In this edition of Hazard we analyse recent boating-related recreational injury data to provide a context for marine injury prevention initiatives in Victoria. We report on injury associated with surf sports separately, and an update report on marine animals injuries is posted on the VISAR website.

Boating-related sports and recreational injury, Victoria July 2000 to June 2002

Karen Ashby & Erin Cassell

Summary

This edition of Hazard provides an overview of unintentional fatal and non-fatal injuries associated with boating-related sport and recreational activities.

There were 18 fatalities, 205 hospital admissions and 517 Emergency Department (ED) presentations (non-admissions) for boating-related injuries over the 2-year period July 2000 to June 2002.

All fatalities resulted from drowning. The activities being engaged in at the time of drowning were fishing from a boat (44%), boating (28%), kayaking/canoeing (17%), riding a personal watercraft (PWC)/jetski (5%) and sailing (5%). By contrast, approximately half of the non-fatal injuries were related to water skiing and PWC/jetski riding.

Two-thirds of fatalities occurred on inland waters and a third in coastal waters. Males predominate at all levels of severity, representing over three-quarters of injured persons and over 90% of fatalities. ED presentations were more heavily weighted towards the 15-29 age group (48%), whereas persons aged 45 years and older were more represented in deaths and hospital admissions (39% and 33% of cases respectively).

The lower extremity (mostly knee, hip/thigh and foot) was the most commonly injured body site for both hospital admissions and ED presentations, accounting for approximately one-third of cases. Forty-three percent of admissions were fractures, most commonly to the spine/back (17% of fractures) and the lower leg (12%).

Recommendations for boating-related drowning prevention include mandatory wearing of personal floatation devices (PFDs) for operators and passengers of recreational vessels, and education and other initiatives to reduce consumption of alcohol during boating activities.

Further research is needed to identify promising and proven measures to reduce injury in water skiing (and related activities), PWC riding, boating (including fishing from boats), sailing, canoeing and kayaking. Data quality improvements and the collection of exposure (time-at-risk) data are also recommended.
Introduction

The great coastal stretches and inland waterways of Victoria provide a perfect setting for a wide variety of recreational boating activities. The Exercise, Recreation and Sport Survey (ERASS) conducted in Victoria in 2001/2 estimated that 114,000 Victorians participated in boating-related sport and recreational activities over the previous 12 months, the most popular being water skiing/powerboating and sailing (SRV, 2003). Fishing had 59,900 participants but fishing from boats could not be separated from other fishing activities (eg. pier or rock fishing).

This edition of Hazard provides an overview of unintentional fatal and non-fatal injuries associated with boating-related sport and recreational activities utilising data from the Marine Incident Database (MID) and the National Coroners Information System (NCIS) (as reported in Bugeja ‘Recreational Vessel Fatalities in Victoria’, 2003) and the Victorian hospital-based injury surveillance databases (the Victorian Admitted Episodes Dataset and the Victorian Emergency Minimum Dataset). Activities covered by this report include recreational boating, water skiing, personal watercraft (PWC or jetski) riding, rowing, canoeing, kayaking, sailing, rafting and kitesurfing. Scuba diving and snorkelling (n=14) were included as it is not known whether boats were involved in the activity.

Hospital emergency department (ED) presentations data underestimate the size of the boating-related recreational injury problem. Several hospitals that are scheduled to join the VEMD in 2004 - Sale, Bairnsdale, Wodonga, Swan Hill, Warrigal, Hamilton and Sandringham - are situated in areas where boating-related watersports are popular. The data for hospital admissions, however, are not affected as the admissions database (VAED) provides complete coverage of hospitals across the state.

Methods

Fatality data were extracted from the recent report ‘Recreational Vessel Fatalities in Victoria’ (Bugeja, 2003), a joint initiative of the State Coroner’s Office, the Department of Human Services and Marine Safety Victoria. The report covers fatal drowning of occupants of recreational vessels between July 1999 and June 2002. We extracted a subset of data from this report covering fatalities in the period July 2000-June 2002. The author supplied supplementary data on fatalities that occurred over this period.

Non-fatal injury data were extracted from two hospital databases held or accessed by VISAR:

- Victorian Admitted Episodes Dataset (VAED) – Victorian public and private hospital admissions (July 2000 to June 2002); and
- Victorian Emergency Minimum Dataset (VEMD) – Victorian public hospital emergency department (ED) presentations (July 2000 to June 2002)

The method for extracting data is described in Box 1 (page 15).

Results

Deaths

Fatality data for the financial years 2000/01 and 2001/2 were extracted from the recent report “Recreation Vessel Fatalities in Victoria” compiled by Bugeja (2003), with additional information on the cases of interest supplied by the author. The Victorian report only covered fatalities due to drowning. Australian Bureau of Statistics (ABS) Fatality File recorded only one non-drowning recreational boating-related injury death in 2000/2, related to Personal Watercraft (PWC/jetski) riding.

There were 15 recreational boating-related incidents resulting in 18 drowning fatalities in Victoria over the 2-year period of interest, seven in 2000/2001 and eleven in 2001/2002. Co-morbidity, in the form of heart disease and abnormalities were identified in four
cases at autopsy. The sport and recreation activities being undertaken at the time of drowning were fishing from a boat (44%), boating (28%), kayaking/canoeing (17%), riding a PWC/jetski (5%) and sailing (5%). Most fatalities (61%) occurred when the vessel was underway.

Over half the drowning deaths occurred after a boat capsize (56%). Other drowning incidents occurred when the deceased tried to swim to shore from a disabled boat (17%), the craft collided with another object (11%), the boat suddenly sank (5%), the deceased was thrown overboard (5%), and when the boat became disabled and the deceased entered the water to bring it to shore (5%).

All eighteen drowning victims, except one, were male. Eighty percent were aged 25-54 years. Half the deceased were classified as ‘experienced’ in the use of the craft, 17% were inexperienced and the remainder had either limited experience or the amount of their experience was unknown.

Drowning more commonly occurred in inland waters (67%, mostly inlets, lakes and rivers) as opposed to coastal waters (33%, mostly bays). Half the fatal incidents occurred in clear weather conditions, a further 28% occurred in cloudy conditions, 6% in rain and the other case reports did not specify the weather conditions. One-third of victims were reported as not having checked the weather conditions before taking out the vessel. Whether or not the other two-thirds checked conditions was unknown. Visibility was reported as ‘good’ at the time of most incidents (56%). Only three fatalities occurred in strong wind conditions. The state of the sea including wind generated swell and ocean swell appeared to be a significant factor in at least half of the cases. In several cases, small vessels were being operated in conditions, both water and weather, that were inappropriate for their size.

Coronial findings indicate that 15 victims (83%) had a personal flotation device (PFD) available for use, however only five (28%) were wearing a PFD when retrieved from the water. A small proportion of victims (11%) carried a radio and only 6% carried a mobile phone. Forty-four percent of victims had no available means of communication. Alcohol was involved in 28% (n=5) of cases; equipment (electrical failure) or material factors played a role in 28% (n=5) of cases.

Over the same 2-year period, July 2000 to June 2002, there were 75 recreational boating-related fatalities in Australia including those that occurred in Victoria. Twenty-eight fatalities (37%) were related to fishing from boats, thirteen victims (17%) were PWC/jetski riding at the time of the fatal event, seven (9%) were canoeing/kayaking, five (7%) were sailing, two were water skiing and one was using a non-powered inflatable craft.

Hospital-treated injury

There were 205 hospital admissions and 517 ED presentations (non-admissions) for boating-related sport and recreational injuries over the 2-year period July 2000 to June 2002.

Table 2 compares the pattern of injury for deaths, admissions and ED presentations (non-admissions):

- Males appear to be over-represented at all levels of severity, representing between 76% and 94% of injured persons.
- Presentations were more heavily weighted towards the 15-29 age group (48%), whereas deaths and admissions were more heavily weighted towards those aged 45 years and older (39% and 33% of cases respectively).
- Fatalities mostly occurred in fishing and motorboat activity whereas approximately half of non-fatal injuries were related to water skiing and PWC (jetski) riding.
- The lower limb was the most commonly injured body site for both hospital admissions and presentations accounting for approximately one-third of cases.
- Forty-three percent of admissions were fractures; most commonly to the spine/back (17% of fractures) and the lower leg (12%).

Crude mean annual rate per 100,000 population of boating-related sport and recreational hospital admissions: Victoria, July 2000 to June 2002 (n=205)

Figure 1

Source: Victorian Admitted Episodes Dataset (VAED) July 2000 to June 2002
### Boating-related sport and recreational injury July 2000 to June 2002

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Deaths</th>
<th>Admissions (VAED)</th>
<th>Presentations (VEMD)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (94%)</td>
<td></td>
<td></td>
<td>male (76%)</td>
</tr>
<tr>
<td>Female (6%)</td>
<td></td>
<td></td>
<td>female (24%)</td>
</tr>
<tr>
<td><strong>Age group in years</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-14 (6%)</td>
<td></td>
<td></td>
<td>0-14 (10%)</td>
</tr>
<tr>
<td>15-29 (28%)</td>
<td></td>
<td></td>
<td>15-29 (48%)</td>
</tr>
<tr>
<td>30-44 (33%)</td>
<td></td>
<td></td>
<td>30-44 (29%)</td>
</tr>
<tr>
<td>45-59 (20%)</td>
<td></td>
<td></td>
<td>45-59 (10%)</td>
</tr>
<tr>
<td>60+ (11%)</td>
<td></td>
<td></td>
<td>60+ (3%)</td>
</tr>
<tr>
<td><strong>Activity/watercraft</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fishing from boat (44%)</td>
<td></td>
<td></td>
<td>Water skiing (24%)</td>
</tr>
<tr>
<td>Motor boating not further specified (28%)</td>
<td></td>
<td></td>
<td>Personal Watercraft (jetski) (23%)</td>
</tr>
<tr>
<td>Canoe/kayaking (17%)</td>
<td></td>
<td></td>
<td>Fishing (9%)</td>
</tr>
<tr>
<td>Personal Watercraft (jetski) (5%)</td>
<td></td>
<td></td>
<td>Sailing (8%)</td>
</tr>
<tr>
<td>Sailing (5%)</td>
<td></td>
<td></td>
<td>Inflatable non-powered craft (3%)</td>
</tr>
<tr>
<td><strong>Cause</strong></td>
<td>Drowning (100%) mostly capsize (50%), swim to shore (17%), collisions (11%) sinking 5%, thrown overboard (5%)</td>
<td>On board incident without craft accident (40%)</td>
<td>Falls (41%)</td>
</tr>
<tr>
<td><strong>Body site injured</strong></td>
<td></td>
<td></td>
<td>Accidental to craft (13%)</td>
</tr>
<tr>
<td>Lower extremity (29%) mostly knee (24%), hip/thigh (22%)</td>
<td></td>
<td></td>
<td>Upper extremity (24%) mostly hand and fingers (35%), shoulder (29%)</td>
</tr>
<tr>
<td>Head, eyes, face and neck (26%) mostly head (59%)</td>
<td></td>
<td></td>
<td>Head, eyes, face and neck (23%) mostly head (47%)</td>
</tr>
<tr>
<td>Trunk (19%) mostly spine/back (41%), abdomen/pelvis (36%)</td>
<td></td>
<td></td>
<td>Trunk (10%)</td>
</tr>
<tr>
<td>Upper extremity (19%)</td>
<td></td>
<td></td>
<td>Other/unspecified (11%)</td>
</tr>
<tr>
<td><strong>Nature of injury</strong></td>
<td>Fractures (43%) mostly spine/back (17%), lower leg (12%), face, hip/thigh and forearm (each 10%)</td>
<td>Open wound (23%) mostly head (33%), face (27%)</td>
<td>Open wound (23%) mostly head (33%), face (27%)</td>
</tr>
<tr>
<td>Sprain/strain (22%) mostly knee (21%), ankle (17%), scapular (12%), shoulder (8%)</td>
<td></td>
<td></td>
<td>Sprain/strain (22%) mostly knee (21%), ankle (17%), scapular (12%), shoulder (8%)</td>
</tr>
<tr>
<td>Fracture (15%)</td>
<td></td>
<td></td>
<td>Fracture (15%)</td>
</tr>
<tr>
<td>Muscle/tendon (10%)</td>
<td></td>
<td></td>
<td>Muscle/tendon (10%)</td>
</tr>
<tr>
<td>Superficial (7%)</td>
<td></td>
<td></td>
<td>Superficial (7%)</td>
</tr>
<tr>
<td>Dislocation (4%)</td>
<td></td>
<td></td>
<td>Dislocation (4%)</td>
</tr>
<tr>
<td>Other/unspecified (19%)</td>
<td></td>
<td></td>
<td>Other/unspecified (19%)</td>
</tr>
</tbody>
</table>

Hospital admissions (n = 205)

Figure 1 shows the age breakdown for all boating-related sport and recreation injury hospital admissions from July 2000 to June 2002. Injury rates were higher for males in all but the 0-4 and 75-79 age groups (but case counts in these age groups were small). The highest rates of boating-related injury for males were seen in age groups 25-29 and 40-44 years (both 4.9 per 100,000 population). We cannot conclude that males are at higher absolute risk of serious injury in boating-related recreational activities than females because available data indicate that their participation in these activities is also much higher (SRV, 2003).

The major causes (mechanisms), body sites injured and the nature of injury are shown in Table 2. As VAED data are captured using the ‘water transport’ codes no further detail of the mechanism of injury are recorded. Admitted ED cases extracted from the VEMD were analysed to provide additional information on hospitalised injury cases by specific activity and are included later in this report.

Forty-three percent of hospital admitted injuries were fractures, most frequently to the spine/back and lower leg (17% and 12% of fractures respectively).

Length of stay

Approximately half (49%) of cases were admitted to hospital for less than 2 days, 37% stayed 2-7 days, 13% stayed 8-30 days and 1% (2 cases) stayed more than 31 days.

Both cases that stayed more than one month suffered from head injuries. Nineteen percent of the stays between 8 and 30 days were spine/back injuries. Table 3 indicates that the shortest stays were for injuries sustained during sailing and non-powered inflatable riding (63% and 71% respectively stayed <2 days). At the other end of the scale, 28% of those injured when fishing from a boat had a length of stay of 8-30 days. The longest stay was an injured PWC rider who stayed 73 days.

Hospital admissions for boating-related sport and recreation injuries by craft/activity type and length of hospital stay: Victoria, July 2000 to June 2002

<table>
<thead>
<tr>
<th>Craft/activity type</th>
<th>Length of stay (days)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;2 days</td>
<td>2-7 days</td>
</tr>
<tr>
<td>Water skiing</td>
<td>28</td>
<td>56</td>
</tr>
<tr>
<td>PWC/jet ski riding</td>
<td>21</td>
<td>44</td>
</tr>
<tr>
<td>Fishing from boat</td>
<td>9</td>
<td>50</td>
</tr>
<tr>
<td>Sailing</td>
<td>10</td>
<td>63</td>
</tr>
<tr>
<td>Canoe/kayaking</td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>Non-powered inflatable</td>
<td>5</td>
<td>71</td>
</tr>
<tr>
<td>Other</td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>Unspecified</td>
<td>22</td>
<td>41</td>
</tr>
<tr>
<td>Total</td>
<td>101</td>
<td>49</td>
</tr>
</tbody>
</table>

Source: Victorian Admitted Episodes Dataset (VAED) July 2000 to June 2002

Table 3

Frequency of boating-related sport and recreation injury ED presentations (non-admissions): Victoria, July 2000 to June 2002 (n = 517)

Comparison of length of stay with all sports injuries

Boating-related hospital stays tend to be longer than stays for injuries related to other sport and recreation activities. For example, 72% of all sports-related admissions recorded on the VEMD over the same time period—July 2000 to June 2002—had a length of hospital stay of less than 2 days, 26% stayed 2-7 days and 3% stayed 8-30 days. The comparative proportions for boating-related sport and recreation were 49%, 37% and 13% respectively hospitalised (Table 3).

Emergency Department presentations, non-admissions (n = 517)

Admitted cases are not included in presentation data to avoid double counting. Accurate rate data are not
ED presentations (non-admissions and admissions) for boating-related injuries by craft/activity type: Victoria, July 2000 to June 2002 (n=604)

<table>
<thead>
<tr>
<th></th>
<th>Non-admission</th>
<th>Admissions*</th>
<th>Total</th>
<th>% requiring admission</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Water skiing and related activities</td>
<td>259</td>
<td>50</td>
<td>34</td>
<td>36</td>
</tr>
<tr>
<td>Boating not further specified</td>
<td>151</td>
<td>29</td>
<td>46</td>
<td>49</td>
</tr>
<tr>
<td>PWC/Jetskiing</td>
<td>39</td>
<td>8</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Sailing/yachting</td>
<td>29</td>
<td>6</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Seba diving</td>
<td>12</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Kayak/canoeing</td>
<td>10</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Rowing</td>
<td>6</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Rafting</td>
<td>6</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Kite surfing</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>517</strong></td>
<td><strong>100</strong></td>
<td><strong>94</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

* The discrepancy between the numbers of hospital admissions for the VEMD and the VAED is likely to be due to incomplete coverage of all hospitals in the VEMD and failure of some VEMD hospitals to identify activity at the time of injury in case narrative data.

Table 4


Available because of the incomplete coverage of the Victorian population by the VEMD. Figure 2 shows the age and gender breakdown for boating-related sport and recreation presentations (based on frequency data). Results of analyses are summarised in Table 2. Males were over-represented in injuries among all age groups. Falls (41%) and collisions with objects and persons (32%) were the major mechanisms of injury. The most common specific injuries were open wounds to the face and head (14% of all recreational boating-related injury ED presentations), and sprains and strains of knees and ankles (5% and 4% respectively).

Severity by sport

The VEMD also records the number of cases subsequently admitted to hospital after ED treatment, thus giving a proxy measure of severity (Table 4). The overall proportion of ED presentations requiring hospital admission was 15%. The highest admission rates were for boating (23%) and kite surfing (20%).

The six highest ranked boating-related sport and recreational activities for injury

This section provides an overview of the available data for the six boating-related recreational activities that were most commonly involved in fatalities and hospital-treated injury (Table 5). The analysis utilises fatality data from the State Coroner’s Office and VAED admissions and VEMD presentations (non-admissions) data for the period July 2000 to June 2002. Ranking is based on frequency data.

1. **WATER SKIING AND RELATED ACTIVITIES**

There were 309 hospital-treated injuries related to water skiing and related activities (50 admissions and 259 presentations). The related activities include wake or knee boarding and tubing. In tubing a person is towed on an inflatable tube or ‘ski biscuit’ behind the ski boat. These related activities are identifiable in the VEMD, but not in the VAED.

Males accounted for 82% of admissions and 75% of presentations. Both admissions and presentations peaked among persons aged 25-29 years (27% and 22% of water skiing and related activity cases, respectively). A further 22% of admissions and 18% of presentations were in the age group 20-24 years.

The six boating-related sport and recreation activities most associated with injury

<table>
<thead>
<tr>
<th></th>
<th>Deaths N</th>
<th>Hospital Admissions N</th>
<th>ED presentations N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water skiing and related activities</td>
<td>0</td>
<td>50</td>
<td>259</td>
</tr>
<tr>
<td>Motorboating/boating not specified</td>
<td>5</td>
<td>n/a</td>
<td>151</td>
</tr>
<tr>
<td>Fishing from boats</td>
<td>8</td>
<td>18</td>
<td>n/a</td>
</tr>
<tr>
<td>Personal Water Craft riding</td>
<td>1</td>
<td>48</td>
<td>39</td>
</tr>
<tr>
<td>Sailing</td>
<td>1</td>
<td>16</td>
<td>29</td>
</tr>
<tr>
<td>Canoeing/Kayaking</td>
<td>3</td>
<td>6</td>
<td>10</td>
</tr>
</tbody>
</table>


Hospital admissions: Victorian Admitted Episodes Dataset (VAED) July 2000 to June 2002

Hospital emergency department presentations (non-admissions): Victorian Emergency Minimum Dataset (VEMD) July 2000 to June 2002
Hospital admissions (n = 50, annual average frequency 25)

Water skiing accounted for almost one-quarter of all admissions for boating-related sport and recreational injuries. Other water skiing-related activities such as tubing are not coded on the VAED, hence admissions data only report water skiing injury cases. Thirty-three admissions were recorded in 2000/01 and 17 in 2001/02. The decrease may be associated with drought conditions that have reduced participation in watersports on inland waterways, although ED presentations were stable over the same period.

Among admissions, the head/face/neck was the most frequently injured body region (30%), followed by the lower extremity (26%) and trunk (20%). Fractures accounted for 42% of water skiing admissions and dislocations a further 12%. One admission was a near drowning. The most common specific injuries were skull fractures (8%), vertebral fractures (8%) and shoulder dislocations (8%).

Fifty-six percent of water skiing injury cases were admitted to hospital for less than 2 days, 34% stayed 2-7 days and 5% stayed 8-30 days. The five cases that had the longest stays were for injuries to the brachial artery (upper extremity, 2 cases), lumbar vertebral fracture (1 case), fractured neck of femur (1 case), and leg trauma that included a hip dislocation, blood vessel and nerve trauma (1 case).

VAED coding does not provide any detail of the circumstances of the injury. However, analysis of case narrative data for admissions recorded on the VEMD (n=28) provides some additional information. One quarter of the VEMD-recorded admissions were caused by hitting a tree when skiing, 14% occurred when a body part was caught in the ski rope and 11% when a boat hit the skier.

Hospital ED presentations (non-admissions) (n = 259, annual average frequency 129)

Fifty percent of all boating-related ED injury presentations were for water skiing and related activities. Most cases (78%, n=203) were associated with water skiing. A further 17% (n=44) were associated with towed boards (wake, knee or ski), and 5% (n=12) with ski biscuits or tubing. One hundred and twenty-two presentations (non-admissions) were recorded in 2000/01 and 137 in 2001/02.

The lower extremity was the most frequently injured body region (34%), mostly the knee (13% of all water skiing presentations), ankle (9%) and feet (7%). Other commonly injured body sites were the head (14%) and the shoulder (9%) (Figure 4). Sprains and strains were the most frequently occurring type of injury accounting for 26% of presentations. Open wounds (18%), fractures (15%), and injuries to the muscles and tendons (10%) were also common. The most frequently occurring specific injuries were open wounds to the head (9% of water skiing and related activity presentations), sprains or strains of the knee (7%), shoulder dislocations (5%) and ankle sprain or strains (5%).

The major mechanism of water skiing injury was a fall while skiing (49%). Other mechanisms included being struck...
by an object (12%, including ski and rope handle), being caught in the towline (9%) and ear problems from contact with the water (3%).

Towed board injuries most commonly resulted from falls from the board (43%) and being struck by the board (32%). All but one of the twelve ski biscuit and tubing injuries occurred when the injured person fell from the biscuit/tube when it was being towed by a boat in the water.

2. MOTOR BOATING, BOATING NOT SPECIFIED

There were 5 deaths and 151 ED presentations for sport and recreation injuries related to motor and other boats. The lack of specificity in text narratives of “boating” cases made it impossible to identify the type of boat involved in ED presentations.

Deaths (n = 5)
The five drowning fatalities occurred in five separate incidents:

• All of the deceased were male

• Three of deceased were aged 25-39, the other two were aged 50-54

• Two of the deceased were noted to be experienced boaters, one was inexperienced and the experience of the other two was not specified

• Two fatalities occurred when the vessel capsized, one when the vessel sank, one when the deceased attempted to swim to shore from a disabled vessel, and the remaining case when the deceased entered the water to bring the disabled vessel to shore

• Alcohol played a role in two fatal incidents

• One victim was wearing a PFD but removed it when nearing the shore after swimming from the vessel.

Hospital ED presentations (non-admissions) (n=151 annual average frequency 76)
Most presentations were male (80%) and one-quarter were aged 25-34. The mechanism for more than a third (36%) of injuries was a fall. Other common mechanisms of injury were being struck by, or colliding with, an object (28%) and cutting and piercing (11%). Five percent were contact with the boat propeller.

Open wounds (29%), sprain/strain (17%) and fractures (14%) were the most common injuries. Lower extremity injuries accounted for 35% of all injuries. Head/face and neck injuries were also common (17%) (Figure 5).

3. FISHING FROM BOATS

There were 8 deaths and 18 admissions for recreational fishing from boats. The broad coding categories of the VEMD and lack of specificity in text narratives made it difficult to distinguish between cases that involved fishing from boats and other fishing localities such as rocks. Only those cases which specified that the person was fishing from a boat at the time of injury were included.

Deaths (n = 8)
Five separate incidents resulted in 8 drowning fatalities.

• Seven of the deceased were male

Motor boating injury by body site (ED presentations only) Figure 5

Fishing from boats injury by body site (admissions only) Figure 6
Hazard 56

4. PERSONAL WATERCRAFT (PWC)/JETSKI RIDING

There was one death and 87 hospital treated injuries (48 admissions and 39 ED presentations) related to PWC riding. ED presentations are obviously under-reported on the VEMD as all admissions enter through the ED.

Males accounted for 85% of admissions and 87% of presentations. Forty percent of admissions were in the age group 35-49 years and a further 19% in the age group 10-14 years, whereas half the presentations were aged 20-29 years (Figure 7).

Deaths (n = 1)

One fatality occurred when a PWC driven by an inexperienced operator collided with a ski boat. The deceased suffered a head injury and was unconscious when thrown into the water and drowned, despite wearing a PFD. Inexperience and speed were identified as contributory factors (Bugeja, 2003).

Hospital Admissions (n = 18)

Most admissions were male (n=15) and one-third were aged 60 years or older. Injuries to the head/face/neck and lower limb were most common (Figure 6). The most frequently occurring injury was fractures (n=10 cases), most commonly of the face and hip.

Hospital admissions (n = 48, annual average frequency 24)

Twenty-three percent of all hospital admissions for boating-related recreational activities were associated with PWC riding. Twenty-six admissions were recorded in 2000/01 and 22 in 2001/02.

The lower extremity was the most frequently injured body site (40%), followed by the head/face (23%) and trunk (21%) (Figure 8). Half the admitted cases were fractures. Open wounds accounted for a further 13% of cases and intracranial injury 10%. One admission was a near drowning. The most common specific injuries were intracranial injury (10%) and tibial fractures (8%).

Forty-four percent of PWC injury cases were admitted to hospital for less than 2 days, 40% stayed 2-7 days, 15% stayed 8-30 days and 2% (one case) stayed more than 31 days. The cases that stayed 8-30 days were admitted with fractures of lumbar vertebra (2 cases), burns (1 case), fractured femur (1 case), head injury including skull fracture (1 case) and leg trauma (1 case). One case stayed in hospital in excess of 10 weeks suffering from multiple injuries including head injuries, fractures of the femur, forearm and patella and numerous open wounds associated with the fractures.

VAED coding does not provide details of the circumstances of the injury. Only six of the admissions were recorded on the VEMD database so further information from that source is limited. Three of the VEMD-recorded admissions involved falls from the PWC, in 2 cases the injured person fell onto the PWC and in the remaining case a person was struck by a PWC.

Hospital ED presentations (non admissions) (n=39, annual average frequency 19)

Eight percent of all ED presentations for boating-related sport and recreational injuries were PWC riding cases. Twenty-one presentations were recorded in 2000/01 and 18 in 2001/02.

The lower extremity was the most frequently injured body region (31%), mostly the foot (13% of all PWC injury presentations), and knee (10%). Other common body sites
6. CANOEING/KAYAKING

There were three deaths, six hospital admissions and 10 ED presentations related to canoeing and kayaking.

**Deaths (n = 3)**

The three fatalities occurred in three separate incidents:

- All of the deceased were male
- Two of the deceased were aged 25-39 and the other was aged 50-54

Case 1: The deceased was paddling a home-made canoe with two other adults. The condition of the canoe had deteriorated with use and was considered unsuitable for the sea conditions at the time of the incident. Neither safety equipment nor PFDs were carried and weather conditions were unsettled. The canoe capsized in changed weather conditions and the deceased drowned.

Case 2: The deceased was an inexperienced kayaker who went kayaking with a friend. The kayak capsized, one person swam to shore, and the other drowned. Neither the deceased nor the friend was wearing a PFD and both had consumed alcohol.

Case 3: The deceased was an experienced kayaker who was paddling a Level 4 rapid (on a scale of 1 – 6) on a Victorian river. Witnesses reported that the deceased was paddling within his capabilities. The deceased became trapped under a large rock while negotiating a rapid. The strong current and turbulent rapids made it impossible for him to free himself and he drowned. The deceased was wearing a helmet and a PFD.

**Hospital admissions (n = 6)**

All admissions, but one, were males. Cases were aged between 25 and 54 years. Dislocations were the most common injury type (33%). Half the injuries were to the shoulder (50%). Five of the six admissions had a length of hospital stay of 2 days, the other was hospitalised for five days.
Hospital ED presentations (n = 10)
Most presentations were male (60%). The most common mechanisms of injury were falling from the canoe/kayak (40%, n=4) and colliding with a fixed object whilst paddling (30%, n=3).

Injuries were sprain/strains, superficial injuries, fractures, dislocations, an open wound and a foreign body. Lower back and shoulder injuries each accounted for 20% of canoe-kayaking injuries.

Discussion
Recreational boat operator license fees were introduced in Victoria in February 2002 for all PWC operators and all operators of other powered boats aged under 21 years, and from 1 February 2003 for all other powered boat operators. The Victorian government set aside a proportion of funding from the fees to expand boating safety initiatives implemented by Marine Safety Victoria (MSV). The newly created MSV Boating Safety Funding Program aims to reduce the potential for injuries and fatalities related to the operation of recreational boats.

MSV has recorded boating-related incidents reported by the Victorian Water Police onto the Marine Incident Database (MID) since its establishment in 1988. In 2002, MSV contracted MUARC to conduct the first-ever detailed analyses of incidents recorded on the MID (MSV, 2002). The availability of hospital-based injury surveillance data through VISAR allowed a more comprehensive picture of the size and nature of the boating-related sport and recreation injury problem to be drawn. The project report, Marine Safety in Victoria (2002), revealed that MID data underestimated the size of the injury problem. Approximately 10 times as many serious (hospitalised) boating-related injuries occurred in Victoria each year than were recorded on the MID. The size of the water skiing injury problem was particularly revealing as these injury incidents are rarely reported to the Water Police and hence few were recorded on the MID. Our study reports fatality and injury data for the latest available two-year period 2000/01 and 2001/2 and expands on the information provided in the MUARC report published in 2002.

Reducing recreational boating-related fatalities
Eighteen Victorians drowned in recreational boating-related incidents in the two-year period July 2000 to June 2002. Over the same period there was an annual average of 37 recreational boating-related fatalities nationally. In Victoria and nationally fishing from boats was the most common activity associated with recreational boating-related drowning.

The drowning incidents reported here are a subset of those included in the comprehensive study of recreational vessel drowning fatalities compiled by Bugeja from MID and Coroners’ data (2003). The major findings and recommendations of that report hold for the subset included in this study. Bugeja (2003) found that, in most instances, drowning resulted from a combination of three factors: hazardous environmental conditions; vessel occupants suddenly and unexpectedly entering the water; and the absence of Personal Flotation Device (PFD) use. PFDs are required by law to be available for each passenger in a recreational vessel. Non-wearing of a PFD was reported as the most significant factor contributing to the drowning deaths. Alcohol was also mentioned as a contributory factor but data on alcohol involvement in drowning cases were incomplete.

The major recommendation from the report was that the National Marine Safety Committee should review and strengthen the Australian Standard for PFD Type 1 (AS1512) and that, subsequently, MSV should prepare a case for the government to regulate that the wearing of PFDs is mandatory in vessels measuring up to and including six metres in length. The report also recommended that MSV enhance education relating to recreational vessel passenger safety; and that MSV and other water safety organisations educate participants in recreational boating activities of the dangers of alcohol consumption in and around aquatic environments.

Personal Flotation Devices (PFDs)
There are three recognised types of PFDs, Types 1, 2 and 3. Only Type 1 is recognised as a life jacket, as it provides the highest level of buoyancy (87 newtons) and is designed to keep the wearer’s head above water and body in a safe floating position. Victorian law requires that a PFD Type 1 is carried for every person on board a boat including persons being towed, and that the PFD must fit the person for whom it is intended.

PFD Types 2 and 3 are buoyancy garments which are only designed to keep the wearer’s head above water. Canoeists and off-the-beach sailors often use type 2 PFDs, whereas water skiers and PWC riders favour Type 3.

There are currently no regulatory requirements that mandate the wearing of PFDs, except by children under the age of 10 years. A child is required to wear an approved PFD type 1, 2 or 3 at all times while the vessel is underway, unless the child is in a deckhouse, cabin, half cabin or secured enclosed space.

In November 2002, MSV commissioned Quantum Market Research to undertake a pre and post evaluation of MSV’s Life Jacket and Licensing campaign. There were 351 phone interviews conducted with registered boat owners over a 5-day period in November 2002. Respondents were typically male, owners of a fishing boat or dinghy (70%) or ski boat (17%), who used their boat seasonally (51%) compared to all year around (26%), on inland lakes or rivers (59%) or on Port Phillip Bay (36%). With respect to carrying and wearing PFDs the study found that: most owners carried a PFD Type 1, either fitted (33%) or foam blocks (26%); most owners never wore a PFD when boating (57%) or do so only on some occasions (26%); and many owners could not name the conditions under...
which PFDs should be worn (Bugeja, 2003).

Since 1988 a number of Coroners’ investigations of recreational vessel fatalities (mostly drownings) have recommended the compulsory wearing of PFDs by vessel operators and passengers (Bugeja, 2003). Acting on a recent Victorian Coroner’s investigation and recommendation (Coroner Byrne 2003), MSV conducted a stakeholder workshop in November 2003 to discuss the issue. MSV is now considering the range of options arising from the discussions at the meeting, from the status quo to legislation to mandate PFD wearing (modelled on Tasmanian legislation passed in 2000). MSV has not yet released its response to the Coroner’s recommendation, which will take key stakeholders’ views into consideration.

At the same time PFD designs continue to improve. Devices currently available on the market act as clothing garments under normal circumstances but inflate as a PFD on contact with the water. This innovative design feature addresses some of the inconvenience factors associated with wearing a PFD at all times.

**Alcohol and injury in watersports**

The Bugeja report (2003) indicated that seven (18%) of the 40 recreational vessel drowning cases that occurred in Victoria from 1999 to 2002 were found to have alcohol present post mortem. Bugeja (2003) noted that the determination of alcohol contribution to drowning deaths is complicated by a number of factors such as the time between the incident occurring and body recovery, putrefaction (decomposition) of the body and the extent of toxicological testing.

She noted that peak alcohol concentration occurs between half an hour and two hours after consumption. However, the time between incident and body recovery for the seven fatalities that had alcohol present post mortem was between 7 hours and 21 days (Bugeja, 2003). For bodies not quickly recovered, decomposition has commenced and this process leads to the formation of alcohol in the body tissue and fluids, making alcohol consumption more difficult to determine.

Driscoll, Harrison and Steenkamp (2003) recently reviewed alcohol use and water safety to assist the development of the Australian National Alcohol Strategy. Part of the project involved a review of the literature on the role of alcohol in serious and fatal injuries resulting from recreational aquatic activity (including swimming and diving). The authors found that there was very little Australian information. However, more comprehensive North American data indicate that alcohol is widely used by participants in recreational aquatic activity.

US studies also indicate that alcohol is detected in the blood of about 30-50% of fatally injured persons involved in recreational aquatic activity. The studies that were reviewed indicated that the relative risk of death associated with recreational boating was approximately 11:1 for persons with a BAC of 0.10g/100ml compared with persons who had not been drinking. The review team concluded that even small amounts of alcohol increase the fatality risk (Driscoll et al, 2003). Water sports/safety organisations and the water police need to be more active in educating watersports participants on the dangers of alcohol consumption and any form of aquatic activity.

A controlled epidemiological study is required to more precisely identify the role of alcohol as a risk factor for boating-related drowning.

**Reducing injury in Personal Watercraft (PWC) riding**

Personal watercraft (PWC), also known as jetskis and wave runners, are small powerboats. The first modern PWC was introduced in 1974 by Kawasaki as the “jet ski”. It was designed to accommodate one rider in a kneeling or standing position, had a 32 horsepower engine and could reach speeds of 30mph (White & Cheatham, 1999). By contrast, current model PWC can accommodate up to 3 passengers, are operated by the driver sitting, standing or kneeling, are able to tow skiers, have engines up to 215 horse power and are speed limited at 65mph (Jones, 2000; PWC Australia, personal communication 2004). There is a trend towards the purchase of three seater models for use by families (David Heyes, PWC Distributors Australia, personal communication, 2004). Current model PWC cost between $11,000 and $22,000 brand new and approximately $7,000 second hand (PWC Australia and Peter Corcoran, MSV, personal communication, 2004). PWC are fast, manoeuvrable and easily launched and recovered. All these features account for their growing popularity.

Although they have some safety features, such as an automatic ‘kill’ switch that shuts off the engine in the event the operator falls off and no exposed propellers, the speed, power and growing popularity of PWC have led to an increase in injuries. Few other vessels are capable of the speeds reached by PWC. Most powered vessels operate at the 20-35 knot range, not up to the PWC range of 60 knots or more (Peter Corcoran, MSV, personal communication 2004)

VISAR data indicate that each year in Victoria PWC are associated with an average of 1 death and at least 45 hospital treated injuries. Victims are typically male aged between 20 and 49 years. In Victoria deaths are fortunately infrequent. However, a preliminary review of the research literature reveals an increasing number of case series reports of PWC related injuries and deaths from several countries.

Latest Victorian figures show that there were 4,255 PWC registered in 2001/02 an increase of 615 on the previous year (Peter Corcoran, MSV, personal communication 2004). The estimated Victorian injury rate is 9.4 per 1,000 registered PWC in 2001/02. If under-reporting is taken into consideration then the Victorian rate is similar to the United States (U.S.) rates reported by Branch et al (1997). They ranged from 8.4-11.4
injuries per 1,000 PWC in operation in the U.S. in all but the final year of the series where the estimated rate was a high 16.2 injuries per 1,000 PWC.

Branche et al (1997) also reported a 4-fold increase in PWC-related injury in the U.S. between 1990 and 1995 and a rate of ED treated injury that is 8.5 times higher for PWC than for motorboats. The number of fatalities reported in the U.S. has grown at an alarming rate, from 5 in 1987 to 57 in 1996 (White & Cheatham, 1999).

Although Victorian hospital-treated injury data indicate that the mechanism of most PWC injuries is falls, the fatality data reported here and international case series indicate that most fatalities and serious PWC injuries occur when the PWC collides with other vessels or fixed objects. Victorian data show that the lower limbs are the most common body region injured. Victorian admissions data show fewer head (17%) and spine/back (6%) injuries compared to the cases series data reported in the literature (13%-54% for head injuries and 20%-38% for spinal injuries) (Haan et al, 2002; Bierle et al, 2002; Jones, 2000; White and Cheatham, 1999; Shatz et al, 1998; Branche et al, 1997).

Behavioural factors contributing to injury noted in the literature include inexperience, operator inattention, excess speed and reckless operation. Bull et al. (2000) note that the operating characteristics of the PWC may contribute to injury. PWC are manoeuvrable only when the throttle is open and, contrary to experience in all other motor vehicles, an obstruction is not avoided by slowing and turning but by maintaining or increasing speed and turning to avoid the hazard (Bull et al, 2000). Also, no braking is available. Stopping is achieved by cutting the throttle and coasting. When the PWC is coasting no steering is possible.

Chalmers et al (2003) reviewed the literature on PWC injuries and found no published evaluations of interventions.

The authors compiled several recommendations for prevention from their reading including: training of operators; developing ‘right of way’ guidelines and general safety guidelines for the use of PFDs; helmet use; regulation of PWC use; and improvements to PWC design. Other recommendations in the literature include promotion of adult supervision of child riders and setting a minimum age requirements for riders (Bull et al, 2000). Right of way guidelines are law in Victoria as are use of PFD and licensing of riders which includes restricting licensing age and speeds for those with restricted licences aged 12-16 years.

Reducing injury in water skiing (wake or knee boarding, sea biscuit riding and tubing)

There are up to 40,000 water skiers in Victoria (SRV, 2003) and an estimated 30 million recreational and competitive water skiers world-wide (Waltrip and Grace, 2001).

An average of 129 Victorians present to hospital each year for injuries associated with water skiing and related activities. Males aged 25-29 are most frequently injured and injuries are typically to the head face and neck (admissions) and lower limbs (admissions and ED presentations). Our study indicated that falls were by far the most common mechanism of injury, followed by collision with objects and being caught in the towline.

Chalmers and Morrison (2003) reviewed the research literature on injury associated with water skiing and reported a similar set of mechanisms. However, some common mechanisms reported from other studies, such as collisions with other skiers and boat propeller injuries, were uncommon in our study. We found only one injury case that was the result of a collision with another skier, and no cases of propeller injury to water skiers. However, there are substantial missing data on the mechanisms of injury in the Victorian hospital datasets and narrative data in the VEMD is of varying quality.

An in-depth follow-up study of injured water skiers is required to better understand the mechanisms of water skiing injury, obtain more detail of the circumstances in which the injuries occur and identify the potential risk factors in order to formulate prevention strategies.

Waltrip and Grace (2001) observed that the types of injuries sustained differed according to the level of participation of the water skier. Competitive skiers sustain knee, back and shoulder injury, whereas recreational skiers are more likely to sustain boat and propeller injury, vaginal and rectal injury and tympanic membrane (ear) injury from falling into water (Waltrip and Grace, 2001).

There are several other activities related to water skiing such as wake or knee boarding and tubing, in which a person is towed on an inflatable tube or ‘ski biscuit’ behind the ski boat. Ten percent of Victorian ED presentations for boating-related injury were associated with these activities. Chalmers and Morrison (2003) report on a Canadian study of child injury hospitalisations related to water tubing. The Canadian authors speculate that the risk of injury for ‘tubing’ is higher than for water skiing, as those being towed in the tube have little control of the tube and are unable to determine the direction of forward momentum. Our Victorian data indicate that although case counts are small (n=18) the proportion of child cases requiring admission is high (33%).

Neither analytic studies nor evaluations of interventions are reported in the literature on water skiing injuries so the evidence for risk factors and prevention strategies is limited. Chalmers and Morrison (2003) suggest that risk factors could include gender and experience, and interventions could include the imposition of speed limits on boats towing skiers, specifically around docks and buoys; avoidance of shallow water; regulation of tow rope lengths; wearing of PFDs; increased responsibility by boat operators; and increased vigilance by observers in boats.
Recommendations

Injury surveillance
- Analyse marine incident and boating-related sport and recreation injury data annually as new data becomes available for research, prevention and evaluation purposes.
- Review data sources for coverage, comprehensiveness and quality, and implement data improvement initiatives.
- VISAR to report back to hospitals on data quality shortcomings and seek support from relevant government departments to encourage hospitals to improve case narrative reports in the Victorian Emergency Minimum Dataset (VEMD).
- Consider the collection of exposure data (participation and/or time-at-risk) for specific boating-related sport and recreational activities to allow the estimation of injury risk per participant /per time unit in these recreational activities, and comparison of injury risk between these and other sport and active recreation activities.
- Liaise with Sports and Recreation Victoria (SRV) to separate water sport and boating relevant categories in future ERASS participation surveys to make their data more useful for injury prevention purposes.

Injury prevention and control initiatives
- The wearing of the most appropriate Personal Flotation Device should be mandatory for the operator and all passengers in recreational vessels that measure six metres or less in length. Prior to legislating for mandatory wearing of PFDs, the Australian Standard (AS 1512) for Type 1 PFDs should be strengthened to at least match the performance and safety requirements of International Standards.
- Information from surveillance data, literature reviews and key stakeholders (safety and sports associations) should be used to design, implement and evaluate interventions to reduce injury in boating and boating-related sport and recreation activities particularly fishing from a boat, personal watercraft (PWC) riding, water skiing/sea biscuit/tubing and canoeing/kayaking.
- Water sports/safety organisations and the water police should be supported to more actively educate watersports participants of the dangers of mixing alcohol use and aquatic activities. Other measures to change the culture of alcohol consumption in water sports should be investigated.

Research
- Conduct comprehensive reviews of published and unpublished literature in the major boating-related sport and recreation activities to better understand the pattern of injury, and contributory factors and to identify, from evaluation reports, the proven and promising strategies and countermeasures to injury.
- Undertake a follow-up study of patients presenting to hospital emergency departments with injury related to participation in boating-related sport and recreation activities to investigate in more detail the pattern of injury, putative risk/contributory and protective factors to injury and potential solutions and to document the first aid and emergency response in the immediate post-injury period, treatment and rehabilitation and any adverse outcomes.
- Conduct studies to investigate the contribution of alcohol to fatal and serious injury in boating related sport and recreational activities.
- Conduct an observation study to determine pre-intervention wearing rates of PFDs prior to the introduction of any mandatory wearing regulations.

References

Useful websites that provide safety and prevention information for boating-related recreation activities include:
http://www.marinesafety.vic.gov.au - the website of the MSV. It provides safety information for recreational boaters, advice on PFD use, and information for enthusiasts of specific activities such as kite surfing
http://ozpwc.com/ozpwc/home/safety.asp - the website of PWC Australia. It provides key messages for PWC safety, and education
http://www.biavic.com.au - the website of the Boating Industry Association of Victoria. It provides a safety equipment guide for vessels of varying sizes
http://www.mast.tas.gov.au - the website of Marine and Safety Tasmania. It provides both general safety information and specific information for recreational boaters
http://www.nmsc.gov.au - the website of the National Marine Safety Committee
http://www.safeboating.org.au - the website of the Australian and New Zealand Safe Boating Education Group, hosted by the Australian Maritime Safety Authority
http://www.amsa.gov.au - the website of the Australian Maritime Safety Authority


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Box 1. Methods of extracting boating related sport and recreational injury from hospital injury datasets

Data were extracted from the Victorian Admitted Episodes Dataset (VAED) and the Victorian Emergency Minimum Dataset (VEMD) using different methods due to database-specific coding issues.

The VAED records hospital admissions for all Victorian hospitals, both public and private. VAED data are coded using the World Health Organization International Classification of Diseases (ICD) coding system. Data for the period July 2000 to June 2002 are coded to ICD version 10. Boating-related sport and recreation injury was identified using the following ICD10 codes: ’V90-94′ covering “water transport”, but excluding cases associated with body surfing. As the focus of this report is recreational injury, cases with an activity code associated with ‘paid’ or ‘other work’ were excluded (n=18), as were intentional cases and cases where the intent was not specified.

The VEMD records public hospital presentations to 28 EDs, representing approximately 80% of statewide ED presentations. Narrative data were utilised to identify specific boating-related recreational injury cases, as there are no specific codes to identify cases. Keywords used in the search included: boat, canoe, catamaran, dinghy, jetski, kayak, kneeboard, parasail, PWC, sail, raft, rowing, scuba, snorkel, surf, tinny, wakeboard, waterski, windsurf and yacht (and spelling variations of these). As this report focuses on unintentional recreational injury, cases with an activity code denoting injuries in ‘paid’ or ‘other work’ were excluded, as were intentional cases or cases where intent was not specified. There were several categories of injury identified using this narrative search strategy that were out of scope of this review. They included injury cases that occurred in boat sheds; when a person was working/repairing a boat or boat building (model and otherwise); and non-specific skiing injury cases that occurred during the official snow skiing season (June to September).

Supplementary analyses of narrative data from VEMD-recorded hospital admissions for boating-related sport and recreation were performed to provide additional information on the circumstances of injury of hospitalised cases as the VAED records no narrative data.
**Injury in surf sports**

Karen Ashby and Damian Morgan

The Exercise, Recreation and Sport Survey (ERASS) conducted in Victoria in 2001/2 found that an estimated 58,000 Victorians participated in surf sports over the previous 12 months (SRV, 2003). Surf sports include board surfing, windsurfing and body surfing.

Hospitalised surf sport-related injuries were identified on the Victorian Admitted Episodes Dataset (VAED) using the ICD10 code ‘V90-94’ covering “water transport” and the fourth character subdivision .8 ‘Other unpowered watercraft (surfboard and windsurfer)’. The VAED could not identify injury associated with body surfing. Emergency Department (ED) presentations were selected from the Victorian Emergency Minimum Dataset (VEMD) if the 250-character text narrative ‘Description of Injury Event’ included the term “surf”, which identified board surfing, windsurfing and body surfing cases.

There were 148 hospital-treated injuries related to surf sports identified in the 2-year period July 2000 to June 2002 (28 admissions and 120 ED presentations), though this may be an under-estimate due to non-specified data. Males accounted for 86% of both admissions and presentations. Persons aged 15-29 years were over-represented in both admissions and presentations (57% and 50% of cases, respectively). A further 13% of admissions and 11% of presentations were aged 10-14 years.

**Hospital admissions (n = 28, annual average frequency 14)**

Twelve admissions for surf sports (not including body surfing) were recorded in 2000/01 and 16 in 2001/02. The head/face/neck was the most frequently injured body region (36%), followed by the lower extremity (25%) and trunk (25%). The major types of injuries were fractures (29%), open wounds (18%), and nerve/spinal injury (14%).

Fifty-seven percent of surf sport injury cases were admitted to hospital for less than 2 days, 29% stayed 2-7 days and 14% stayed 8-30 days. The four cases that had the longest stays were treated for multiple fractured vertebrae (2 cases), concussion and oedema of spinal cord (1 case), and hip dislocation (1 case).

VAED coding does not provide any detail of the circumstances of the injury, nor does it categorise surf sports separately. However, analysis of case narrative data for admissions recorded on the VEMD (n = 14) provides more details of the events surrounding these injuries. Most injuries (79%) were to surf board riders, and 21% were to windsurfers. The most commonly reported mechanism of injury was being “dumped” by a wave (21%).

**Hospital ED presentations (non-admissions) (n = 120, annual average frequency 60)**

Forty-seven presentations (non-admissions) were recorded in 2000/01 and 73 in 2001/02. Most surf sport injuries occurred in surf board riding (88%), followed by windsurfing (8%) and bodysurfing (4%).

The most commonly injured body regions were the lower extremity [28%, mostly foot and toe (12%) and knee injuries (6%)], head/face/neck (28%) and shoulder (13%). Sprains and strains were most frequently occurring types of injury accounting for 28% of presentations. Open wounds (27%), dislocation (10%) and fractures (9%) were also common. The most frequently occurring specific injuries were open wounds to the face (13% of surf sport presentations), and shoulder dislocations (8%).

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1 Damian Morgan is a PhD student at the Monash University Accident Research Centre investigating surf beach drowning. http://www.general.monash.edu.au/MUARC/hons/students.htm
The most common mechanism of injury reported was being struck by an object (44%), mostly a surfboard (22% of all surf sport injuries). Other mechanisms included falls (26%), being dumped by a wave (4%), colliding with another person (4%) and cutting/piercing (4%).

Many injury mechanisms, and resultant injury types, are common to the three surf sports discussed here (surfing, windsurfing, and body surfing), although the frequency of occurrence is likely to vary between activities. For board surfers, being hit by their own or another surfer’s board is the major mechanism of acute injury (Nathanson et al. 2002). Other mechanisms identified in Nathanson et al.’s study include: contact with the ocean floor; hydraulic wave energy; excessive body motion; and marine animal stings or bites. As for board riders, the commonest reported injury mechanism for windsurfers is contact with the board (Chalmers & Morrison, 2003). Injuries related to equipment involve the boom, footstrap and fins (Chalmers & Morrison, 2003). Wave dumping of inexperienced body surfers places them at risk of spinal injury or drowning (Hartung, 1990). Studies of specific surf sports injuries, mechanisms and treatments have also reported abdominal trauma and ocular injuries (Kim et al. 1998; Choo et al, 2002).

Precise data on exposure (time at risk) together with accurate injury data are required to determine the true injury rate for surf sports. These data are also needed to assess the extent to which the overrepresentation of injuries to males aged 15-29 years is a reflection of this subgroup’s exposure to surf sport activities.

A number of authors have discussed equipment modifications as an injury prevention strategy in surf sport activities (Kim et al. 1998; Choo et al, 2002; Navarro, 2001). The rounding of sharp edges on surfboard noses and fins is an obvious measure but will lack acceptance among users if equipment performance is reduced. Full body wetsuits also offer some protection. Based on the author’s observations (DM), specially designed protective equipment such as helmets, booties, eye goggles and gloves are not in common use among Victorian surf sport participants. Further research is required to determine the most effective strategies for promoting the acceptance of protective clothing and equipment and other potential injury prevention measures (such as surf beach education) among surf sport participants.

Discussion

The 1230km Victorian coastline includes 588 surf beaches and abundant surf breaks over sand bars, rocks, and reefs (Short, 1996). These surf spots, many within a day trip of Melbourne, provide a range of opportunities to learn and practice surf sports under varying wave and water conditions. Injury hazards manifest in surf sports stem from a combination of factors pertaining to environmental conditions (e.g., wave action), equipment used in performing the activity (e.g., surfboards), the activity itself (e.g., paddling), human interaction (e.g., crowding), and ocean-based hazards (e.g., stinging jellyfish) (Chalmers & Morrison, 2003; Nathan et al., 2002; Navarro, 2001).

The patterns of injury type, body location and mechanism found in this study is broadly similar to studies of surf sport injury in Victoria and elsewhere (Lowdon, 1983; Hartung, 1990; Nathanson et al. 2002). In this study, 30% of surf sports injuries requiring hospital treatment were to the head/face/neck body region; this finding accords with two previous studies that attributed 37% of surf sport injuries to this body region (Lowdon, 1983; Nathanson et al. 2002). The proportion of injuries to the lower extremities reported in this study (28%) fell between the figures reported by Lowdon et al. (21%) and Nathanson et al. (37%). Open wounds, sprains, strains and fractures were found to be common injuries requiring hospital treatment in our study. Similarly in Nathanson et al.’s study, based on self report (rather than hospital treated cases) from 1237 (mostly US) surfers, found that lacerations comprised 42% of acute injuries, followed by contusions (13%), sprains (12%) and fractures (8%).

Many injury mechanisms, and resultant injury types, are common to the three surf sports discussed here (surfing, windsurfing, and body surfing), although the frequency of occurrence is likely to vary between activities. For board surfers, being hit by their own or another surfer’s board is the major mechanism of acute injury (Nathanson et al. 2002). Other mechanisms identified in Nathanson et al.’s study include: contact with the ocean floor; hydraulic wave energy; excessive body motion; and marine animal stings or bites. As for board riders, the commonest reported injury mechanism for windsurfers is contact with the board (Chalmers & Morrison, 2003). Injuries related to equipment involve the boom, footstrap and fins (Chalmers & Morrison, 2003). Wave dumping of inexperienced body surfers places them at risk of spinal injury or drowning (Hartung, 1990). Studies of specific surf sports injuries, mechanisms and treatments have also reported abdominal trauma and ocular injuries (Kim et al. 1998; Choo et al, 2002).

Precise data on exposure (time at risk) together with accurate injury data are required to determine the true injury rate for surf sports. These data are also needed to assess the extent to which the overrepresentation of injuries to males aged 15-29 years is a reflection of this subgroup’s exposure to surf sport activities.

A number of authors have discussed equipment modifications as an injury prevention strategy in surf sport activities (Kim et al. 1998; Choo et al, 2002; Navarro, 2001). The rounding of sharp edges on surfboard noses and fins is an obvious measure but will lack acceptance among users if equipment performance is reduced. Full body wetsuits also offer some protection. Based on the author’s observations (DM), specially designed protective equipment such as helmets, booties, eye goggles and gloves are not in common use among Victorian surf sport participants. Further research is required to determine the most effective strategies for promoting the acceptance of protective clothing and equipment and other potential injury prevention measures (such as surf beach education) among surf sport participants.

References


The next VSCN network meeting will be held on Wed 7 April at 9.30 a.m. at VicRoads, 60 Denmark St., Kew Theme: Road Safety to celebrate World Health Day 2004 - Road Safety email for program: vscn.vscn@rch.org.au
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Access to coronial data and links with the development of the Coronal's Services statistical database are valued by VISAR.

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The advice and technical back-up provided by NISU is of fundamental importance to VISAR.

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VISAR data:
VISAR collects and analyses information on injury problems to underpin the development of prevention strategies and their implementation. VISAR analyses are publicly available for teaching, research and prevention purposes. Requests for information should be directed to the VISAR Co-ordinator or the Director by contacting them at the VISAR office.

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