Accident Analysis and Prevention 43 (2011) 447–450

Contents lists available at ScienceDirect

Accident Analysis and Prevention

journal homepage: www.elsevier.com/locate/aap

Developing a tool to measure safe recreational boating practice

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ARTICLE INFO

Article history:
Received 6 May 2010
Received in revised form 9 September 2010
Accepted 13 September 2010

Keywords:
Boating safety scale
Recreational boating safety
Recreational boater behaviour

ABSTRACT

To reduce the number of recreational boating injuries and incidents, appropriate educational measures are important to improve boat operator safety practice. A tool (the boating safety scale (BSS)) to measure safe practice was developed and tested among Western Australian recreational boaters. The BSS allowed the identification of factors influencing safety behaviour among recreational boaters. Using a database of registered recreational vessels, a telephone survey was conducted in 2008 among a sample of 1002 boat owners and a response fraction of 47.5% was achieved. The majority of boaters displayed a moderate level of safe boating behaviour based on BSS scores. Not being a member of a boating association and going boating less often in protected waters was associated with a higher level of boating safety behaviour. With further development, the BSS can provide information to assist is designing effective intervention strategies to reduce the number of boating-related fatalities, injuries and incidents.

1. Introduction

Recreational boating is a popular leisure activity and boat ownership has shown a consistent growth over recent decades, with more than 90,000 boats registered in Western Australia (WA) in 2009 (DOT, 2009). Due to increases in the number of boats and their usage, the potential for injuries and incidents also increase. Nationally it has been suggested that boating incidents cause more harm than rail and aviation accidents combined, and that boating was second only to road transport as a cause of transport-related injury (O'Connor, 2005). In WA is has been estimated that an average of five persons die and 126 new hospital admissions as the result of boating related incidents each year (Pikora, 2009).

To date several national and international studies have reviewed and assessed boating incidents and injuries thereby providing a list of factors that may contribute. These factors can be broadly classified into human, environmental, and boat/equipment related factors. The non-use of PFD's (Bell et al., 2000; Treser et al., 1997) is a common human contributing factor for recreational boating incidents and injuries. Environmental factors include hazardous wind or sea conditions (Ashby et al., 2007), restricted visibility, floating or submerged objects and poor bar conditions (O'Connor, 2008). The most common boat/equipment factors include machinery failure, inadequate stability and buoyancy (Cassell and Congiu, 2005), engine too big for vessel, and hull failure (O'Connor, 2008). Previous work indicates that human factors make a large contribution to recreational boating incidents followed by environmental and boat/equipment factors (Cassell and Congiu, 2005; O'Connor, 2008).

Given the reported prevalence of unsafe boating practices, it is important to develop methods to identify boaters prone to unsafe boating practices and/or risk taking behaviours that may assist in developing boating injury prevention interventions. In addition, such an assessment tool would be useful when researching individual differences related to sensation seeking/risk taking in boating. In this way, such a tool could be used to identify subpopulations and tailor safe boating behaviour education messages. The purpose of this study was to identify key boating safety practices and to develop a tool (the boating safety scale (BSS)) to assist in measuring safe boating practice among recreational boaters in WA.

2. Methods

The methods use for the survey have been published previously (Virk and Pikora, 2010). Briefly, using a database of all recreational vessels registered in WA that is maintained by the Marine Safety Business Unit at the WA Department of Transport (DOT), a random sample of 3000 registered recreational vessel owners was obtained which was further divided into segments based on vessel type and location. The metropolitan and regional split was so that the sample could reflect any differences in boater safety behaviour based on location. Using these 3000 boaters, a sample of 1002 adult boaters in both metropolitan ($n = 564$) and regional areas ($n = 438$) was recruited to participate in a telephone survey. The eligibility

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doi:10.1016/j.aap.2010.09.016

Table 1
Practices undertaken when preparing to go boating (prompted).

	(*n*)	Ideal frequency	Maximum score
Highly important safety practices			
Check fuel supply	(942)	Every time	15
General boat and equipment check	(905)	Every time	15
Check bucket or bailer	(725)	Every time	15
Check weather conditions	(896)	Every time	15
Log on	(353)	Every time	15
Inform someone of trip details	(766)	Every time	15
Moderately important safety practices			
Check EPIRB	(551)	Every time	10
Check anchor and line	(795)	Every time	10
Check flares	(739)	Every time	10
Check life jackets/PFD's	(872)	Every time	10
Check radio	(603)	Every time	10
Regularly service engine	(846)	Once a year	10
Show passengers safety equipment	(695)	Every time	10
Least important safety practices			
Check batteries	(749)	Every time	5
Check boat stability	(555)	Every time	5
Total			170

Table 2
Type of safety equipment carried on board (prompted).

	(*n*)	Maximum score
Highly important items		
Anchor and line	(573)	3
Bilge pump or bail bucket	(852)	3
Marine radio	(659)	3
Life jackets/PFD's	(976)	3
EPIRB	(637)	3
Visual distress signals	(876)	3
Moderately important items		
General maps	(399)	2
GPS	(554)	2
Navigation charts	(412)	2
Tool kit	(813)	2
Fire extinguisher	(696)	2
First aid kit	(696)	2
Safety rope	(811)	2
Least important items		
Cellular phone/mobile phone	(832)	1
Compass	(566)	1
Flashlights	(581)	1
Navigation lights	(594)	1
Equipment for reaching someone in the water	(652)	1
Ring/other throwable floatation device	(320)	1
Sound signals	(301)	1
Total		39

criteria for the survey were that they were WA residents and had a current registered recreational vessel with the DOT. The data was collected during February and March 2008 using a CATI (computer-assisted telephone interviewing) system. The University of Western Australia Human Ethics Committee provided ethics approval for the survey. The response fraction for the telephone survey was 47.5% (i.e., 1002 surveys/2109 calls (including 1034 refused, 16 language barriers, 57 screening)). The survey instrument used was patterned after previous surveys conducted in 2003 and 2006 and contained a total of 33 separate questions, including the items related to safe boating practice.

2.1. Boating safety scale measures

With assistance of expert opinion from staff at the DOT, the BSS was developed based on two questionnaire items: "*Which of the following would you do when preparing to go boating*" (prompted; included 15 items); and "*How often do you do this (every time, most times, occasionally, once a year, less than once a year)*"; "*Which safety equipment do you carry on board*" (prompted; included 20 items)? These items were included based on their importance towards the safety construct and the information they provide. The first 15 items dealt with safety knowledge and attitude and the other 20 items with the actions resulting from safety knowledge and attitude. In the safety knowledge and attitude items, the responses were "Yes" and "No" with "Every time", "Most times", "Occasionally", "Once a year" and "Less than once a year" the responses for actions.

Staff at the DOT provided expert opinion to identify and list each item in terms of its level of importance towards the safety construct, i.e., "Highly Important", "Moderately Important" and "Least Important" (Tables 1 and 2). Similarly, opinion was sought to describe the "Ideal Frequency" for each item (Table 1). In this study, "Highly Important" items (score = 3) were those that should always be checked and/or carried when going boating, irrespective of the location, while the "Least Important" items were those that are not as important irrespective of boating location (score = 1). "Moderately Important" were those items that fell between the highly and least important (score = 2).

Similarly "Ideal frequency" was the most accepted and most recommended frequency towards the safety construct for a particular item. For all the items reflecting safety knowledge and attitude, "Every time" was considered as the ideal frequency except for the item "Regularly service engines", in which case "Once a year" was the ideal frequency. Each item was assigned a value between one and five. For example if "Every time" is the ideal frequency for an item, then "Every time" = 5, "Most time" = 4, "Occasionally" = 3, "Once a year" = 2, and "Less than once a year" = 1. The ideal frequency for any item was assigned a maximum of five points. For example, the item "Regularly service engines", "Once a year" is the ideal frequency, therefore "Once a year" = 5, "Less than once a year" = 4 while the other items "Every time"/"Most times"/"Occasionally" = 5 (Table 1).

For the 15 items related to boat safety knowledge and attitude, the importance based score for each item was multiplied with the frequency for that item. The individual scores for each of the 15 items were then summed and a total score for each respondent's boat safety knowledge and attitude was obtained. The maximum score was 170 (Table 1).

For the other 20 items, only importance based scores were calculated as the frequency of these items was not obtained. The maximum score obtained was 39 (Table 2). These scores represented two different safety constructs, one boat safety knowledge and attitude of the vessel owners while the other represented actions taken by owners based on their boat safety knowledge and attitude. To give equal weighting to the constructs, a percentage out of 100 was calculated for each construct and these were summed to provide a final BSS as a percentage of the respondent's score out of 200.

2.2. Data analysis

Statistical Package for the Social Sciences (SPSS) version 14 for Windows was used to analyse the data. Descriptive analyses were undertaken using frequencies and cross-tabulations and χ^2 test statistics were used to examine any associations between variables. A series of logistic regression analyses were conducted to investigate the association between obtaining a high BSS score ($\geq$83.67) and the demographic variables and boating characteristics. The first regression analysis was a single factor model in which each factor was considered in isolation. The final model included only those factors that were significant ($p < 0.05$).

Table 3
Descriptive analysis of the boating safety (BSS) score.

Boating safety score	%
Mean	68.18
Standard error of mean	0.604
Standard deviation	19.13
Median	70.93
Maximum score	100.00
Minimum score	6.09
Quartiles	
25th (lower quartile)	55.35
50th (median)	70.93
75th (upper quartile)	83.67

3. Results

The BSS score was calculated as a percentage with the range between 6% and 100% and a mean of 68% (Table 3). Higher scores indicate a higher level of boating safety behaviour. For the purpose of the analysis, the BSS score was divided into quartiles (<55.35, 55.35–70.92, 70.93–83.66 and ≥83.67).

The odds of obtaining a high BSS score (≥83.67) were significantly associated ($p < 0.05$) with type of vessel, frequency of boating, location go boating most often and membership of a boating association (Table 4). Compared with those who had "Open boat" vessel, those with "Cabin" (OR 0.33; 95% CI 0.20–0.54) and "Half cabin" (OR 0.33; 95% CI 0.19–0.57) vessels were three times less likely to achieve a high score (≥83.67). Compared with those who went boating less often (i.e., less than once a week), recreational boaters who boated more often were less likely to obtain a high score (OR 0.59; 95% CI 0.36–0.95 boating once a week and OR 0.55; 95% CI 0.32–0.94 boating more than once a week). Interestingly, those who went boating in areas other than protected waters were less likely to achieve a high BSS score (OR 0.61; 95% CI 0.41–0.90 for inshore ocean waters and OR 0.30; 95% CI 0.20–0.45 for offshore ocean waters). In addition, members of a boating association were less likely to obtain a high score (OR 0.55; 95% CI 0.38–0.77) than non-members.

4. Discussion

The aim of this study was to measure safe recreational boating practice using the BSS. The mean BSS score among the recreational boaters was 68% and median was 71% indicating that the majority of the boaters scored more than 50% and that the majority displayed a moderate level of boating safety behaviour.

After adjusting for age, a higher level of boating safety behaviour (i.e., BSS score ≥83.67) was significantly associated with not having membership of a boating association and going boating less often in protected waters. In addition, "open boat" vessels were more likely to obtain a higher score (BSS ≥83.67) when compared with

Table 4
Multivariate analysis of boaters who scored high (≥83.67) compared with those who scored low (<83.67) on boating safety scale (BSS).

Factors	(*n*)	Single Factor		Final Model		95% CI
		OR	*p*-Value	OR	*p*-Value	
Demographic characteristics						
Age	(996)	1.00	0.489	1.01	0.445	(0.99–1.01)
Boating characteristics						
Type of vessel	(1002)					
Open boat	374	1.00		1.00		
Runabout	267	0.81	0.303	0.95	0.820	(0.62–1.44)
Cabin	118	0.24	0.000	0.33	0.000	(0.20–0.54)
Half cabin	77	0.25	0.000	0.33	0.000	(0.19–0.57)
PWC	40	1.89	0.241	2.06	0.196	(0.68–6.19)
Centre consol	37	0.38	0.011	0.64	0.258	(0.29–1.38)
Yacht	33	0.28	0.001	0.47	0.067	(0.20–1.05)
Other	56	0.97	0.930	1.08	0.845	(0.50–2.31)
Activities	(1002)					
Fishing	683	1.00		[a]		
Cruising/motoring	190	0.78	0.177			
Water sports	85	3.32	0.002			
Other	44	1.17	0.669			
Overall boating experience	(992)					
11+ years	741	1.00		[a]		
6–10 years	132	1.35	0.184			
≤5 years	119	2.45	0.001			
Frequency of boating	(1002)					
Every couple of weeks	362	1.00		1.00		
Once a month	224	1.02	0.918	0.84	0.428	(0.54–1.29)
Less than once a month	187	1.33	0.204	0.86	0.536	(0.53–1.38)
Once a week	132	0.70	0.116	0.59	0.031	(0.36–0.95)
More than once a week	97	0.58	0.030	0.55	0.029	(0.32–0.94)
Location go boating	(1002)					
Protected waters	404	1.00		1.00		
Inshore ocean waters	339	0.54	0.001	0.61	0.014	(0.41–0.90)
Offshore ocean waters	259	0.23	0.000	0.30	0.000	(0.20–0.45)
Member boating association	(1002)					
No	735	1.00		1.00		
Yes	267	0.38	0.000	0.55	0.001	(0.38–0.77)
Obtained RST qualification	(1002)					
Yes	694	1.00		[a]		
No	308	1.41	0.038			
Completed any boating education	(998)					
Yes	760	1.00		[a]		
No	238	0.32	0.000			

OR, odds ratio; CI, confidence interval.
[a] Factor not significant in final model.

cabin and half cabin vessels. This finding needs to be interpreted with caution as it may reflect that more of these vessels were in the sample. Those who went boating more often (i.e., once a week or more) were less likely to obtain higher score (BSS ≥83.67) when compared with those who went boating less frequently. This suggests that those who go boating more frequently are more likely to score lower for safety behaviour that may reflect that these boaters might not actually check items at the suggested rates due to higher levels of familiarity and recent use of their vessel. Similarly, boaters who go in open waters compared with protected waters were less likely to report higher levels of safety behaviour. It could be because of personality differences, with higher risk taking boaters going to open waters for boating. However, these findings necessitate further exploration. Surprisingly, membership of a boating association was associated with obtaining a lower safety score (BSS <83.67) suggesting that they are less safe on the water. These findings may reflect that increased confidence that is gained through experience may result in less safety seeking behaviour among the boaters (Bell et al., 2000).

These results can assist when selecting sections among the boating community to target and tailor boating safety promotion messages. Based on Diffusion of Innovations Theory, 10–20% of laggards within the community are slower at adopting safety practices (Rogers, 1983). This slow uptake may be due to monetary or time constraints, or with feelings of complacency. Therefore, it is important to identify different groups within the boating community and to target and adapt boating safety messages to suit the needs of each group.

4.1. Strengths and limitations

The strength of this study is the development of a BSS to measure safety behaviour among recreational boaters that will provide guidance in developing and tailoring education strategies to suit different target groups.

There are some limitations to this study. The first was the reliance on self-reported data that may have resulted in boaters over-reporting safe boating practices due to social desirability and fear factors. However, previous studies investigating boater behaviour have collected self-reported data (Miller and Pikora, 2008; Pelot et al., 2004). Another limitation is that the sampling frame included only registered vessel owners and that information about passengers and other people who rent and/or borrow the vessel was not collected. This was because the database used only provided contact information for vessel owners. However, databases of registered vessel owners have also been used in previous recreational boater surveys (Howland et al., 1996; Mello and Nirenburg, 2004; Pelot et al., 2004; Penaloza, 1992).

There are limitations related to the development of the BSS. To measure boating safety practice requires a valid and reliable instrument. The selection of questionnaire items used when developing the scale was based on a review of previous studies and expert opinion from DOT staff. Further development and testing of this scale is highly recommended. Secondly, not all the factors that may reflect safe boating practice were included in the scale due to the historical nature of the questionnaire. Further work is recommended to determine whether additional or substituted items will strengthen the scale. These may include items related to knowledge and the appropriate use of safety items as well as standard operating procedures across a range of situations (such as inclement weather, injuries, and emergencies). Thirdly, there was limited reliability analyses carried out due to time constraints and it is recommended that future use of the BSS include more comprehensive reliability and validity testing. It is also recommended that future use of the BSS may also include outcome measures including linking to fatalities and injuries, as well as vessel damage and near misses. This was not possible in the current study due to the low number of these events reported among the boaters included in the sample. However, the results from this study provide the first objective record of information related to safe boating practices among recreational boat owners and the use of such measures is recommended in future studies.

5. Conclusion

The boating safety scale is still at the development stage and research is warranted to further develop, test and improve the BSS. With additional development, the use of such a scale would assist in identifying subpopulations of recreational boaters who are more likely to participate in unsafe recreational boating safety practices. The provision of this type of information would assist in designing more effective intervention strategies to reduce the number of boating-related fatalities, injuries and incidents.

Acknowledgements

This research was undertaken as a part of the marine safety program of research conducted at the School of Population Health at the University of Western Australia for the Marine Safety Business Unit at the Department of Transport, Western Australia. The authors acknowledge the contributions of the staff at the Marine Safety Business Unit at DOT for providing advice and support for the study as well as the participants who completed the survey. The views presented in this paper are those of the authors and do not necessarily reflect the views of the funding organization.

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