Another expense seldom quantified is the cost to employers of losing an employee, including finding and training a replacement, known as friction costs. Economists sometimes also assess how much a family would be willing to pay to avoid death of a family member, known as willingness to pay costs, which can be in the millions of dollars.

As a result, when government agencies place a value on a human life, known as the Value of a Statistical Life (VSL), the figures are several times higher than the victim's lost wages and benefits. In illustration, the 2013 VSL from the US Department of Transport for a motor vehicle death is assessed at US $9.1 million per death, with a possible range of $5.2 to 12.9 million (United States Secretary of Transportation, 2013). With regard to air pollution deaths, the US Environmental Protection Agency set the VSL at $9.1 million in 2010, up from $6.8 million during the Bush administration (Appelbaum, 2011; Partnoy, 2012). Considering prevention of deaths from tobacco smoking, the US Food and Drug Administration set the VSL at $7.9 million in 2010, up from 5 million in 2008. In Alberta and British Columbia during the 1990s, estimates of total individual and societal costs of a motor vehicle death were C$2.9 million, based in part on US costs applied to Canadian incidence data (Anielski, 2001). Costs of boating deaths were assumed similar to a road crash (Lawrence et al., 2006).

Hence, what is a reasonable assessment for the average cost of a life lost to immersion? Should it be C$10 million or more, or somewhere between this figure and the average in Canada for lost wages and benefits of C$1 million? The average victim of smoking and of air pollution would be older than a boating victim, and hence losses would be expected to be higher for the boater. Adding a million dollars in other family and community economic losses to the C$1 million in lost wages for the victim alone would provide a conservative savings benefit of C$2 million for each death averted by effective regulation mandating wearing of a PFD.

Based on available research, it is assumed that two out of three boating deaths could have been prevented if legislation mandating PFD wearing had been implemented in Canada, where it is cooler and wearing more comfortable than in much of Australia and the United States. Such legislation has been recommended repeatedly in previous Canadian Red Cross drowning surveillance reports over the past two decades. This intervention could have prevented on the order of 2,115 of 3,140 boating immersion deaths during 1991-2010.

If one accepts an estimated average value of $2 million per life lost, foregone benefits due to lack of mandatory wearing could have exceeded $4 billion during the 20 years of surveillance, or $200 million per year. However, considering the much higher costs of a life used by other agencies, actual lost savings could have been as high as C$20 billion, about a billion per year. Clearly, whatever the case, continued failure to act by regulators will be costly, in the range of 200 million to a billion dollars each year.

During the past twenty years, compliance with frequently ignored current regulations – requiring only PFDs in the boat, not wearing – was very low, and going forward the almost inevitable losses are too great to ignore. In comparison, the cost of enforcing legislation mandating PDF wearing would be minimal, and could be covered by revenues from boating licenses, mandatory training, and fines.

ANTICIPATED REACTION TO PFD LEGISLATION IN CANADA

Research indicates that the majority of Canadian boaters favor some sort of mandatory wear legislation (Environics, 2002). Of more than 4,000 boaters interviewed, 59% supported laws mandating wear of PFDs at all times when on the water. Another 27% indicated PFDs should be mandatory only in certain conditions. Only 11% felt that there should be no laws requiring mandatory wear. The survey found that 60% of boaters would always and 30% sometimes wear a PFD, if non-wearing would affect their ability to pursue an insurance claim in the event of a boating incident. 14% of boaters did not believe they need to wear a PFD. While most adult boaters agreed that the importance of wearing a PFD outweighs any reason for not wearing one, PFD wear was not a priority for the majority.

Hence, while there is public support for legislation, prior to and during introduction of legislation and enforcement, acceptability should be enhanced. This could be done by conveying valid information on the serious risks of non-wearing and on the great benefits of wearing, using appropriate targeted health promotion messages, including observed benefits of legislation in Victoria State, Australia.

LIMITATIONS

This report is based on boaters who died as a result of immersion and/or trauma, and does not necessarily reflect the general 'live' boating population. The prevalence of wearing a PFD is likely lower among those who died than the living boating population, and hence the data mentioned in this report should not be extrapolated to the general boating population.

Due to not all information being available to coroners/medical examiners and/or police at the time of the incident, data are missing for some variables. The percentage of missing data ranged from 0.2% for sex of victim to more than 50% for variables such as distance from shore and wind conditions. Multiple imputation can be used to approximate missing values based on other information; however, more complete information from investigating police and coroners would aid in advancing research and life-saving programs.

CONCLUSION

Red Cross and other research spanning a quarter century supports the need for effective interventions to increase wearing of flotation devices among Canadian boaters. For children and youth, wearing of a PFD by parents and other adults is a key factor in protection. With respect to cold conditions, supplementary protection is essential. Indigenous people, especially male adults, youth, and children merit special attention. Swim programs that certify everyone in basic water competence should be supported, provided key preventive measures for boating safety such as PFD wear are integral.

Evaluations of various interventions show the greatest effectiveness far and away to be legislation requiring wearing, together with enforcement. Enforcement of current regulations is relatively ineffective and inefficient, being costly, difficult, and invasive, since a boat must be stopped, operators questioned, and devices inspected to verify whether the appropriate number of flotation devices is present in the boat. Enforcement of regulations requiring wearing of flotation should be considerably easier, less invasive, and less costly since observation of boat occupants should suffice in most instances.

If in Canada our legislators and other decision makers should replicate the results in Victoria State, Australia, especially for youth and adult males in their productive years, annual cost savings could be in the range of $200 million to $1 billion. This would represent the single greatest decrease in Canadian immersion deaths and increase in cost savings ever observed from a single water-related injury intervention.

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APPENDIX 1

RESULTS TABLES

Note: Many tables below were summarised in figures with the text; tables provide additional details.

WATER-RELATED FATALITIES

Table 1. Water-related deaths* by activity and cause of death†, Canada 1991-2010 (n=10,511)

	Boating		Aquatic		Non-aquatic		Land, ice, air transport		Bathing		Unknown		Total
Cause of death	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Immersion	3,140	32	2,189	22	1,862	19	1,532	15	736	7	502	5	9,961
Drowning without hypothermia	2,605	29	2,146	24	1,679	19	1,278	14	735	8	484	5	8,927
Drowning complicated by hypothermia	438	51	36	4	150	18	215	25	0	0	15	2	854
Hypothermia complicated by drowning	22	73	2	7	0	0	6	20	0	0	0	0	30
Hypothermia only	75	50	5	3	33	22	33	22	1	1	3	2	150
Trauma	183	36	127	25	84	16	105	20	11	2	3	1	513
Other	1	4	17	61	4	14	3	11	3	11	0	0	28
Unknown	0	0	0	0	1	11	3	33	2	22	3	33	9
Total	3,324	32	2,333	22	1,951	19	1,643	16	752	7	508	5	10,511

** Includes death from all causes: drowning, immersion hypothermia, trauma, and other/unknown*

† Immersion deaths are based on primary and secondary causes of death; for trauma, only primary cause of death was considered

Table 2. Water-related deaths* by activity and purpose, Canada 1991-2010 (n=10,511)

	Recreational		Occupational		Daily living		Attempting Rescue		Other		Unknown		Total
Activity	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Boating	2,553	77	376	11	293	9	50	2	12	<1	40	1	3,324
Aquatic	2,126	91	46	2	15	1	100	1	26	4	20	1	2,333
Non-aquatic	1,278	66	64	3	436	22	39	2	23	1	111	6	1,951
Land, ice and air transport	454	28	162	10	986	60	3	<1	13	1	25	2	1,643
Bathing	5	1	0	0	744	99	0	0	0	0	3	<1	752
Unknown	12	2	1	<1	4	1	0	0	3	1	488	96	508
Total	6,428	61	649	6	2,478	24	192	2	77	1	687	7	10,511

** Includes death from all causes: drowning, immersion hypothermia, trauma, and other/unknown*

BOATING OVERVIEW

Table 3. Boating deaths* by type of cause of death and purpose, Canada 1991-2010 (n=3,324)

	Recreational		Occupational		Daily living		Attempting Rescue		Other		Unknown		Total
Cause of death*	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Immersion	2,393	76	366	12	285	9	49	2	9	<1	38	1	3,140
Trauma	159	87	10	5	8	4	1	1	3	2	2	1	183
Other	1	100	0	0	0	0	0	0	0	0	0	0	1
Total	2,553	77	376	11	293	9	50	2	12	<1	40	1	3,324

** Includes deaths based on primary cause of death*

Table 4. Boating deaths* by purpose and type of incident, Canada 1991-2010 (n=3,324)

	Fell overboard		Capsized		Collision		Swamped		Other		Rescue person/ object		Unknown		Total
Purpose	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Recreational	647	25	1,003	39	203	8	301	12	99	4	21	1	279	11	2,553
Occupational	101	27	114	30	17	5	93	25	23	6	0	0	28	7	376
Daily living	84	29	97	33	23	8	31	11	21	7	2	1	35	12	293
Attempting rescue	7	14	11	22	1	2	1	2	6	12	24	48	2	2	50
Other	0	0	3	25	3	25	2	17	2	17	0	0	2	17	12
Unknown	7	18	12	30	4	10	4	10	2	5	0	0	11	28	40
Total	846	25	1,240	37	251	8	432	13	153	5	47	1	355	11	3,324

** Includes death from all causes: drowning, immersion hypothermia, trauma, and other/unknown*

Table 5. Boating deaths* by cause of death* and type of incident, Canada 1991-2010 (n=3,324)

	Fell overboard		Capsized		Collision		Swamped		Other		Rescue person/ object		Unknown		Total
Cause of death*	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Immersion	812	26	1,231	39	123	4	432	14	140	4	47	2	355	11	3,140
Trauma	34	19	8	4	128	70	0	0	13	7	0	0	0	0	183
Other	0	0	1	100	0	0	0	0	0	0	0	0	0	0	1
Total	846	25	1,240	37	251	8	432	13	153	5	47	1	355	11	3,324

** Includes deaths based on primary cause of death*

Table 6. Boating deaths* by activity and use of a personal flotation device, Canada 1991-2010 (n=3,324)													
	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Activity	n	%	n	%	n	%	n	%	n	%	n	%	n
Recreational	352	14	95	4	584	23	626	25	491	19	405	16	2,553
Fishing	110	12	41	4	272	29	208	22	177	19	117	13	925
Power boating	70	10	20	3	183	27	142	21	134	19	140	20	689
Canoeing	53	14	14	4	55	15	147	40	67	18	36	10	372
Hunting	14	10	3	2	31	22	31	22	28	20	32	23	139
Kayaking	39	38	6	6	10	10	18	18	9	9	20	20	102
Sailing	23	29	2	3	13	16	8	10	23	29	11	14	80
Other non-power boating	1	2	4	6	2	3	33	49	18	27	9	13	67
Swimming	0	0	0	0	0	0	3	27	1	9	7	64	11
Other activity	3	5	2	4	8	14	13	23	15	26	16	28	57
Unknown	1	17	0	0	1	17	0	0	1	17	3	50	6
Occupational	41	11	8	2	89	24	32	9	81	22	125	33	376
Fishing	20	9	6	3	59	26	21	9	63	27	61	27	230
Marine shipping	7	13	0	0	5	9	0	0	2	4	41	75	55
Fishing guiding	1	10	0	0	3	30	2	20	3	30	1	10	10
Aquaculture	2	25	1	13	2	25	0	0	1	13	2	25	8
Other	11	15	1	1	20	28	9	13	12	18	18	25	71
Unknown	0	0	0	0	0	0	0	0	0	0	2	100	2
Daily living	16	5	2	1	25	9	96	33	66	23	88	30	293
Boat travel	11	7	1	1	18	11	52	32	31	19	48	30	161
Fishing for food	2	4	0	0	3	5	26	46	18	32	8	14	57
Other	3	4	1	1	4	5	18	24	17	23	32	43	75
Attempting Rescue	1	2	3	6	12	24	14	28	15	30	5	10	50
Other	1	8	0	0	1	8	5	42	2	17	3	25	12
Unknown	3	8	1	3	1	3	11	28	11	28	13	33	40
Total	414	12	109	3	712	21	784	24	666	20	639	19	3,324

** Includes death from all causes: drowning, immersion hypothermia, trauma, and other/unknown*

Table 7. Boating deaths* by type of boat and use of a personal flotation device, Canada 1991-2010 (n=3,324)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Type of boat	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Powerboat	231	11	59	3	549	27	370	18	386	19	444	22	2,039
Large powerboat (>5.5metres)	62	13	11	2	134	27	40	8	82	17	167	34	496
Small open fishing-type craft (≤5.5 metres)	99	11	28	3	273	31	206	23	155	18	121	14	882
Other small craft (≤5.5 metres)	23	13	10	6	48	28	30	17	39	22	24	14	174
Powerboat, size unknown	18	5	8	2	86	23	68	18	94	25	103	27	377
Personal watercraft	28	38	2	3	5	7	19	26	5	7	15	20	74
Powerboat, type unknown	1	3	0	0	3	8	7	19	11	31	14	39	36
Unpowered boat	175	16	44	4	140	13	383	35	233	21	128	12	1,093
Canoe	76	12	24	4	97	15	250	39	129	20	66	10	642
Sailboat or sailboard	24	26	2	2	14	15	8	9	32	34	14	15	94
Rowboat	7	7	3	3	13	12	55	51	22	21	7	7	107
Inflatable	26	33	4	5	3	4	23	29	12	15	11	14	79
Kayak	41	36	8	7	12	10	20	17	12	10	22	19	115
Pedal/paddle boat	0	0	2	11	1	5	12	63	3	16	1	5	19
Other unpowered boat	1	4	1	4	0	0	13	48	7	26	5	19	27
Unpowered boat, type unknown	0	0	0	0	0	0	2	20	6	60	2	20	10
Unknown	8	4	6	3	23	12	31	16	57	30	67	35	192
Total	414	12	109	3	712	21	784	24	666	20	639	19	3,324

** Includes death from all causes: drowning, immersion hypothermia, trauma, and other/unknown*

Table 8. Boating deaths* by type of boat and purpose, Canada 1991-2010 (n=3,324)

	Recreational		Occupational		Daily living		Attempting Rescue		Other		Unknown		Total
Type of boat	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Powerboat	1,449	71	353	17	183	9	28	1	9	0	17	1	2,039
Large powerboat (>5.5 m)	189	38	248	50	48	10	4	1	3	1	4	1	496
Small open powerboat (≤5.5 m)	728	83	56	6	78	9	11	1	3	0	6	1	882
Other small open (<5.5m)	144	83	11	6	15	9	0	0	0	0	4	2	174
Personal watercraft	71	96	1	1	0	0	0	0	2	3	0	0	74
Powerboat, size unknown	317	77	37	9	42	10	13	3	1	0	3	1	413
Unpowered boat	984	90	12	1	71	6	19	2	1	0	6	1	1,093
Canoe	572	89	6	1	53	8	8	1	1	0	2	0	642
Kayak	109	95	0	0	2	2	4	3	0	0	0	0	115
Rowboat	91	85	5	5	9	8	1	1	0	0	1	1	107
Sailboat or sailboard	88	94	0	0	3	3	1	1	0	0	2	2	94
Inflatable	76	96	0	0	2	3	1	1	0	0	0	0	79
Pedal/paddle boat	17	89	0	0	0	0	2	11	0	0	0	0	19
Other unpowered boat	22	81	1	4	1	4	2	7	0	0	1	4	27
Unpowered boat, type unknown	9	90	0	0	1	10	0	0	0	0	0	0	10
Other	10	50	2	10	6	30	0	0	0	0	2	10	20
Unknown	110	64	9	5	33	19	3	2	2	1	15	9	172
Total	2,553	77	376	11	293	9	50	2	12	0	40	1	3,324

** Includes death from all causes: drowning, immersion hypothermia, trauma, and other/unknown*

RECREATION AND DAILY LIFE

Table 9. Boating deaths during recreation and daily life by cause of death and use of a personal flotation device, Canada 1991-2010 (n=2,846)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Cause of death	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Immersion	327	12	94	4	585	22	715	27	528	20	429	16	2,678
Drowning without hypothermia	186	8	65	3	500	22	626	28	473	21	379	17	2,229
Drowning complicated by hypothermia	93	25	23	6	78	21	83	22	48	13	48	13	373
Hypothermia complicated by drowning	9	53	4	24	1	6	0	0	3	18	0	0	17
Hypothermia only	39	66	2	3	6	10	6	10	4	7	2	3	59
Trauma	40	24	3	2	24	14	7	4	29	17	64	38	167
Other	1	100	0	0	0	0	0	0	0	0	0	0	1
Total	368	13	97	3	609	21	722	25	557	20	493	17	2,846

RECREATION AND DAILY LIFE: IMMERSION DEATHS

Table 10. Boating immersion deaths* during recreation and daily life by activity and use of a personal flotation device, Canada 1991-2010 (n=2,678)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Activity by purpose	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Recreational	**311**	**13**	**92**	**4**	**560**	**23**	**620**	**26**	**463**	**19**	**347**	**15**	**2,393**
Fishing from boat	109	12	41	4	270	30	208	23	173	19	113	12	914
Power boating	46	8	19	3	163	28	138	24	112	19	98	17	576
Canoeing	53	14	14	4	55	15	147	40	67	18	35	9	371
Hunting	13	9	3	2	31	23	31	23	28	20	31	23	137
Kayaking	37	38	5	5	10	10	17	17	9	9	20	20	98
Sailing	21	27	2	3	13	17	8	10	23	30	10	13	77
Other non-power boating	1	2	4	6	1	2	33	50	18	27	9	14	66
White-water rafting	19	76	0	0	0	0	3	12	2	8	1	4	25
Rowing	0	0	0	0	6	26	10	43	5	22	2	9	23
Other rafting	5	24	1	5	1	5	7	33	4	19	3	14	21
Swimming	0	0	0	0	0	0	3	38	1	13	4	50	8
Being towed by boat	3	38	1	13	0	0	1	13	3	38	0	0	8
Partying	0	0	0	0	2	33	1	17	2	33	1	17	6
Other	3	5	2	4	7	12	13	23	15	26	17	30	57
Unknown	1	17	0	0	1	17	0	0	1	17	3	50	6
Daily living	**16**	**6**	**2**	**1**	**25**	**9**	**95**	**33**	**65**	**23**	**82**	**29**	**285**
Boat travel	11	7	1	1	18	12	51	33	30	19	43	28	154
Fishing for food	2	4	0	0	3	5	26	46	18	32	8	14	57
Travel -other	0	0	0	0	1	33	0	0	0	0	2	67	3
Other	3	4	1	1	3	4	18	25	17	24	29	41	71
Total	**327**	**12**	**94**	**4**	**585**	**22**	**715**	**27**	**528**	**20**	**429**	**16**	**2,678**

** Includes drowning and immersion hypothermia deaths*

Table 11. Boating immersion deaths* during recreation and daily life by type of incident and use of a personal flotation device, Canada 1991-2010 (n=2,678)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Type of incident	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Capsized	161	15	43	4	206	19	350	32	199	18	133	12	1,092
Fell overboard	31	4	11	2	185	26	156	22	185	26	132	19	700
Swamped	66	20	18	5	82	25	87	26	53	16	26	8	332
Collision	12	11	4	4	17	16	25	24	20	19	28	26	106
Rescue	0	0	1	4	8	35	7	30	7	30	0	0	23
Other	9	8	6	5	25	23	19	17	19	17	33	30	111
Unknown	48	15	11	4	62	20	71	23	45	14	77	25	314
Total	327	12	94	4	585	22	715	27	528	20	429	16	2,678

** Includes drowning and immersion hypothermia deaths*

Table 12. Boating immersion deaths* during recreation and daily life by age and sex and use of a personal flotation device, Canada 1991-2010 (n=2,678)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Males†	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
<1	0	0	0	0	0	0	4	100	0	0	0	0	4
1 to 4	3	23	1	8	2	15	3	23	2	15	2	15	13
5 to 14	9	23	0	0	6	15	12	30	5	13	8	20	40
15 to 19	22	11	13	7	25	13	82	41	38	19	18	9	198
20 to 24	16	7	8	3	31	13	101	44	49	21	27	12	232
25 to 34	52	11	17	4	93	20	137	29	85	18	91	19	475
35 to 44	65	13	8	2	107	22	123	25	111	23	73	15	487
45 to 54	61	15	15	4	100	24	84	20	73	18	80	19	413
55 to 64	37	11	13	4	92	28	61	18	87	26	42	13	332
65 to 74	20	10	10	5	56	27	41	20	40	19	43	20	210
75+	6	8	4	5	26	33	20	25	14	18	9	11	79
Unknown	1	13	0	0	4	50	0	0	1	13	2	25	8
Total	292	12	89	4	542	22	668	27	505	20	395	16	2,491
Females													
<1	0	0	0	0	0	0	0	0	0	0	0	0	0
1 to 4	0	0	1	20	1	20	1	20	0	0	2	40	5
5 to 14	4	24	0	0	3	18	8	47	0	0	2	12	17
15 to 19	3	14	2	10	4	19	6	29	2	10	4	19	21
20 to 24	5	29	2	12	0	0	3	18	3	18	4	24	17
25 to 34	7	28	0	0	6	24	7	28	1	4	4	16	25
35 to 44	5	14	0	0	11	31	9	25	4	11	7	19	36
45 to 54	8	24	0	0	13	38	4	12	6	18	3	9	34
55 to 64	2	11	0	0	1	6	5	28	5	28	5	28	18
65 to 74	1	13	0	0	2	25	1	13	1	13	3	38	8
75+	0	0	0	0	2	40	2	40	1	20	0	0	5
Unknown	0	0	0	0	0	0	1	100	0	0	0	0	1
Total	35	19	5	3	43	23	47	25	23	12	34	18	187

** Includes drowning and immersion hypothermia deaths*

† Three victims of unknown sex were imputed as male

Table 13. Boating immersion deaths* during recreation and daily life by blood alcohol levels and use of a personal flotation device, Canada 1991-2010 (victims ≥15 years of age, n=2,426)†

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Alcohol involvement	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
No alcohol	188	20	42	5	225	24	220	24	157	17	98	11	930
Above legal limit	32	5	19	3	134	20	186	28	177	27	112	17	660
Equal or below	18	8	5	2	70	30	80	34	39	17	21	9	233
Alcohol suspected	3	2	2	1	25	15	65	38	31	18	43	25	169
Unknown	63	15	17	4	81	19	92	21	67	15	114	26	434
Total	304	13	85	4	535	22	643	27	471	19	388	16	2,426

** Includes drowning and immersion hypothermia deaths*

† This table excludes victims for whom decomposition rendered blood alcohol unreliable, no blood alcohol sample was taken (n=62), sample taken (n=111). Limit refers to federal legal limit of 80 mg%; some provinces have lower limits

Table 14. Boating immersion deaths* during recreation and daily life by drug involvement and use of a personal flotation device, Canada 1991-2010 (victims ≥15 years of age, n=2,541)†

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Drug involvement	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
No drugs	**160**	**15**	**42**	**4**	**231**	**22**	**280**	**26**	**229**	**22**	**123**	**12**	**1,065**
Illegal drugs													
Confirmed	**17**	**11**	**7**	**5**	**28**	**18**	**51**	**33**	**34**	**22**	**18**	**12**	**155**
Cannabis	12	13	3	3	19	21	27	29	22	24	9	10	92
Cocaine	1	4	1	4	5	19	9	35	6	23	4	15	26
Other (PCP/opiates)	0	0	3	20	3	20	5	33	3	20	1	7	15
Suspected	**3**	**8**	**0**	**0**	**8**	**20**	**14**	**35**	**7**	**18**	**8**	**20**	**40**
Legal drugs													
Confirmed	**6**	**8**	**6**	**8**	**22**	**28**	**20**	**25**	**17**	**22**	**8**	**10**	**79**
Anticonvulsants	0	0	0	0	0	0	0	0	1	100	0	0	1
Pain-killers	0	0	0	0	1	20	1	20	1	20	2	40	5
Anti-depressants	0	0	1	25	1	25	1	25	1	25	0	0	4
Suspected	2	12	1	6	4	24	5	29	2	12	3	18	17
Unknown	**119**	**10**	**35**	**3**	**263**	**22**	**297**	**25**	**220**	**19**	**251**	**21**	**1,185**
Total	**307**	**12**	**91**	**4**	**556**	**22**	**667**	**26**	**509**	**20**	**411**	**16**	**2,541**

** Includes drowning and immersion hypothermia deaths*

† This table excludes victims for whom decomposition rendered blood sample unreliable (n=58)

Table 15. Boating immersion deaths* during recreation and daily life by swimming ability and use of a personal flotation device, Canada 1991-2010 (victims ≥5 years of age, n=2,656)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Swimming ability	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Non-swimmer	12	4	8	3	98	32	102	34	63	21	20	7	303
Weak	16	9	5	3	47	27	71	41	33	19	3	2	175
Average	12	11	5	5	32	30	38	36	12	11	7	7	106
Strong	14	13	5	5	30	29	31	30	18	17	7	7	105
Skill level not identified	32	14	8	4	55	24	58	26	41	18	31	14	225
Unknown	238	14	61	4	320	18	407	23	359	21	357	20	1,742
Total	324	12	92	3	582	22	707	27	526	20	425	16	2,656

** Includes drowning and immersion hypothermia deaths*

Table 16. Boating immersion deaths* during recreation and daily life by boating experience and use of a personal flotation device, Canada 1991-2010 (n=2,678)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Boating experience	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Inexperienced boater	32	23	9	6	28	20	48	34	13	9	12	8	142
Occasional boater	35	21	2	1	41	25	54	33	23	14	10	6	165
Experienced boater	92	15	16	3	145	24	130	22	120	20	101	17	604
Unknown	168	10	67	4	371	21	483	27	372	21	306	17	1,767
Total	327	12	94	4	585	22	715	27	528	20	429	16	2,678

** Includes drowning and immersion hypothermia deaths*

Table 17. Boating immersion deaths* during recreation and daily life by indigenous ethnicity and use of a personal flotation device, Canada 1991-2010 (n=2,678)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Ethnicity	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Non-Indigenous	235	15	66	4	389	24	407	25	326	20	193	12	1,616
Indigenous†	13	3	8	2	48	12	154	39	88	22	89	22	400
Unknown	79	12	20	3	148	22	154	23	114	17	147	22	662
Total	327	12	94	4	585	22	715	27	528	20	429	16	2,678

** Includes drowning and immersion hypothermia deaths*

† Includes Indigenous person, definite (n=368) and Indigenous person, probable (n=32)

Table 18. Boating immersion deaths* during recreation and daily life by type of boat and use of a personal flotation device, Canada 1991-2010 (n=2,678)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Type of boat	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Powered all	**154**	**10**	**49**	**3**	**428**	**29**	**327**	**22**	**275**	**19**	**248**	**17**	**1,481**
Large powerboat (>5.5 m)	24	12	5	2	63	31	27	13	32	16	52	26	203
Small open powerboat (≤5.5 m)	87	11	25	3	251	32	190	24	133	17	90	12	776
Other small open (<5.5m)	20	14	9	6	41	29	30	21	29	20	14	10	143
Personal watercraft	8	24	2	6	3	9	14	42	5	15	1	3	33
Powerboat, size unknown	15	5	8	2	70	21	66	20	76	23	91	28	326
Unpowered all	**166**	**16**	**41**	**4**	**138**	**13**	**366**	**35**	**206**	**20**	**123**	**12**	**1,040**
Canoe	76	12	24	4	96	15	240	38	124	20	64	10	624
Kayak	38	36	6	6	12	11	18	17	11	10	22	21	107
Rowboat	6	6	3	3	12	12	52	53	18	18	7	7	98
Sailboat or sailboard	21	24	2	2	14	16	8	9	30	34	12	14	87
Inflatable	24	32	3	4	3	4	23	31	10	14	11	15	74
Pedal/paddle boat	0	0	2	12	1	6	11	65	2	12	1	6	17
Other unpowered boat	1	4	1	4	0	0	12	52	5	22	4	17	23
Unpowered boat, type unknown	0	0	0	0	0	0	2	20	6	60	2	20	10
Other	0	0	0	0	1	7	9	60	3	20	2	13	15
Unknown	7	5	4	3	18	13	13	9	44	31	56	39	142
Total	327	12	94	4	585	22	715	27	528	20	429	16	2,678

** Includes drowning and immersion hypothermia deaths*

Table 19. Boating immersion deaths* during recreation and daily life by body of water† and use of a personal flotation device, Canada 1991-2010 (n=2,678)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Body of water†	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Lake or pond	147	9	56	3	405	25	476	30	304	19	222	14	1,610
Ocean	67	17	11	3	53	13	70	17	93	23	112	28	406
River, stream, creek, waterfall	112	17	27	4	126	20	163	25	126	20	92	14	646
Other	0	0	0	0	1	9	5	45	4	36	1	9	11
Unknown	1	20	0	0	0	0	1	20	1	20	2	40	5
Total	327	12	94	4	585	22	715	27	528	20	429	16	2,678

** Includes drowning and immersion hypothermia deaths*

† Incidents occurring in reservoir/artificial lake/dugout/retention pond were included under lake/pond (n=27); incidents occurring in dam/inlet or spillway were included under river category (n=9); other body of water includes canals (n=8)

Table 20. Boating immersion deaths* during recreation and daily life by current and use of a personal flotation device, Canada 1991-2010 (n=2,678)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Current	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
No current	81	9	33	4	239	26	276	31	186	21	89	10	904
River current	**97**	**21**	**17**	**4**	**95**	**20**	**126**	**27**	**75**	**16**	**59**	**13**	**469**
Rapids, white water	53	35	6	4	22	14	30	20	28	18	13	9	152
Fast current	33	12	8	3	64	23	88	32	43	15	43	15	279
Hydraulic current	7	0	1	0	1	0	1	0	1	0	1	0	12
Dam spillway	1	9	1	9	3	27	3	27	2	18	1	9	11
Waterfall	3	20	1	7	5	33	4	27	1	7	1	7	15
Ocean current	**35**	**20**	**6**	**4**	**27**	**16**	**17**	**10**	**55**	**32**	**31**	**18**	**171**
Ocean undertow	2	0	0	0	3	0	3	0	6	0	7	0	21
Tide	33	22	6	4	24	16	14	9	49	33	24	16	150
Other	3	9	1	3	9	28	3	9	8	25	8	25	32
Unknown	111	10	37	3	215	20	293	27	204	19	242	22	1,102
Total	327	12	94	4	585	22	715	27	528	20	429	16	2,678

** Includes drowning and immersion hypothermia deaths*

Table 21. Boating immersion deaths* during recreation and daily life by wind conditions and use of a personal flotation device, Canada 1991-2010 (n=2,678)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Wind conditions	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Strong winds	109	19	28	5	141	25	144	25	70	12	81	14	573
Breeze/windy	37	16	10	4	61	27	55	24	38	17	24	11	225
Calm	16	8	6	3	63	31	55	27	44	21	22	11	206
Unknown	165	10	50	3	320	19	461	28	376	22	302	18	1,674
Total	327	12	94	4	585	22	715	27	528	20	429	16	2,678

** Includes drowning and immersion hypothermia deaths*

Table 22. Boating immersion deaths* during recreation and daily life by wave conditions and use of a personal flotation device, Canada 1991-2010 (n=2,678)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Wave conditions	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Storm/gale force	13	16	0	0	23	29	11	14	16	20	17	21	80
Rough, white-caps	127	22	28	5	144	25	129	22	72	13	74	13	574
Choppy, small waves	42	17	14	6	55	22	80	33	33	13	21	9	245
Calm	20	6	9	3	92	27	121	35	64	19	35	10	341
Other	8	35	1	4	4	17	4	17	6	26	0	0	23
Unknown	117	8	42	3	267	19	370	26	337	24	282	20	1,415
Total	327	12	94	4	585	22	715	27	528	20	429	16	2,678

** Includes drowning and immersion hypothermia deaths*

Table 23. Boating immersion deaths* during recreation and daily life by water temperature and use of a personal flotation device, Canada 1991-2010 (n=2,678)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Water temperature	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Very cold (<10°C)	114	20	21	4	113	19	138	24	123	21	71	12	580
Cold/cool (10 to 20°C)	75	15	25	5	121	24	126	25	112	22	52	10	511
Warm or hot (≥21°C)	3	6	2	4	14	30	16	34	6	13	6	13	47
Unknown	135	9	46	3	337	22	435	28	287	19	300	19	1,540
Total	327	12	94	4	585	22	715	27	528	20	429	16	2,678

** Includes drowning and immersion hypothermia deaths*

Table 24. Boating immersion deaths* during recreation and daily life by ice conditions and use of a personal flotation device, Canada 1991-2010 (n=2,678)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Ice conditions	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Irrelevant	271	12	80	4	507	23	599	27	455	20	323	14	2,235
Intact, but thin or soft	1	13	0	0	2	25	3	38	1	13	1	13	8
Open hole	1	17	0	0	0	0	3	50	2	33	0	0	6
Floe or pack ice	7	24	0	0	3	10	14	48	2	7	3	10	29
Cracked, broken ice	1	25	1	25	0	0	0	0	0	0	2	50	4
Other	1	17	1	17	0	0	4	67	0	0	0	0	6
Unknown	45	12	12	3	73	19	92	24	68	17	100	26	390
Total	327	12	94	4	585	22	715	27	528	20	429	16	2,678

** Includes drowning and immersion hypothermia deaths*

Table 25. Cold water boating immersion deaths* during recreation and daily life by use of a personal flotation device, Canada 1991-2010 (n=2,678)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Type of immersion	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Cold water immersions	240	20	48	4	240	20	229	19	236	19	234	19	1,227
All immersions	327	12	94	4	585	22	715	27	528	20	429	16	2,678

** Includes drowning and immersion hypothermia deaths*

Table 26. Boating immersion deaths* during recreation and daily life by light conditions and use of a personal flotation device, Canada 1991-2010 (n=2,678)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Light conditions	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Light	203	14	57	4	358	25	387	27	272	19	151	11	1,428
Twilight	3	9	1	3	7	21	9	27	7	21	6	18	33
Dawn	6	19	1	3	4	13	10	32	8	26	2	6	31
Dusk	22	12	4	2	40	21	64	34	41	21	20	10	191
Dark	30	7	13	3	74	17	115	26	93	21	109	25	434
Unknown	63	11	18	3	102	18	130	23	107	19	141	25	561
Total	327	12	94	4	585	22	715	27	528	20	429	16	2,678

** Includes drowning and immersion hypothermia deaths*

Table 27. Boating immersion deaths* during recreation and daily life by distance from shore and use of a personal flotation device, Canada 1991-2010 (n=2,678)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Distance from shore	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
0 to 2 metres	10	9	1	1	11	10	17	16	26	25	41	39	106
2.1 to 15 metres	28	14	4	2	42	20	68	33	50	24	13	6	205
16 to 50 metres	9	4	5	2	50	24	82	39	37	18	26	12	209
More than 50 metres	86	14	32	5	151	25	172	28	112	18	60	10	613
Unknown	194	13	52	3	331	21	376	24	303	20	289	19	1,545
Total	327	12	94	4	585	22	715	27	528	20	429	16	2,678

** Includes drowning and immersion hypothermia deaths*

Table 28. Boating immersion deaths* during recreation and daily life by depth of water and use of a personal flotation device, Canada 1991-2010 (n=2,678)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Depth of water	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
0 to 1 metre	6	19	0	0	6	19	3	9	9	28	8	25	32
1.1 to 2.5 metres	12	8	3	2	22	15	59	41	33	23	14	10	143
More than 2.5 metres	102	11	27	3	219	23	264	28	208	22	116	12	936
Unknown	207	13	64	4	338	22	389	25	278	18	291	19	1,567
Total	327	12	94	4	585	22	715	27	528	20	429	16	2,678

** Includes drowning and immersion hypothermia deaths*

Table 29. Boating immersion deaths* during recreation and daily life by rural/urban location of incident and use of a personal flotation device, Canada 1991-2010 (n=2,678)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Location of incident	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Urban†	68	10	27	4	129	20	200	30	122	19	111	17	657
Rural	257	13	67	3	448	23	501	25	400	20	306	15	1,979
Unknown	2	5	0	0	8	19	14	33	6	14	12	29	42
Total	327	12	94	4	585	22	715	27	528	20	429	16	2,678

** Includes drowning and immersion hypothermia deaths*

† Urban locations are cities and towns with >1,000 population

Table 30. Boating immersion deaths* during recreation and daily life by residence of deceased and use of a personal flotation device, Canada 1991-2010 (n=2,678)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Residence of deceased	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Urban†	233	14	69	4	388	24	437	27	289	18	227	14	1,643
Rural	72	8	19	2	158	18	259	29	202	23	168	19	878
Unknown	22	14	6	4	39	25	19	12	37	24	34	22	157
Total	327	12	94	4	585	22	715	27	528	20	429	16	2,678

** Includes drowning and immersion hypothermia deaths*

† Urban locations are cities and towns with >1,000 population

Table 31. Boating immersion deaths* during recreation and daily life by month of incident and use of a personal flotation device, Canada 1991-2010 (n=2,678)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Month	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
January	4	14	1	3	6	21	4	14	6	21	8	28	29
February	4	18	0	0	4	18	1	5	1	5	12	55	22
March	9	16	6	11	10	18	7	12	15	26	10	18	57
April	16	13	3	2	31	25	31	25	32	26	10	8	123
May	58	14	9	2	92	22	134	32	66	16	54	13	413
June	67	14	16	3	114	24	125	27	91	19	57	12	470
July	60	13	15	3	105	22	153	32	73	15	67	14	473
August	39	10	12	3	95	24	92	24	81	21	72	18	391
September	29	9	18	6	71	23	79	25	69	22	49	16	315
October	26	10	11	4	41	16	60	23	59	23	59	23	256
November	12	14	3	4	13	15	17	20	24	28	16	19	85
December	3	13	0	0	0	0	5	22	7	30	8	35	23
Unknown	0	0	0	0	3	14	7	33	4	19	7	33	21
Total	327	12	94	4	585	22	715	27	528	20	429	16	2,678

** Includes drowning and immersion hypothermia deaths*

Table 32. Boating immersion deaths* during recreation and daily life by day of week and use of a personal flotation device, Canada 1991-2010 (n=2,678)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Day of week	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Monday	27	9	14	5	66	23	71	25	55	19	54	19	287
Tuesday	35	13	11	4	39	14	76	28	61	22	53	19	275
Wednesday	32	12	8	3	59	22	69	26	50	19	50	19	268
Thursday	35	12	10	3	71	24	72	24	78	26	34	11	300
Friday	47	14	12	4	69	21	87	27	58	18	52	16	325
Saturday	88	14	20	3	163	25	153	24	115	18	104	16	643
Sunday	59	11	19	4	111	20	177	33	106	20	70	13	542
Unknown	4	11	0	0	7	18	10	26	5	13	12	32	38
Total	327	12	94	4	585	22	715	27	528	20	429	16	2,678

** Includes drowning and immersion hypothermia deaths*

Table 33. Boating immersion deaths* during recreation and daily life by supervision/accompaniment and use of a personal flotation device, Canada 1991-2010 (n=2,678)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Accompaniment	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Alone	66	9	17	2	166	23	172	23	154	21	162	22	737
With at least one adult	221	14	63	4	360	23	417	26	301	19	219	14	1,581
With adults and minors	19	13	2	1	39	27	44	30	16	11	25	17	145
With adult bystanders	8	18	3	7	7	16	12	27	8	18	6	14	44
With minors only	7	9	5	6	8	10	44	55	12	15	4	5	80
With others (not specified)	6	8	4	5	4	5	20	27	32	44	7	10	73
Unknown	0	0	0	0	1	6	6	33	5	28	6	33	18
Total	327	12	94	4	585	22	715	27	528	20	429	16	2,678

** Includes drowning and immersion hypothermia deaths*

Table 34. Boating immersion deaths* during recreation and daily life by number of victims and use of a personal flotation device, Canada 1993-2010† (n=2,296)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Number of victims	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Single victim	188	11	54	3	382	23	445	27	363	22	218	13	1,650
Multiple victims	97	15	35	5	132	20	156	24	110	17	116	18	646
2 victims	67	15	29	6	95	21	110	24	84	18	71	16	456
3 victims	19	18	5	5	21	20	36	34	17	16	8	8	106
≥ 4 victims	10	16	1	2	8	13	10	16	8	13	24	39	61
Unknown	1	4	0	0	8	35	0	0	1	4	13	57	23
Total	285	12	89	4	514	22	601	26	473	21	334	15	2,296

** Includes drowning and immersion hypothermia deaths*

† Data unavailable for 1991-1992

Table 35. Boating immersion deaths* during recreation and daily life by sex and single/multiple victim incident, Canada 1993-2010† (n=2,296)

	Single		Multiple		Total
Sex	**n**	**%**	**n**	**%**	**n**
Male	1,562	73	577	27	2,139
Female	88	56	69	44	157
Total	1,650	72	646	28	2,296

** Includes drowning and immersion hypothermia deaths*

† Data unavailable for 1991-1992

Table 36. Boating immersion deaths* during recreation and daily life by age group and single/multiple victim incident, Canada 1993-2010† (n=2,296)

	Single		Multiple		Total
Age group	**n**	**%**	**n**	**%**	**n**
<1	1	100	0	0	1
1 to 4	6	46	7	54	13
5 to 14	23	45	28	55	51
15 to 19	114	63	68	37	182
20 to 24	136	68	64	32	200
25 to 34	267	64	151	36	418
35 to 44	318	69	141	31	459
45 to 54	296	78	85	22	381
55 to 64	257	81	59	19	316
65 to 74	169	88	23	12	192
75+	63	82	14	18	77
Unknown	0	0	6	100	6
Total	1,650	72	646	28	2,296

** Includes drowning and immersion hypothermia deaths*

† Data unavailable for 1991-1992

Table 37. Boating immersion deaths* during recreation and daily life by indigenous ethnicity and single/multiple victim incident, Canada 1993-2010† (n=2,296)

	Single		Multiple		Total
Ethnicity	**n**	**%**	**n**	**%**	**n**
Non-Indigenous	1,105	74	393	26	1,498
Indigenous‡	189	58	136	42	325
Unknown	356	75	117	25	473
Total	1,650	72	646	28	2,296

** Includes drowning and immersion hypothermia deaths*

† Data unavailable for 1991-1992

‡ Included those of definite and probable indigenous ethnicity

Table 38. Boating immersion deaths* during recreation and daily life by type of boat and single/multiple victim incident, Canada 1993-2010† (n=2,296)

	Single		Multiple		Total
Type of boat	**n**	**%**	**n**	**%**	**n**
Powered boat	839	68	402	32	1,241
Unpowered boat	704	77	210	23	914
Unknown	107	76	34	24	141
Total	1,650	72	646	28	2,296

** Includes drowning and immersion hypothermia deaths*

† Data unavailable for 1991-1992

Table 39. Boating immersion deaths* during recreation and daily life by body of water‡ and single/multiple victim incident, Canada 1993-2010† (n=2,296)

	Single		Multiple		Total
Body of water‡	**n**	**%**	**n**	**%**	**n**
Lake or pond	1,011	74	364	26	1,375
Ocean	193	56	153	44	346
River, creek, stream or waterfall	437	78	126	22	563
Other	5	63	3	37	8
Unknown	4	100	0	0	4
Total	1,650	72	646	28	2,296

** Includes drowning and immersion hypothermia deaths*

† Data unavailable for 1991-1992

‡ Incidents occurring in reservoir/artificial lake/dugout/retention pond were included under lake/pond (n=22); incidents occurring in dam/inlet or spillway were included under river category (n=8); other body of water includes canals (n=6)

Table 40. Boating immersion deaths* during recreation and daily life by survivor response and use of a personal flotation device, Canada 1996-2010† (n=1,805)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Survivor response	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Boat did not capsize or swamp, or no survivors	120	11	37	3	273	24	257	23	269	24	176	16	1,132
No choice to stay with boat or swim for shore	18	21	3	4	32	38	16	19	13	15	2	2	84
Stayed with boat	18	18	6	6	15	15	37	37	18	18	7	7	101
Swam for shore immediately	19	11	7	4	29	16	75	42	39	22	11	6	180
Swam for shore after a delay	6	7	3	4	25	30	28	33	17	20	5	6	84
Other	7	17	1	2	7	17	14	33	11	26	2	5	42
Unknown	37	20	6	3	40	22	45	25	30	16	24	13	182
Total	225	12	63	3	421	23	472	26	397	22	227	13	1,805

** Includes drowning and immersion hypothermia deaths*

† Data unavailable for 1991-1992

Table 41. Boating immersion deaths* during recreation and daily life by victim response and use of a personal flotation device, Canada 1996-2010† (n=1,805)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Victim response	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Boat did not capsize or swamp	67	8	24	3	210	26	163	20	209	26	140	17	813
No choice to stay with boat or swim for shore	63	21	15	5	79	27	77	26	45	15	18	6	297
Stayed with boat	14	17	6	7	15	18	24	29	16	19	8	10	83
Swam for shore immediately	8	7	2	2	24	21	50	45	22	20	6	5	112
Swam for shore after a delay	8	14	3	5	12	21	23	40	11	19	1	2	58
Other	15	19	1	1	11	14	31	40	16	21	3	4	77
Unknown	50	14	12	3	70	19	104	28	78	21	51	14	365
Total	225	12	63	3	421	23	472	26	397	22	227	13	1,805

** Includes drowning and immersion hypothermia deaths*

† Data unavailable for 1991-1992

Table 42. Boating immersion deaths* during recreation and daily life by region and use of a personal flotation device, Canada 1991-2010 (n=2,678)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Region	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Newfoundland	20	15	10	7	15	11	34	25	39	29	18	13	136
Nova Scotia	11	9	3	2	17	14	21	17	48	39	23	19	123
Prince Edward Island	0	0	0	0	5	29	5	29	1	6	6	35	17
New Brunswick	11	14	5	6	24	30	17	21	16	20	7	9	80
Quebec	68	14	24	5	105	21	190	39	46	9	57	12	490
Ontario	70	8	17	2	249	30	204	25	142	17	146	18	828
Manitoba	10	7	6	4	26	19	56	41	18	13	22	16	138
Saskatchewan	7	6	3	3	12	11	35	31	37	33	18	16	112
Alberta	24	16	6	4	30	20	34	22	42	28	16	11	152
British Columbia	79	17	15	3	83	17	74	16	127	27	99	21	477
Territories	27	22	5	4	19	15	45	36	12	10	17	14	125
Canada	327	12	94	4	585	22	715	27	528	20	429	16	2,678

** Includes drowning and immersion hypothermia deaths*

Table 43. Boating immersion deaths* during recreation and daily life by 5-year period and use of a personal flotation device, Canada 1991-2010 (n=2,678)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Time period	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
1991-1995	102	12	31	4	164	19	243	28	131	15	202	23	873
1996-2000	79	11	19	3	161	22	209	29	158	22	93	13	719
2001-2005	76	13	18	3	128	23	125	22	141	25	77	14	565
2006-2010	70	13	26	5	132	25	138	26	98	19	57	11	521
1991-2010	327	12	94	4	585	22	715	27	528	20	429	16	2,678

** Includes drowning and immersion hypothermia deaths*

Table 44. Boating immersion deaths* during recreation and daily life by 5-year time period, type of boat and use of a personal flotation device, Canada 1991-2010 (n=2,678)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Type of boat	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Powerboat	154	10	49	3	428	29	327	22	275	19	248	17	1,481
1991-1995	53	10	19	4	131	24	130	24	71	13	134	25	538
1996-2000	42	10	11	3	119	29	103	25	88	21	48	12	411
2001-2005	34	12	8	3	86	30	49	17	67	23	43	15	287
2006-2010	25	10	11	4	92	38	45	18	49	20	23	9	245
Unpowered	166	16	41	4	138	13	366	35	206	20	123	12	1,040
1991-1995	46	16	10	3	28	10	104	36	52	18	49	17	289
1996-2000	36	13	8	3	37	14	103	38	57	21	32	12	273
2001-2005	41	17	9	4	38	16	71	29	61	25	25	10	245
2006-2010	43	18	14	6	35	15	88	38	36	15	17	7	233
All boats combined†	327	12	94	4	585	22	715	27	528	20	429	16	2,678
1991-1995	102	12	31	4	164	19	243	28	131	15	202	23	873
1996-2000	79	11	19	3	161	22	209	29	158	22	93	13	719
2001-2005	76	13	18	3	128	23	125	22	141	25	77	14	565
2006-2010	70	13	26	5	132	25	138	26	98	19	57	11	521

** Includes drowning and immersion hypothermia deaths*

† There were 157 deaths where power/unpowered was unknown; these deaths were included in all boats combined but excluded from the breakdown of powered/unpowered

RECREATION AND DAILY LIFE: TRAUMA DEATHS

Table 45. Boating trauma deaths during recreation and daily life by type of boating incident and use of a personal flotation device , Canada 1991-2010 (n=167)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Type of incident	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Fell overboard	6	19	0	0	6	19	0	0	13	27	6	19	31
Struck by propeller	0	0	0	0	3	21	0	0	9	27	2	14	14
Capsized	3	43	1	14	1	14	0	0	2	29	0	0	7
Collision	27	23	2	2	17	14	6	5	13	11	55	46	120
Two boats	14	27	0	0	11	22	3	6	2	4	21	41	51
Boat and object	10	19	2	4	6	12	3	6	10	19	21	40	52
Boat and person	1	13	0	0	1	13	0	0	0	0	6	75	8
Victim was swimmer	0	0	0	0	1	25	0	0	0	0	3	75	4
Victim was towed	1	25	0	0	0	0	0	0	0	0	3	75	4
Other	4	44	0	0	0	0	1	11	1	11	3	33	9
Total	40	24	3	2	24	14	7	4	29	17	64	38	167

Table 46. Boating trauma deaths during recreation and daily life by nature of injury* and use of a personal flotation device, Canada 1991-2010 (n=167)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Nature of injury	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Serious head injuries	14	21	2	3	11	16	5	7	9	13	27	40	68
Superficial head injuries	0	0	1	20	2	40	0	0	2	40	0	0	5
Spinal injuries	4	24	0	0	0	0	4	24	1	6	8	47	17
Bone fracture or dislocation	5	23	1	5	3	14	1	5	4	18	8	36	22
Major lacerations	11	26	0	0	7	17	3	7	8	19	13	31	42
Other	13	31	0	0	6	14	1	2	4	10	18	43	42

** There may have been more than one injury per victim*

Table 47. Boating trauma deaths during recreation and daily life by sex and use of a personal flotation device, Canada 1991-2010 (n=167)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Sex	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Males	26	20	3	2	21	17	6	5	27	21	44	35	127
Females	14	35	0	0	3	8	1	3	2	5	20	50	40
Total	40	24	3	2	24	14	7	4	29	17	64	38	167

Table 48. Boating trauma deaths during recreation and daily life by age and use of a personal flotation device, Canada 1991-2010 (n=167)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Age group	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
<1	0	0	0	0	1	100	0	0	0	0	0	0	1
1 to 4	2	50	0	0	0	0	0	0	0	0	2	50	4
5 to 14	7	64	0	0	0	0	0	0	0	0	4	36	11
15 to 19	3	15	0	0	1	5	1	5	5	25	10	50	20
20 to 24	3	18	0	0	2	12	2	12	5	29	5	29	17
25 to 34	8	24	1	3	8	24	1	3	7	21	8	24	33
35 to 44	11	32	0	0	3	9	1	3	4	12	15	44	34
45 to 54	3	11	0	0	4	14	2	7	5	18	14	50	28
55 to 64	1	11	1	11	3	33	0	0	1	11	3	33	9
65 to 74	2	33	1	17	0	0	0	0	1	17	2	33	6
75+	0	0	0	0	2	50	0	0	1	25	1	25	4
Total	40	24	3	2	24	14	7	4	29	17	64	38	167

Table 49. Boating trauma deaths during recreation and daily life by type of boat and use of a personal flotation device, Canada 1991-2010 (n=167)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Type of boat	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Powered total	**33**	**22**	**1**	**1**	**23**	**15**	**6**	**4**	**27**	**18**	**60**	**40**	**150**
Large (>5.5m)	5	15	0	0	6	18	2	6	8	24	13	38	34
Small open fishing-type craft (≤5.5 metres)	3	10	1	3	6	20	0	0	6	20	14	47	30
Other small craft (≤5.5 metres)	3	19	0	0	2	13	0	0	5	31	6	38	16
Personal watercraft	20	53	0	0	2	5	4	11	0	0	12	32	38
Powerboat, size unknown	2	6	0	0	7	22	0	0	8	25	15	47	32
Unpowered total	**7**	**47**	**2**	**13**	**1**	**7**	**1**	**7**	**2**	**13**	**2**	**13**	**15**
Canoe	0	0	0	0	0	0	0	0	0	0	1	100	1
Kayak	2	50	1	25	0	0	1	25	0	0	0	0	4
Rowboat	1	50	0	0	1	50	0	0	0	0	0	0	2
Sailboard or sailboard	2	50	0	0	0	0	0	0	1	25	1	25	4
Inflatable	2	50	1	25	0	0	0	0	1	25	0	0	4
Other/Unknown	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**100**	**2**
Total	**40**	**24**	**3**	**2**	**24**	**14**	**7**	**4**	**29**	**17**	**64**	**38**	**167**

Table 50. Boating trauma deaths during recreation and daily life by region and use of a personal flotation device, Canada 1991-2010 (n=167)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Region	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Atlantic	3	23	0	0	4	31	0	0	1	8	5	38	13
Quebec	12	41	0	0	4	14	2	7	1	3	10	34	29
Ontario	9	15	1	2	8	14	1	2	10	17	30	51	59
Prairies	6	33	1	6	3	17	1	6	3	17	4	22	18
British Columbia	10	21	1	2	5	11	3	6	14	30	14	30	47
Territories	0	0	0	0	0	0	0	0	0	0	1	100	1
Canada	40	24	3	2	24	14	7	4	29	17	64	38	167

SPECIAL POPULATIONS FOR PREVENTION

PROFILE OF WEAK AND NON-SWIMMERS

Table 51. Boating immersion deaths* of weak and non-swimmers during recreation and daily life by type of incident and use of a personal flotation device, Canada 1991-2010 (victims ≥5 years of age, n=478)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Type of incident	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Capsized	14	7	6	3	48	23	86	42	47	23	5	2	206
Fell overboard	5	3	3	2	60	40	35	23	36	24	11	7	150
Swamped	8	13	3	5	20	32	26	42	4	6	1	2	62
Collision	1	7	0	0	4	27	5	33	3	20	2	13	15
Jumped overboard	0	0	0	0	2	33	2	33	2	33	0	0	6
Other	0	0	0	0	8	44	5	28	2	11	3	17	18
Unknown	0	0	1	5	3	14	14	67	2	10	1	5	21
Total	28	6	13	3	145	30	173	36	96	20	23	5	478

** Includes drowning and immersion hypothermia deaths*

Table 52. Boating immersion deaths* of weak and non-swimmers during recreation and daily life by age group, sex and use of a personal flotation device, Canada 1991-2010 (victims ≥5 years of age, n=478)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Males	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
5 to 14	1	11	0	0	0	0	5	56	1	11	2	22	9
15 to 19	1	3	1	3	7	20	16	46	10	29	0	0	35
20 to 24	3	7	2	4	6	13	26	58	7	16	1	2	45
25 to 34	5	6	2	2	26	29	38	43	15	17	3	3	89
35 to 44	3	3	2	2	24	27	34	38	23	26	3	3	89
45 to 54	9	11	3	4	27	33	23	28	15	18	6	7	83
55 to 64	2	3	2	3	22	36	16	26	16	26	3	5	61
65 to 74	3	8	1	3	17	45	8	21	7	18	2	5	38
75+	0	0	0	0	6	67	2	22	1	11	0	0	9
Unknown	0	0	0	0	1	100	0	0	0	0	0	0	1
Total	27	6	13	3	136	30	168	37	95	21	20	4	459
Females													
5 to 14	0	0	0	0	1	33	2	67	0	0	0	0	3
15 to 19	0	0	0	0	0	0	0	0	0	0	1	100	1
20 to 24	0	0	0	0	0	0	0	0	0	0	0	0	0
25 to 34	0	0	0	0	2	67	1	33	0	0	0	0	3
35 to 44	0	0	0	0	2	100	0	0	0	0	0	0	2
45 to 54	1	17	0	0	3	50	0	0	1	17	1	17	6
55 to 64	0	0	0	0	0	0	2	100	0	0	0	0	2
65 to 74	0	0	0	0	1	50	0	0	0	0	1	50	2
75+	0	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	1	5	0	0	9	47	5	26	1	5	3	16	19

** Includes drowning and immersion hypothermia deaths*

Table 53. Boating immersion deaths* of weak and non-swimmers during recreation and daily life by type of boat and use of a personal flotation device, Canada 1991-2010 (victims ≥5 years of age, n=478)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Type of boat	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Powerboat	18	7	9	3	109	41	61	23	55	21	15	6	267
Large powerboat (>5.5 metres)	0	0	2	8	15	58	4	15	4	15	1	4	26
Small open fishing-type craft (≤5.5 metres)	14	9	3	2	68	43	41	26	27	17	4	3	157
Other small craft (≤5.5 metres)	4	15	2	8	10	38	3	12	6	23	1	4	26
Personal watercraft	0	0	0	0	1	17	2	33	3	50	0	0	6
Powerboat, size unknown	0	0	2	4	15	29	11	21	15	29	9	17	52
Unpowered boat	10	5	4	2	33	16	111	55	39	19	4	2	201
Canoe	5	4	2	2	22	17	74	58	23	18	2	2	128
Kayak	2	33	1	17	1	17	1	17	1	17	0	0	6
Rowboat	0	0	0	0	5	19	17	63	5	19	0	0	27
Sailboat or sailboard	1	8	0	0	4	33	2	17	4	33	1	8	12
Inflatable	2	13	0	0	1	6	10	63	2	13	1	6	16
Pedal/paddle boat	0	0	0	0	0	0	6	75	2	25	0	0	8
Other unpowered boat	0	0	1	33	0	0	1	33	1	33	0	0	3
Unpowered boat, type unknown	0	0	0	0	0	0	0	0	1	100	0	0	1
Unknown	0	0	0	0	0	0	1	100	0	0	0	0	1
Other	0	0	0	0	3	33	0	0	2	22	4	44	9
Total	28	6	13	3	145	30	173	36	96	20	23	5	478

** Includes drowning and immersion hypothermia deaths*

Table 54. Boating immersion deaths* of weak and non-swimmers during recreation and daily life by urban/rural residence and use of a personal flotation device, Canada 1991-2010 (victims ≥5 years of age, n=478)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Residence	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Urban†	19	6	13	4	96	30	108	34	62	20	17	5	315
Rural	8	6	0	0	41	29	59	42	29	20	5	4	142
Unknown	1	5	0	0	8	38	6	29	5	24	1	5	21
Total	28	6	13	3	145	30	173	36	96	20	23	5	478

** Includes drowning and immersion hypothermia deaths*

† Urban locations are cities and towns with >1,000 population

Table 55. Boating immersion deaths* of weak and non-swimmers during recreation and daily life by urban/rural location of incident and use of a personal flotation device, Canada 1991-2010 (victims ≥5 years of age, n=478)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Location	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Urban†	2	2	5	5	28	25	43	39	20	18	12	11	110
Rural	26	7	8	2	117	33	123	34	74	21	11	3	359
Unknown	0	0	0	0	0	0	7	78	2	22	0	0	9
Total	28	6	13	3	145	30	173	36	96	20	23	5	478

** Includes drowning and immersion hypothermia deaths*

† Urban locations are cities and towns with >1,000 population

Table 56. Boating immersion deaths* of weak and non-swimmers during recreation and daily life by distance from shore and use of a personal flotation device, Canada 1991-2010 (victims ≥5 years of age, n=478)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Distance from shore	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
0 to 2 metres	1	8	0	0	1	8	4	33	2	17	4	33	12
2.1 to 15 metres	3	5	2	3	18	31	22	38	12	21	1	2	58
16 to 50 metres	0	0	0	0	18	31	26	44	10	17	5	8	59
More than 50 metres	10	9	2	2	37	32	46	40	18	16	2	2	115
Unknown	14	6	9	4	71	30	75	32	54	23	11	5	234
Total	28	6	13	3	145	30	173	36	96	20	23	5	478

** Includes drowning and immersion hypothermia deaths*

Table 57. Boating immersion deaths* of weak and non-swimmers during recreation and daily life by depth of water and use of a personal flotation device, Canada 1991-2010 (victims ≥5 years of age, n=478)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Depth of water	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
0 to 1 metre	0	0	0	0	1	25	0	0	1	25	2	50	4
1.1 to 2.5 metres	1	3	0	0	5	13	22	58	9	24	1	3	38
More than 2.5 metres	11	6	3	2	58	29	73	37	45	23	8	4	198
Unknown	16	7	10	4	81	34	78	33	41	17	12	5	238
Total	28	6	13	3	145	30	173	36	96	20	23	5	478

** Includes drowning and immersion hypothermia deaths*

Table 58. Boating immersion deaths* of child and youth boaters during recreation and daily life by activity and use of a personal flotation device, Canada 1991-2010 (n=298)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Purpose & activity	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Children 0-14 years	**16**	**20**	**2**	**3**	**12**	**15**	**28**	**35**	**7**	**9**	**14**	**18**	**79**
Recreational	**16**	**25**	**2**	**3**	**11**	**17**	**16**	**25**	**7**	**11**	**12**	**19**	**64**
Fishing from boat	2	18	1	9	1	9	4	36	0	0	3	27	11
Power boating	8	33	1	4	7	29	2	8	0	0	6	25	24
Canoeing	3	43	0	0	0	0	2	29	2	29	0	0	7
Hunting	1	25	0	0	3	75	0	0	0	0	0	0	4
Sailing	1	50	0	0	0	0	0	0	1	50	0	0	2
Other unpowered boating	0	0	0	0	0	0	3	43	4	57	0	0	7
Rowing	0	0	0	0	0	0	2	100	0	0	0	0	2
Other rafting	1	25	0	0	0	0	2	50	0	0	1	25	4
Other	0	0	0	0	0	0	1	33	0	0	2	67	3
Daily living	**0**	**0**	**0**	**0**	**1**	**7**	**12**	**80**	**0**	**0**	**2**	**13**	**15**
Boat travel	0	0	0	0	0	0	6	75	0	0	2	25	8
Fishing for food	0	0	0	0	1	25	3	75	0	0	0	0	4
Other	0	0	0	0	0	0	3	100	0	0	0	0	3
Youth 15-19 years	**25**	**11**	**15**	**7**	**29**	**13**	**88**	**40**	**40**	**18**	**22**	**10**	**219**
Recreational	**25**	**12**	**15**	**7**	**29**	**14**	**83**	**41**	**35**	**17**	**17**	**8**	**204**
Fishing from boat	6	12	4	8	7	14	12	24	15	30	6	12	50
Power boating	4	10	4	10	12	30	13	33	3	8	4	10	40
Canoeing	6	8	4	5	7	9	38	51	15	20	4	5	74
Hunting	0	0	0	0	1	25	2	50	1	25	0	0	4
Kayaking	3	33	0	0	1	11	5	56	0	0	0	0	9
Sailing	3	75	0	0	0	0	1	25	0	0	0	0	4
Other unpowered boating	0	0	3	23	0	0	8	62	1	8	1	8	13
White-water rafting	2	67	0	0	0	0	1	33	0	0	0	0	3
Rowing	0	0	0	0	1	33	2	67	0	0	0	0	3
Other rafting	0	0	0	0	0	0	1	100	0	0	0	0	1
Swimming	0	0	0	0	0	0	0	0	0	0	1	100	1
Other	1	100	0	0	0	0	0	0	0	0	0	0	1
Unknown	0	0	0	0	0	0	0	0	0	0	1	100	1
Daily living	**0**	**0**	**0**	**0**	**0**	**0**	**5**	**33**	**5**	**33**	**5**	**33**	**15**
Boat travel	0	0	0	0	0	0	1	17	4	67	1	17	6
Fishing for food	0	0	0	0	0	0	4	80	1	20	0	0	5
Other	0	0	0	0	0	0	0	0	0	0	4	100	4

** Includes drowning and immersion hypothermia deaths*

Table 59. Boating immersion deaths* of child and youth boaters during recreation and daily life by indigenous ethnicity and use of a personal flotation device, Canada 1991-2010 (n=298)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Ethnicity	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Children 0-14 years	**16**	**20**	**2**	**3**	**12**	**15**	**28**	**35**	**7**	**9**	**14**	**18**	**79**
Non-indigenous	13	33	2	5	6	15	8	21	2	5	8	21	39
Indigenous†	0	0	0	0	6	20	19	63	3	10	2	7	30
Unknown	3	30	0	0	0	0	1	10	2	20	4	40	10
Youth 15-19 years	**25**	**11**	**15**	**7**	**29**	**13**	**88**	**40**	**40**	**18**	**22**	**10**	**219**
Non-indigenous	17	13	9	7	18	14	54	41	26	20	8	6	132
Indigenous†	0	0	2	5	1	3	23	58	7	18	7	18	40
Unknown	8	17	4	9	10	21	11	23	7	15	7	15	47

** Includes drowning and immersion hypothermia deaths*

† Included those of definite and probable indigenous ethnicity

Table 60. Boating immersion deaths* of child and youth boaters during recreation and daily life by supervision/ accompaniment and use of a personal flotation device, Canada 1991-2010 (n=298)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Supervision	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Children 0-14 years	**16**	**20**	**2**	**3**	**12**	**15**	**28**	**35**	**7**	**9**	**14**	**18**	**79**
Alone	0	0	0	0	0	0	2	40	1	20	2	40	5
With at least one adult	9	31	1	3	5	17	8	28	2	7	4	14	29
With adults and minors	6	20	1	3	7	23	11	37	0	0	5	17	30
With minors only	1	7	0	0	0	0	7	47	4	27	3	20	15
Youth 15-19 years	**25**	**11**	**15**	**7**	**29**	**13**	**88**	**40**	**40**	**18**	**22**	**10**	**219**
Alone	1	8	0	0	2	17	3	25	3	25	3	25	12
With at least one adult	14	11	6	5	21	17	48	39	21	17	13	11	123
With adults and minors	4	21	1	5	4	21	3	16	3	16	4	21	19
With adult bystanders	1	25	1	25	1	25	1	25	0	0	0	0	4
With minors only	3	10	5	16	1	3	20	65	2	6	0	0	31
With others (not specified)	2	7	2	7	0	0	12	41	11	38	2	7	29
Unknown	0	0	0	0	0	0	1	100	0	0	0	0	1

** Includes drowning and immersion hypothermia deaths*

OCCUPATIONAL ACTIVITIES

Table 61. Boating deaths during occupational activities by cause of death and use of a personal flotation device, Canada 1991-2010 (n=376)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Cause of death	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Immersion	39	11	8	2	86	23	32	9	80	22	121	33	366
Drowning without hypothermia	22	7	6	2	70	24	26	9	64	22	109	37	297
Drowning complicated by hypothermia	9	17	2	4	13	25	3	6	15	28	11	21	53
Hypothermia complicated by drowning	5	100	0	0	0	0	0	0	0	0	0	0	5
Hypothermia only	3	27	0	0	3	27	3	27	1	9	1	9	11
Trauma	2	20	0	0	3	30	0	0	1	10	4	40	10
Total	41	11	8	2	89	24	32	9	81	22	125	33	376

OCCUPATIONAL ACTIVITIES: IMMERSION DEATHS

Table 62. Boating immersion deaths* during occupational activities by activity and use of a personal flotation device, Canada 1991-2010 (n=366)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Activity	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Commercial fishing	20	9	6	3	59	26	21	9	62	27	59	26	227
Marine shipping	6	12	0	0	4	8	0	0	2	4	40	77	52
Fishing guide or charter	1	10	0	0	3	30	2	20	3	30	1	10	10
Aquaculture	2	25	1	13	2	25	0	0	1	13	2	25	8
Other	10	15	1	1	18	27	9	13	12	18	17	25	67
Unknown	0	0	0	0	0	0	0	0	0	0	2	100	2
Total	39	11	8	2	86	23	32	9	80	22	121	33	366

** Includes drowning and immersion hypothermia deaths*

Table 63. Boating immersion deaths* during occupational activities by type of boating incident and use of a personal flotation device, Canada 1991-2010 (n=366)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Boating incident	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Capsized	10	9	3	3	30	27	13	12	30	27	27	24	113
Fell overboard	5	5	0	0	26	27	9	9	28	29	30	31	98
Swamped	16	17	5	5	18	19	3	3	15	16	36	39	93
Collision	0	0	0	0	7	50	3	21	1	7	3	21	14
Other	6	30	0	0	2	10	0	0	1	5	11	55	20
Unknown	2	7	0	0	3	11	4	14	5	18	14	50	28
Total	39	11	8	2	86	23	32	9	80	22	121	33	366

** Includes drowning and immersion hypothermia deaths*

Table 64. Boating immersion deaths* during occupational activities by sex and use of a personal flotation device, Canada 1991-2010 (n=366)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Sex	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Males	38	11	7	2	84	24	30	8	80	22	118	33	357
Females	1	11	1	11	2	22	2	22	0	0	3	33	9
Total	39	11	8	2	86	23	32	9	80	22	121	33	366

** Includes drowning and immersion hypothermia deaths*

Table 65. Boating immersion deaths* during occupational activities by age and use of a personal flotation device, Canada 1991-2010 (n=366)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Age group	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
<1	0	0	0	0	0	0	0	0	0	0	0	0	0
1 to 4	0	0	0	0	0	0	0	0	0	0	0	0	0
5 to 14	0	0	0	0	0	0	0	0	0	0	0	0	0
15 to 19	0	0	1	11	2	22	2	22	3	33	1	11	9
20 to 24	3	14	1	5	8	36	2	9	3	14	5	23	22
25 to 34	7	11	1	2	21	32	10	15	10	15	16	25	65
35 to 44	6	7	3	3	17	19	4	4	28	31	33	36	91
45 to 54	10	15	1	2	14	22	6	9	16	25	18	28	65
55 to 64	8	18	1	2	13	29	5	11	11	24	7	16	45
65 to 74	3	18	0	0	6	35	1	6	3	18	4	24	17
75+	0	0	0	0	0	0	1	20	4	80	0	0	5
Unknown	2	4	0	0	5	11	1	2	2	4	37	79	47
Total	39	11	8	2	86	23	32	9	80	22	121	33	366

** Includes drowning and immersion hypothermia deaths*

Table 66. Boating immersion deaths* during occupational activities by swimming ability and use of a personal flotation device, Canada 1991-2010 (victims ≥5 years of age, n=366)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Swimming ability	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Non-swimmer	2	7	0	0	8	29	3	11	13	46	2	7	28
Weak swimmer	3	27	0	0	6	55	0	0	1	9	1	9	11
Average swimmer	0	0	0	0	3	50	2	33	1	17	0	0	6
Strong swimmer	0	0	0	0	1	50	0	0	0	0	1	50	2
Swimmer, level unknown	1	7	2	13	5	33	0	0	6	40	1	7	15
Unknown	33	11	6	2	63	21	27	9	59	19	116	38	304
Total	39	11	8	2	86	23	32	9	80	22	121	33	366

** Includes drowning and immersion hypothermia deaths*

Table 67. Boating immersion deaths* during occupational activities by boating experience and use of a personal flotation device, Canada 1991-2010 (n=366)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Boating experience	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Inexperienced boater	1	25	0	0	2	50	0	0	1	25	0	0	4
Occasional boater	0	0	0	0	1	100	0	0	0	0	0	0	1
Experienced boater	29	12	6	3	67	28	19	8	62	26	53	22	236
Unknown	9	7	2	2	16	13	13	10	17	14	68	54	125
Total	39	11	8	2	86	23	32	9	80	22	121	33	366

** Includes drowning and immersion hypothermia deaths*

Table 68. Boating immersion deaths* during occupational activities by type of boat and use of a personal flotation device, Canada 1991-2010 (n=366)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Type of boat	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Powered	38	11	8	2	81	24	28	8	72	21	117	34	344
Large (>5.5m)	30	13	6	3	58	24	10	4	39	16	97	40	240
Small open fishing-type craft (≤5.5 metres)	7	13	1	2	12	22	12	22	13	24	10	18	55
Other small craft (≤5.5 metres)	0	0	1	9	5	45	0	0	5	45	0	0	11
Personal watercraft	0	0	0	0	0	0	0	0	0	0	1	100	1
Powerboat, size unknown	1	3	0	0	6	16	6	16	15	41	9	24	37
Unpowered	0	0	0	0	1	8	4	33	5	42	2	17	12
Canoe	0	0	0	0	1	17	2	33	2	33	1	17	6
Rowboat	0	0	0	0	0	0	2	40	3	60	0	0	5
Other unpowered	0	0	0	0	0	0	0	0	0	0	1	100	1
Other	0	0	0	0	1	50	0	0	1	50	0	0	2
Unknown	1	13	0	0	3	38	0	0	2	25	2	25	8
Total	39	11	8	2	86	23	32	9	80	22	121	33	366

** Includes drowning and immersion hypothermia deaths*

Table 69. Boating immersion deaths* during occupational activities by body of water and use of a personal flotation device, Canada 1991-2010 (n=366)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Body of water	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Lake or pond	3	6	1	2	11	22	12	24	16	32	7	14	50
Ocean	33	12	7	2	65	23	17	6	58	20	105	37	285
River/creek/stream/waterfall	3	10	0	0	10	33	3	10	5	17	9	30	30
Other	0	0	0	0	0	0	0	0	1	100	0	0	1
Unknown	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	39	11	8	2	86	23	32	9	80	22	121	33	366

** Includes drowning and immersion hypothermia deaths*

Table 70. Boating immersion deaths* during occupational activities by wind conditions and use of a personal flotation device, Canada 1991-2010 (n=366)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Wind conditions	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Strong winds	22	16	6	4	25	18	6	4	27	20	51	37	137
Breezy/windy	5	12	1	2	20	48	4	10	7	17	5	12	42
Calm	0	0	0	0	7	37	2	11	6	32	4	21	19
Unknown	12	7	1	1	34	20	20	12	40	24	61	36	168
Total	39	11	8	2	86	23	32	9	80	22	121	33	366

** Includes drowning and immersion hypothermia deaths*

Table 71. Boating immersion deaths* during occupational activities by wave conditions and use of a personal flotation device, Canada 1991-2010 (n=366)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Wave conditions	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Calm	2	7	0	0	11	39	2	7	9	32	4	14	28
Choppy/small waves	2	9	1	4	11	48	1	4	4	17	4	17	23
Rough waves	9	13	3	4	18	26	6	9	18	26	16	23	70
Storm/gale force wave conditions	16	18	3	3	15	17	1	1	11	13	41	47	87
Other	0	0	0	0	1	25	0	0	2	50	1	25	4
Unknown	10	6	1	1	30	19	22	14	36	23	55	36	154
Total	39	11	8	2	86	23	32	9	80	22	121	33	366

** Includes drowning and immersion hypothermia deaths*

Table 72. Boating immersion deaths* during occupational activities by water temperature and use of a personal flotation device, Canada 1991-2010 (n=366)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Water temperature	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Very cold (<10°C)	29	14	5	2	51	25	13	6	31	15	73	36	202
Cold/cool (10 to 20°C)	4	9	0	0	17	36	1	2	15	32	10	21	47
Warm or hot (≥21°C)	0	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	6	5	3	3	18	15	18	15	34	29	38	32	117
Total	39	11	8	2	86	23	32	9	80	22	121	33	366

** Includes drowning and immersion hypothermia deaths*

Table 73. Boating immersion deaths* during occupational activities by distance from shore and use of a personal flotation device, Canada 1991-2010 (n=366)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Distance from shore	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
0 to 2 metres	0	0	0	0	4	31	0	0	3	23	6	46	13
2.1 to 15 metres	1	9	0	0	4	36	1	9	2	18	3	27	11
16 to 50 metres	1	6	1	6	6	33	4	22	4	22	2	11	18
More than 50 metres	23	11	6	3	53	25	11	5	37	18	78	38	208
Unknown	14	12	1	1	19	16	16	14	34	29	32	28	116
Total	39	11	8	2	86	23	32	9	80	22	121	33	366

** Includes drowning and immersion hypothermia deaths*

Table 74. Boating immersion deaths* during occupational activities by depth of water and use of a personal flotation device, Canada 1991-2010 (n=366)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Depth of water	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
0 to 1 metre	0	0	1	25	0	0	2	50	0	0	1	25	4
1.1 to 2.5 metres	0	0	0	0	1	20	1	20	1	20	2	40	5
More than 2.5 metres	29	12	6	3	62	26	14	6	44	19	81	34	236
Unknown	10	8	1	1	23	19	15	12	35	29	37	31	121
Total	39	11	8	2	86	23	32	9	80	22	121	33	366

** Includes drowning and immersion hypothermia deaths*

Table 75. Boating immersion deaths* during occupational activities by region and use of a personal flotation device, Canada 1991-2010 (n=366)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Region	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Newfoundland & Labrador	9	12	2	3	29	38	6	8	13	17	18	23	77
Nova Scotia	5	5	0	0	13	14	5	5	18	19	55	57	96
Prince Edward Island	0	0	0	0	1	11	2	22	5	56	1	11	9
New Brunswick	3	13	2	8	10	42	0	0	3	13	6	25	24
Quebec	2	9	0	0	4	18	6	27	5	23	5	23	22
Ontario	1	5	1	5	3	15	0	0	7	35	8	40	20
Prairie Provinces	1	4	0	0	4	17	8	33	9	38	2	8	24
British Columbia	14	18	3	4	17	21	1	1	20	25	25	31	80
Northern Territories	4	29	0	0	5	36	4	29	0	0	1	7	14
Canada	39	11	8	2	86	23	32	9	80	22	121	33	366

** Includes drowning and immersion hypothermia deaths*

Table 76. Boating immersion deaths* during occupational activities by 5-year period and use of a personal flotation device, Canada 1991-2010 (n=366)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Time period	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
1991-1995	13	9	4	3	32	21	11	7	22	15	68	45	150
1996-2000	14	15	2	2	20	21	12	13	28	29	20	21	96
2001-2005	7	10	1	1	19	28	8	12	15	22	19	28	69
2006-2010	5	10	1	2	15	29	1	2	15	29	14	27	51
1991-2010	39	11	8	2	86	23	32	9	80	22	121	33	366

** Includes drowning and immersion hypothermia deaths*

NON-BOATING ACTIVITIES

Table 77. Potential PFD use deaths* by activity and use of a personal flotation device, Canada 1991-2010 (n=620)

	Worn properly		Improperly worn		Present, not worn		Not present		Not worn, uncertain if present		Unknown		Total
Activity	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Recreational and daily living													
Scuba diving	42	35	4	3	2	2	0	0	1	1	72	60	121
Fishing in water	1	2	0	0	4	8	14	27	5	10	28	54	52
Snowmobiling†	35	9	13	3	5	1	116	31	17	4	193	51	379
ATV on ice‡	1	3	0	0	0	0	4	14	1	3	23	79	29
Occupational													
Motor vehicles on ice	1	3	0	0	1	3	2	5	1	3	34	87	39
Car or pick-up truck	0	0	0	0	0	0	0	0	0	0	3	100	3
Transport truck	0	0	0	0	0	0	0	0	0	0	2	100	2
Snowmobile	0	0	0	0	0	0	0	0	0	0	10	100	10
Heavy machinery	1	4	0	0	1	4	0	0	1	4	20	87	23
Unknown	0	0	0	0	0	0	0	0	0	0	1	100	1

* *Includes death from all causes: drowning, immersion hypothermia, trauma, and other/unknown*

† *Snowmobile deaths included those where the activity was recorded as recreational snowmobiling, daily living snowmobile travel, or where there was record of snowmobile as the type of vehicle/transport*

‡ *ATV deaths included those where the activity was recorded as recreational ATV riding or where there was record of ATV as the type of vehicle/transport, and there was mention of the presence of ice*

APPENDIX 2

MULTIPLE LOGISTIC REGRESSION ANALYSES

Table 78. Multiple logistic regression results for boating immersion deaths, Canada 1991-2010 (n=2,572)						
	Odds ratio	Standard Error	t	P> |t|	95% Confidence Interval	
Personal Factors						
Sex						
Female	1.176	0.281	0.68	0.499	0.735	1.880
Male (reference)	1.0					
Age of victim						
0-4	1.227	0.887	0.28	0.777	0.296	5.088
5-14	2.596*	1.010	2.45	0.014	1.211	5.567
15-19	0.874	0.230	-0.51	0.609	0.521	1.464
20-24	0.581*	0.155	-2.04	0.043	0.344	0.982
45-54	1.459*	0.267	2.06	0.040	1.017	2.092
55-64	0.916	0.185	-0.43	0.666	0.617	1.362
65+	0.702	0.164	-1.51	0.131	0.444	1.111
25-44 (reference)	1.0					
Indigenous ethnicity						
Yes	0.335*	0.091	-4.04	0.000	0.196	0.573
No (reference)	1.0					
Alcohol						
Equal/below	0.352*	0.086	-4.29	0.000	0.218	0.567
Above	0.274*	0.056	-6.35	0.000	0.183	0.410
Suspected	0.135*	0.073	-3.68	0.001	0.045	0.406
No alcohol (reference)	1.0					
Swimming ability						
Average	2.230*	0.574	3.12	0.015	1.228	4.047
Strong	1.612	0.565	1.36	0.208	0.724	3.588
Non-swimmer/weak (reference)	1.0					
Environmental Factors						
Rural/urban residence						
Rural	0.709	0.136	-1.80	0.082	0.481	1.047
Urban (reference)	1.0					
Rural/urban incident						
Rural	1.690*	0.290	3.06	0.003	1.203	2.373
Urban (reference)	1.0					
Waves						
Storm waves/whitecaps	1.860*	0.317	3.64	0.001	1.314	2.633
No waves/calm (reference)	1.0					
Water temperature						
Very cold	1.401*	0.196	2.42	0.016	1.065	1.844
Warm/hot/ cool (reference)	1.0					
Current						
Presence of current	0.708	0.226	-1.08	0.291	0.365	1.371
No current (reference)	1.0					

Body of water						
Lake/pond	0.391	0.123	-2.98	0.005	0.207	0.738
River	1.080	0.201	0.42	0.678	0.750	1.557
Ocean (reference)	1.0					
Supervision						
With adult(s)	1.079	0.184	0.44	0.657	0.772	1.507
With minor(s)	0.538	0.238	-1.40	0.161	0.227	1.279
With other(s) – age not specified	0.606	0.298	-1.02	0.309	0.231	1.591
Alone (reference)	1.0					
Equipment Factors						
Boat type						
Powered	0.630	0.087	-3.34	0.001	0.481	0.827
Unpowered (reference)	1.0					

** Odds ratio significant at the p<0.05 level; confidence intervals do not cross 1.0; results highlighted in pink are statistically significant, controlling for other variables in the model*

Table 79. Multiple logistic regression results for recreational/daily life boating immersion deaths, Canada 1991-2010 (n=2,276)						
	Odds ratio	Standard Error	t	P> |t|	95% Confidence Interval	
Personal Factors						
Sex						
Female	0.985	0.254	-0.06	0.955	0.592	1.640
Male (reference)	1.0					
Age of victim						
0-4	1.126	0.910	0.15	0.883	0.226	5.614
5-14	2.500*	1.008	2.28	0.023	1.135	5.509
15-19	0.858	0.233	-0.56	0.573	0.504	1.462
20-24	0.511*	0.149	-2.30	0.022	0.287	0.908
45-54	1.433	0.278	1.86	0.064	0.980	2.097
55-64	0.695	0.163	-1.55	0.122	0.438	1.102
65+	0.569*	0.140	-2.28	0.022	0.351	0.923
25-44 (reference)	1.0					
Indigenous ethnicity						
Yes	0.219*	0.084	-3.95	0.001	0.089	0.487
No (reference)	1.0					
Alcohol						
Equal/below	0.327*	0.091	-4.03	0.000	0.189	0.567
Above	0.234*	0.049	-6.88	0.000	0.155	0.355
Suspected	0.113*	0.072	-3.42	0.003	0.030	0.432
No alcohol (reference)	1.0					
Swimming ability						
Average	2.969*	0.924	3.50	0.010	1.425	6.185
Strong	2.122	1.072	1.49	0.189	0.607	7.413
Non-swimmer/weak (reference)	1.0					
Environmental Factors						
Rural/urban residence						
Rural	0.786	0.147	-1.28	0.202	0.542	1.140
Urban (reference)	1.0					
Rural/urban incident						
Rural	1.861*	0.324	3.57	0.000	1.322	2.619
Urban (reference)	1.0					
Waves						
Storm waves/whitecaps	1.836*	0.380	2.93	0.009	1.185	2.845
No waves/calm (reference)	1.0					
Water temperature						
Very cold	1.331	0.280	1.36	0.197	0.844	2.100
Warm/hot/ cool (reference)	1.0					
Current						
Presence of current	0.741	0.280	-0.79	0.438	0.334	1.641
No current (reference)	1.0					

Body of water						
Lake/pond	0.360*	0.127	-2.90	0.006	0.177	0.730
River	0.986	0.203	-0.07	0.945	0.658	1.478
Ocean (reference)	1.0					
Supervision						
With adult(s)	1.106	0.218	0.51	0.612	0.746	1.638
With minor(s)	0.540	0.283	-1.18	0.242	0.191	1.526
With other(s) – age not specified	0.631	0.338	-0.86	0.391	0.220	1.810
Alone (reference)	1.0					
Equipment Factors						
Boat type						
Powered	0.686*	0.106	-2.45	0.015	0.506	0.930
Unpowered (reference)	1.0					

** Odds ratio significant at the p<0.05 level; confidence intervals do not cross 1.0; results highlighted in pink are statistically significant, controlling for other variables in the model*

Table 80. Multiple logistic regression results for occupational boating immersion deaths, Canada 1991-2010 (n=245)						
	Odds ratio	**Standard Error**	**t**	**P> |t|**	**95% Confidence Interval**	
Personal Factors						
Age of victim						
15-24	1.144	1.092	0.14	0.889	0.159	8.242
45-54	2.368	1.546	1.32	0.199	0.617	9.091
55+	2.290	1.130	1.68	0.093	0.870	6.029
25-44 (reference)	1.0					
Indigenous ethnicity						
Yes	2.175	1.240	1.36	0.173	0.711	6.649
No (reference)	1.0					
Swimming ability						
Average/ Strong	0.383	0.488	-0.75	0.482	0.016	9.134
Non-swimmer/weak (reference)	1.0					
Environmental Factors						
Rural/urban residence						
Rural	0.474	0.318	-1.11	0.283	0.114	1.965
Urban (reference)	1.0					
Rural/urban incident						
Rural	1.450	0.971	0.56	0.583	0.368	5.723
Urban (reference)	1.0					
Waves						
Storm waves/whitecaps	2.837	2.099	1.41	0.179	0.588	13.695
No waves/calm (reference)	1.0					
Water temperature						
Very cold	2.801	1.991	1.45	0.161	0.642	12.224
Warm/hot/ cool (reference)	1.0					
Current						
Presence of current	1.068	0.846	0.08	0.935	0.202	5.651
No current (reference)	1.0					

** Odds ratio significant at the p<0.05 level; confidence intervals do not cross 1.0; results highlighted in pink are statistically significant, controlling for other variables in the model*

APPENDIX 3

REVIEW AND COMPARISON OF PFD LEGISLATION AS OF 2014-15

Table 81. Canadian legislation requiring lifejacket/PFD wearing or presence for recreational boaters by region

Region	Circumstances
Newfoundland and Labrador	One Canadian approved personal flotation device or lifejacket of appropriate size for each person on board
Nova Scotia	One Canadian approved personal flotation device or lifejacket of appropriate size for each person on board
PEI	One Canadian approved personal flotation device or lifejacket of appropriate size for each person on board
New Brunswick	One Canadian approved personal flotation device or lifejacket of appropriate size for each person on board
Quebec	One Canadian approved personal flotation device or lifejacket of appropriate size for each person on board
Ontario	One Canadian approved personal flotation device or lifejacket of appropriate size for each person on board
Manitoba	One Canadian approved personal flotation device or lifejacket of appropriate size for each person on board
Saskatchewan	One Canadian approved personal flotation device or lifejacket of appropriate size for each person on board
Alberta	One Canadian approved personal flotation device or lifejacket of appropriate size for each person on board
Calgary	Unless he is wearing and continues while he is on or in the water an approved Personal Floatation Device or Life Jacket no person shall (a) Enter or remain in; (b) Get on or remain on; (c) Hold on to; a vessel in or on any portion of the waters of any natural or man-made rivers, streams, brooks, canals, lakes, reservoirs or other waterways or watercourses which are contained within the boundaries of the City. "Vessel" refers to a device of any kind used as a means of water transportation, including any inflatable rubber or canvas device capable of sustaining a person afloat in the water.
BC	One Canadian approved personal flotation device or lifejacket of appropriate size for each person on board
Northwest Territories	One Canadian approved personal flotation device or lifejacket of appropriate size for each person on board
Yukon	One Canadian approved personal flotation device or lifejacket of appropriate size for each person on board
Nunavut	One Canadian approved personal flotation device or lifejacket of appropriate size for each person on board

Table 82. Canadian legislation requiring lifejacket/PFD wearing or presence for occupational boaters by region	
Region	**Circumstances**
Newfoundland and Labrador	Where a worker is employed under conditions which expose him or her to a risk of drowning, he or she shall wear a personal flotation device appropriate to the work environment or hazards.
Nova Scotia	Where a person is exposed to the risk of drowning at a workplace, an employer must do one of the following: (a) provide and ensure the use of a life jacket or personal flotation device for the person; (b) provide an alternative means of protection that ensures an equivalent level of safety to prevent a person from drowning.
Prince Edward Island	The employer shall ensure that where an employee is exposed to a risk of drowning, the employee is (a) provided with and shall wear a life jacket or buoyancy device that meets the applicable standards and specifications set out and referred to in the Canadian General Standards Board (CGSB); or (b) protected by a safety net or fall protection system or by a solid platform with a guard rail and a safe access that will prevent the employee from falling into the water or other liquid.
New Brunswick	If an employee is exposed to a risk of drowning, an owner of a place of employment, an employer and a contractor shall each ensure the employee uses one of the following: (a) a fall-protection system; (b) a life jacket; (c) a personal flotation device; (d) an automatically inflatable personal flotation device; or (e) a personal safety net. An employer and a contractor shall each ensure that an employee wears a life jacket or flotation device when being transported in a boat.
Quebec	Where, in a work place, there is a hazard of drowning, the employer shall provide every person granted access to the work place with (*a*) a life jacket or buoyancy device that meets the standards set out in the Canadian General Standards Board Standard; (*b*) a safety net or a fall-protection system.
Ontario	Every worker who is exposed to the hazard of falling into water shall wear a life jacket.
Manitoba	An employer must ensure that each worker who is transported by or works on a boat is provided with his or her own life jacket or personal flotation device that is kept within the immediate reach of the worker at all times.
Saskatchewan	An employer or contractor shall ensure that a life jacket or personal flotation device is provided for each worker who is transported by boat or works from a boat, and that each worker uses the life jacket or personal flotation device at all times when the worker is in the boat.
Alberta	If there is a foreseeable danger that a worker could be exposed to the hazard of drowning, an employer must ensure that the worker wears a life jacket. This does not apply if other safety measures are in place that will protect a worker from the hazard of drowning. Despite subsections (1) and (2), if a worker performs work from a boat for an extended period of time, the worker may wear a personal flotation device if the employer ensures that there is also a life jacket readily accessible to each worker on the boat.
British Columbia	A worker who is employed under conditions which involve a risk of drowning must wear an approved personal flotation device (PFD) or lifejacket with sufficient buoyancy to keep the worker's head above water. This does not apply if other acceptable safety measures are in place which will protect workers from the risk of drowning, or the water is too shallow to allow the lifejacket or PFD to function effectively.
Northwest Territories	Where a worker is required to work at a place from which the worker could fall and drown, and the worker is not protected by a guardrail, an employer shall (a) provide the worker with a life jacket and ensure that the worker uses it, and ensure that the rescue equipment and personnel described in subsection (3) are readily available; (4) An employer shall ensure that a life jacket or personal flotation device is provided for each worker who is transported by boat or works from a boat, and that each worker uses the life jacket or personal flotation device at all times when the worker is in the boat.
Yukon	Each worker shall be provided with, and be required to use, an appropriate personal flotation device with the required buoyancy where a worker is employed in a situation where there is a risk of drowning unless (a) other safety measures acceptable to the Director are in place that will protect workers from the risk of drowning, or (b) the water is too shallow to allow the personal flotation device to function effectively.
Nunavut	Where a worker is required to work at a place from which the worker could fall and drown, and the worker is not protected by a guardrail, an employer shall (a) provide the worker with a life jacket and ensure that the worker uses it, and ensure that the rescue equipment and personnel described in subsection (3) are readily available; An employer shall ensure that a life jacket or personal flotation device is provided for each worker who is transported by boat or works from a boat, and that each worker uses the life jacket or personal flotation device at all times when the worker is in the boat.

Table 83. Legislation requiring wearing of a lifejacket/PFD by persons boating by country/state		
Country/State	**Age**	**Circumstances**
Ireland	<16 years	On board an open craft or while on deck of a decked craft, other than when vessel is made fast to the shore or at anchor.
	All ages	Pleasure craft <7 metres in length while on board an open craft or while on the deck of a decked craft, other than when the craft is made fast to the shore or at anchor; onboard a PWC or being towed by a PWC; when being towed by a pleasure craft.
United States*	<13 years	On board a recreational vessel when the vessel is underway, except when below deck or in an enclosed cabin.
Australia		
New South Wales	<12 years	On board vessels <4.8 metres in length; on board vessels <8 metres in length in an open area when vessel is underway
	All ages	On board canoes or kayaks when on open waters, white water or >100 metres from shore on enclosed waters; on board any vessel when crossing a coastal bar, personal watercraft, when being towed by a vessel or off-the-beach vessel; on board kiteboard and sailboards when >400 metres from shore; when on alpine waters and the vessel is <4.8 metres in length or wearing fishing waders; on any vessel when directed to do so by the master of the vessel.
Northern Territory	All ages	When driving a PWC that is towing a water-skier, water skiers
Queensland	<12 years	On board open vessels <4.8 metres in length when vessel is underway
	All ages	When crossing designated coastal bar in open boats <4.8 metres; on board personal water craft; water skiers.
South Australia	All ages	On board a canoe, kayak, rowboat, dinghy, vessels that can carry the operator and no other person, sailboard, kiteboard, being towed behind a vessel, PWC; tender vessels when ≥1500 metres from shore.
Tasmania	<12 years	Recreational motor boat or motor-propelled tender of any length while vessel is under power, except when in an enclosed cabin.
	All ages	Recreational motor boat or motor-propelled tender that is <6 metres in length and is under power.
Victoria	<10 years	At all times on any vessel, regardless of size, when they are in an open area of the vessel that is underway.
	All ages	Powerboats ≤4.8 metres in length; when in open area of the vessel that is underway for yachts and powerboats >4.8 metres in length but ≤12 metres in length; off the beach sailing yachts, PWCs, canoes, kayaks, rowing boats, rafts, pedal boats, fun boats, stand up paddle boats, kiteboards, sail boards, and recreational tenders.
Western Australia	All ages	On board a PWC.
New Zealand	All ages	In situations of heightened risk, such as when crossing a bar, in rough water, during an emergency, and by non-swimmers.

** Note: State laws supersede the federal U.S. law; state laws vary by age and circumstances under which children must wear a lifejacket/PFD.*

Table 84. Bylaws requiring wearing of lifejacket/PFD by persons boating by country/state/ municipality		
Location	**Age**	**Circumstances**
Canada		
Calgary, Alberta	All ages	A vessel in or on any portion of the waters or any natural or man-made rivers, streams, brooks, canals, lakes, reservoirs, or other waterways or watercourses which are within the boundaries of the City of Calgary.
New Zealand		
Auckland	All ages	On board a small vessel (<6 metres) at all times unless below deck or moored alongside a wharf or older than 15 on board a vessel used to tender; on board a vessel >6 metres in circumstances where tides, river flows, visibility, rough seas, adverse weather, emergencies or other situations cause danger or risk to the safety of persons on board; when being towed by a vessel.
Bay of Plenty	All ages	When being towed by a pleasure craft; when in circumstances where tides, river flows, rough seas, bar crossings or adverse weather, adverse visibility, emergencies.
Canterbury	All ages	On board vessels in circumstances where tides, river flows, rough seas, adverse weather, adverse visibility or emergencies, darkness are present; on board vessels <6 metres which are propelled solely by oars or paddles when the vessel is underway, unless the person in charge of the vessel who is over the age of 15 years has given permission for PFD not to be worn; when being towed by a vessel.
Gisborne	All ages	When being towed by a pleasure craft; when in circumstances where tides, river flows, rough seas, bar crossings or adverse weather, adverse visibility, emergencies.
Hawke's Bay	All ages	At all times on all craft ≤6 metres and all paddle craft when the craft is underway or preparing to become underway; when being towed by a vessel.
Lake Taupo	All Ages	On board a vessel than is <6 metres in length unless the skipper has given permission for PFD not to be worn; on board a vessel than is ≥6 metres in length if the skipper deems is necessary; being towed by a vessel; on board a personal watercraft.
Marlborough	All ages	On board vessels in circumstances where tides, river flows, rough seas, adverse weather, adverse visibility or emergencies, darkness; when being towed by a vessel.
Manawatu-Wanganui	All ages	Recreational craft <6 metres in length unless person in charge of craft has given permission for PFDs not to be worn. Person in charge of craft must not give permission to not wear PFDs unless conditions are such that there is no significant increase in risk to safety to any person; recreational craft ≥6 metres in length when conditions are such that there is significant increase in risk to safety.
Nelson City	All ages	On board recreational vessel that is <6 metres in length, unless the person in charge of the vessel has given permission for PFDs not to be worn because the conditions are such that there is no significant risk to the safety of any persons through not wearing a PFD; on board recreational vessels in circumstances where tides, river flows, rough seas, adverse weather, adverse visibility or emergencies, darkness; when being towed by a vessel.
Northland	All ages	On board vessels in circumstances where tides, river flows, rough seas, adverse weather, adverse visibility or emergencies, darkness; on board vessels <6 metres which is propelled solely by oars or paddles when the vessel is underway, unless the person in charge of the vessel who is over the age of 15 years has given permission for PFD not to be worn; when being towed by a vessel.
Otago	All ages	On board vessels in circumstances where tides, river flows, rough seas, adverse weather, adverse visibility or emergencies.
Queenstown	All ages	On board of a recreational craft than is <6 metres in length; on board a recreational craft that is ≥6 metres in length in circumstances where river flows, rough waters, adverse weather, adverse visibility or emergencies; being towed by a vessel.
Southland	All ages	On board a craft <6 metres in length; on board craft ≥6 metres in length in circumstances where tides, river flows, visibility, rough seas, adverse weather, emergencies or other situations present an increased risk to the safety of persons on board; when being towed by any vessel.
Taranaki	All ages	On board vessels in circumstances where tides, river flows, rough seas, adverse weather, adverse visibility or emergencies, darkness; when being towed by a vessel.
Tasman	All ages	For children under 15 years old who cannot swim when on board any vessel at all times; when a motorised vessel is being navigated in any river in speeds in excess of 10 knots; when crossing any bar during outgoing tide; when a vessel is being navigated at speeds in excess of 10 knots during darkness; when operating a vessel that lacks a substantially enclosed helming position at speeds in excess of 30 knots; on board vessels in circumstances where tides, river flows, rough seas, adverse weather, adverse visibility or emergencies, darkness; when being towed by a vessel.

Waikato	All ages	On board vessels ≤6 metres or less when vessel is underway; on board vessels >6 metres unless the skipper has assessed the risk and considers it ok for PFD not to be worn, except PFD must be worn when crossing a bar, situations of low visibility, rough seas, adverse weather, boating at night, high river flows, in an emergency.
Wellington	All ages	On board vessels <6 metres in length unless the skipper decides it is safe to take them off; on large vessels, must be worn in risky conditions such as going through breakers, bad weather, low visibility and during emergencies.
West Coast	All ages	On board vessels in circumstances where tides, river flows, rough seas, adverse weather, adverse visibility or emergencies, darkness; when being towed by a vessel.

APPENDIX 4

COST OF LOST WAGES/INCOME AND BENEFITS FROM WATER-RELATED AND BOATING FATALITIES

Table 85. Cost of lost wages/income and benefits* from water-related and boating fatalities; excludes all other costs,† Canada 1991-2010

Age	Average cost per death ($)	Number of deaths		Costs for water-related fatalities ($)	Costs for boating fatalities ($)
		Water-related fatalities	Boating fatalities		
0	884,661	68	5	60,156,947	4,423,305
1	906,580	126	3	114,229,140	2,719,741
2	924,760	179	7	165,532,083	6,473,322
3	943,252	131	4	123,566,072	3,773,010
4	962,071	132	8	126,993,368	7,696,568
5	981,235	70	8	68,686,474	7,849,883
6	1,000,766	74	8	74,056,712	8,006,131
7	1,020,676	60	3	61,240,555	3,062,028
8	1,040,966	50	6	52,048,292	6,245,795
9	1,061,664	49	10	52,021,558	10,616,645
10	1,082,775	43	5	46,559,310	5,413,873
11	1,104,305	39	3	43,067,880	3,312,914
12	1,126,268	48	8	54,060,880	9,010,147
13	1,215,998	63	8	76,607,897	9,727,987
14	1,171,592	95	11	111,301,210	12,887,509
15	1,194,990	107	26	127,863,925	31,069,739
16	1,218,935	148	43	180,402,428	52,414,219
17	1,236,172	189	56	233,636,562	69,225,648
18	1,253,845	206	60	258,292,032	75,230,689
19	1,271,951	220	69	279,829,328	87,764,653
20	1,290,471	222	59	286,484,518	76,137,777
21	1,298,727	232	60	301,304,612	77,923,606
22	1,307,171	199	65	260,127,071	84,966,129
23	1,315,795	175	55	230,264,103	72,368,718
24	1,324,602	210	62	278,166,319	82,125,294
25	1,333,568	159	57	212,037,283	76,013,366
26	1,323,432	160	61	211,749,078	80,729,336
27	1,313,091	180	62	236,356,454	81,411,668
28	1,302,543	180	62	234,457,672	80,757,643
29	1,291,788	159	60	205,394,248	77,507,264
30	1,280,849	168	61	215,182,593	78,131,775
31	1,269,708	176	63	223,468,683	79,991,631
32	1,258,401	180	77	226,512,209	96,896,889
33	1,246,897	174	69	216,960,071	86,035,890
34	1,235,217	156	56	192,693,810	69,172,137
35	1,223,356	173	65	211,640,573	79,518,134
36	1,201,642	168	56	201,875,775	67,291,925
37	1,179,551	176	69	207,600,935	81,389,003
38	1,157,080	160	65	185,132,733	75,210,173
39	1,134,218	180	71	204,159,164	80,529,448
40	1,110,960	176	72	195,528,938	79,989,111
41	1,087,312	204	78	221,811,734	84,810,369
42	1,063,264	176	74	187,134,380	78,681,500
43	1,038,812	156	61	162,054,676	63,367,534
44	1,013,961	165	60	167,303,618	60,837,679
45	988,703	159	60	157,203,825	59,322,198
46	960,494	162	56	155,600,011	53,787,658
47	931,819	167	60	155,613,845	55,909,166
48	902,677	134	51	120,958,731	46,036,532
49	873,063	154	61	134,451,642	53,256,819
50	842,970	143	54	120,544,732	45,520,388

51	812,401	144	52	116,985,740	42,244,851
52	781,350	138	46	107,826,266	35,942,089
53	749,809	162	70	121,469,056	52,486,629
54	717,765	122	50	87,567,329	35,888,250
55	685,221	124	49	84,967,363	33,575,813
56	675,201	127	49	85,750,527	33,084,849
57	662,310	94	38	62,257,181	25,167,797
58	639,198	102	42	65,198,199	26,846,317
59	615,838	107	51	65,894,665	31,407,737
60	592,214	102	39	60,405,825	23,096,345
61	568,343	97	33	55,129,311	18,755,332
62	544,215	94	39	51,156,222	21,224,390
63	519,839	96	33	49,904,591	17,154,703
64	495,208	93	37	46,054,366	18,322,705
65	470,318	88	37	41,387,974	17,401,762
66	454,244	88	31	39,973,513	14,081,579
67	438,169	72	26	31,548,166	11,392,393
68	422,104	81	32	34,190,462	13,507,343
69	406,075	85	28	34,516,404	11,370,110
70	390,093	72	20	28,086,671	7,801,853
71	374,171	68	21	25,443,659	7,857,601
72	358,331	70	17	25,083,150	6,091,622
73	342,587	76	26	26,036,590	8,907,255
74	326,956	54	12	17,655,609	3,923,469
75	311,452	60	13	18,687,131	4,048,878
76	296,091	60	16	17,765,480	4,737,461
77	280,886	50	8	14,044,284	2,247,085
78	265,850	41	9	10,899,837	2,392,647
79	250,991	63	8	15,812,408	2,007,925
80	236,311	35	11	8,270,890	2,599,423
81	221,822	35	6	7,763,758	1,330,930
82	207,515	34	7	7,055,499	1,452,603
83	193,382	39	7	7,541,881	1,353,671
84	179,405	37	4	6,637,996	717,621
85	165,558	19	1	3,145,599	165,558
86	151,793	25	2	3,794,816	303,585
87	138,049	16	0	2,208,789	0
88	124,228	16	0	1,987,644	0
89	110,195	14	1	1,542,723	110,195
90	95,750	10	2	957,505	191,501
91	80,612	11	0	886,728	0
92	64,326	6	0	385,958	0
93	46,207	7	2	323,448	92,414
94	25,257	4	0	101,030	0
≥95	0	11	0	0	0
Unknown	713,397‡	82	56	58,498,519	39,950,208
Total		10,511	3,324	$ 10,182,727,451	$ 3,263,785,061

** Calculations by the authors, methods and sub-costs by age and sex for Canada based on suggestions of Dr. Ted Miller, Pacific Institute for Research and Evaluation. Data on lost wages from Statistics Canada Table 202-0407. Income of individuals, by sex, age group and income source, for an average of 1991-2010 for both sexes; benefits at 25% of lost salary; healthy life expectancy was considered.*

† Excluded from this table are lost household production, hospital or other medical costs for victims surviving to hospital, police, coroner, search and rescue costs, societal and family costs of raising a child, willingness to pay, employer's friction costs of replacing an employee, welfare and employment insurance expenses for government, statistical value of a life, legal fees, funeral costs, etc. These other economic losses are considered in the discussion, with examples.

‡ Where age was unknown, the mean cost of death was used.