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Risk of Drowning: The "Iceberg Phenomenon" Revisited

Kevin Moran

Three decades ago, Schuman and colleagues (1977) used the visual metaphor of an iceberg whose underwater base contained a substantial layer of self-reported incidents that posed a serious threat to life so as to illustrate the true extent of the risk of drowning. This present study uses the iceberg metaphor to explore the magnitude of that risk among youth. In addition to describing the fatal and nonfatal drowning incidents at the visual tip of the iceberg, the study presents data from surf rescue records and survey data on exposure to risk and incidence of a life-threatening submersion experience. Most youth had participated in some swimming (98%) or other aquatic activity (94%), and more than one third (37%) reported having had a life-threatening submersion experience. Significantly more females had experienced such an incident (females 41%, males 34%). For one third of youth (30%), the experience had made them more cautious around water, but most (66%) reported no aversive effect. The author discusses the value of the iceberg phenomenon as a visual metaphor of the risk of drowning and its implications on the education of young people.

Fatal and nonfatal drowning statistics are often used in drowning prevention advocacy as indicators of the magnitude of the problem and its cost to society. Globally in 2004, 175,000 children under the age of 20 years drowned and, for children under the age of 14 years, WHO global annual estimates for nonfatal drowning range from two and three million (World Health Organisation, 2008). It has been estimated that for each fatal drowning, between one and four nonfatal events are serious enough to warrant hospitalization (Meyer, Theodorou, & Berg, 2006). The true extent of submersion incidents that may precipitate or constitute a drowning episode is probably much higher than estimates based on mortality and morbidity alone.

While the WHO recommends that outcomes of submersion injury be classified as death, morbidity, and no morbidity (Van Beeck, Branche, Szpilman, Modell, & Bierens, 2005), little is known about the latter category, those who experience a life-threatening drowning incident but who are not hospitalized or who are released from medical care before becoming a public health statistic. Some evidence of the extent of no-morbidity submersion injury is available from rescue statistics. For example, Szpilman (1997) reported that 94% of surf rescue victims requiring medical treatment postrescue were released directly from the site after initial medical

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care. Little is known about those victims who experience a life-threatening incident yet are never reported as “public health” or “rescue” statistics.

From the outset, it is important to note that recent changes in terminology around the concepts of drowning and near-drowning impact on this study and current definitions necessitate reemphasis before proceeding. As a consequence of much expert debate, notably at the World Congress on Drowning in Amsterdam, 2002 and via its associated World Task Forces on Drowning, the WHO adopted recommendations that defined drowning as a process rather than an outcome (Idris et al., 2003; Van Beeck et al., 2005). In adopting a new definition of drowning as “the process of experiencing respiratory impairment from submersion/immersion in liquid” (Van Beeck et al., 2005, p. 854), the term *near-drowning* previously used to describe a nonfatal drowning incident was no longer recommended for use. Unfortunately, the term *near drowning* is still frequently and inappropriately used in the media and in public parlance to describe potentially fatal, drowning-related incidents. For the purpose of this study that seeks to illustrate the true extent of risk of drowning using nonreported as well as “official” data, incidents where victims were at serious risk of drowning are to be referred to as *life-threatening submersion experiences* (LTSEs).

More than 30 years ago, Schuman, Rowe, Glazer, and Redding (1977) used the visual metaphor of an iceberg to explore just how many people are subjected to serious risk of drowning without necessarily experiencing submersion, aspiration, or hypoxia (see Figure 1). The illustration identifies mortality and morbidity as the visual tip of the iceberg above water, underpinned below the water surface by rescue statistics, and nonreported, no-morbidity drowning episodes that further define the extent of risk of drowning. Schuman et al. (1977) noted that 15% of South Carolina school children reported experiencing a “near miss” at least once in the previous year. Others (Verbrugge, 1986; Verbrugge & Ascione, 1987) have used the iceberg metaphor to describe people’s health and injury morbidity, with data that included not only deaths and hospital treatment but also visits to health professionals, self-treated symptoms, and daily symptoms. Kelly and Miles-Doan (1997) used Verbrugge’s “iceberg of morbidity” concept to explore the impact of social inequality on the base of the iceberg (representing day-to-day injuries that prompt self-care or no care).

Recent evidence suggests that the risk of drowning may be greater than that described by Schuman et al. (1977). A recent water safety survey of 1,000 American adults found that almost half (48%) of the respondents reported an experience where they “nearly drowned” (American Red Cross, 2009). McCool, Moran, and Ameratunga (2006), investigating perception of drowning risk among more than 3,000 adult beachgoers in the Auckland region, found that one third (30%) reported having had a life-threatening submersion experience. Gulliver and Begg (2005) noted that males reported most (63%) of the 141 self-reported submersion incidents among 1,000 21-year-old New Zealand young adults. Little is known about the extent of life-threatening submersion experiences among youth, a group universally recognized as being at high risk of drowning. Furthermore, how young victims are extricated from this life-threatening episode and what subsequent impact such an incident may have has not been the subject of study. Some studies have considered the aversive impact of previous experience of a life-threatening submersion on water phobia (Graham & Gaffan, 1997; Poulton, Menzies, Craske,

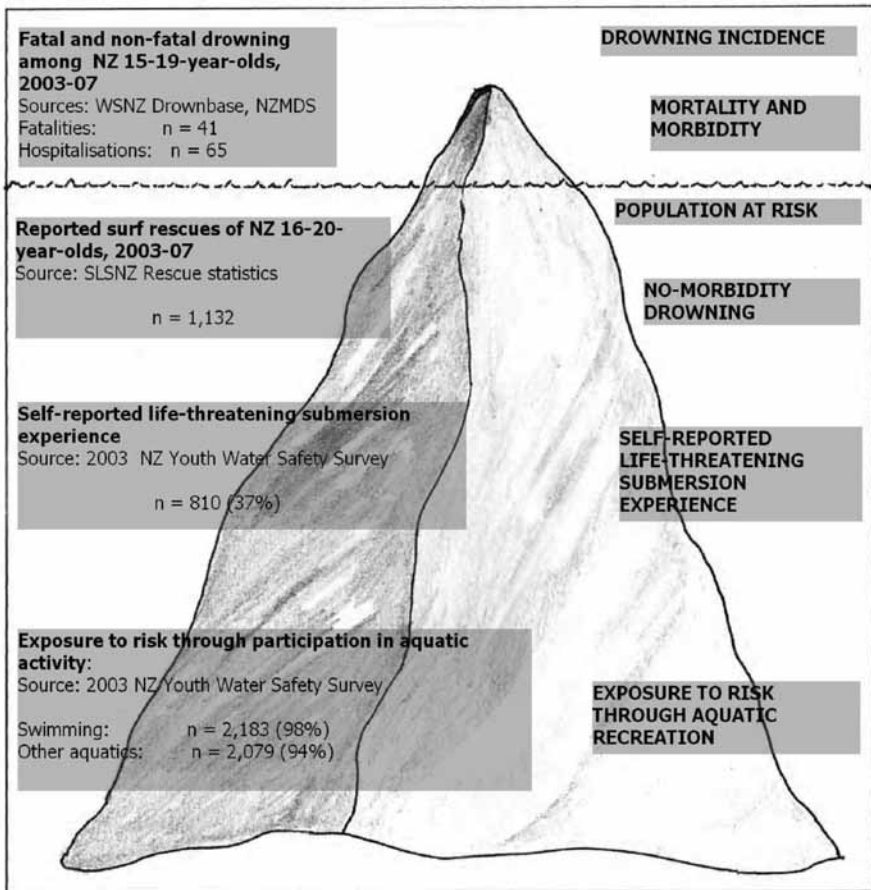


Figure 1 — The risk of drowning iceberg (Schuman et al., 1977).

Langley, & Silva, 1999), but little is known about how such experience might shape continuing participation in aquatic recreational activity or the subsequent practice of water safety. It is the purpose of this paper to examine youth risk of drowning with reference to not only evidence from the tip of the iceberg consisting of mortality, morbidity, and rescue data, but also the self-reported incidence of life-threatening submersion experiences and exposure to risk that constitutes the base of the drowning risk iceberg.

Method

Four sources of data have been used to identify the extent of drowning risk among New Zealand youth for the 5-year period from 2003-2007. Fatal drowning (mortality) statistics were obtained from Water Safety New Zealand's Drownbase™, a

comprehensive, multiple-source, and integrated database (WSNZ, 2009). Nonfatal drowning incidents (with morbidity) were obtained from NZ Ministry of Health hospitalization data and comprised of records of publicly funded hospital discharges with any reported ICD 10-AM injury codes W65-W74 (accidental drowning and submersion), excluding Emergency Department stays of less than 24 hours. These two sources comprise the visible tip of the risk iceberg (see Figure 1).

In addition, rescue statistics from the annual rescue reports of Surf Life Saving New Zealand (SLSNZ) were included so as to provide evidence of the extent of life-threatening submersion experiences necessitating rescue among youth in the beach/surf environment (B. Sullivan, SLSNZ, personal communication, July 10, 2009). The use of rescue data to further illustrate the extent of drowning risk is justified on the basis that surf beaches are a popular site of youth aquatic recreation with most New Zealand youth visiting patrolled (76%) and nonpatrolled (68%) surf beaches as previously reported (Moran, 2008).

Beneath these upper layers of “official” data, two further sources of evidence from the New Zealand Youth Water Safety Survey (Moran, 2003) have been included in the base of the iceberg, namely self-reported exposure to risk and life-threatening submersion experiences. Information on exposure to risk was not included in Schuman’s original risk of drowning iceberg (Schuman et al., 1977), but the concept is central to an understanding of the epidemiology of drowning incidence and frequently used to explain why some population subgroups have higher injury rates than others (Roberts, Norton, & Taua, 1996). The nature and extent of exposure to risk of drowning among youth has already been reported in a previous *International Journal of Aquatic Recreation and Education* article (Moran, 2008) and thus the data on exposure to risk only will be reported here (see Figure 1) as indicative of a further refinement of Schuman’s original iceberg metaphor (Schuman et al., 1977). The following methodology will thus focus on previously unreported evidence of youth life-threatening submersion experience and its consequences.

Survey Population

Information on the incidence of youth life-threatening submersion experience and their exposure to risk as a consequence of aquatic activity were obtained as part of a national water safety survey (Moran, 2003). As previously reported (Moran, 2008), the participants in this study were a nationwide sample of 2,202 youth, 4% of a target population of approximately 50,000 year-11 students in New Zealand. All participants (age range 15–19 years, $M = 15$ years 8 months, $SD = 1.85$) were enrolled in full time study in 41 high schools throughout New Zealand.

Instrumentation

A written questionnaire was reviewed by a panel of experts to establish content validity and pilot studies undertaken to ascertain reliability (Moran, 2008). The survey was completed under the direction of survey administrators during school hours in the second (autumn) school term in 2003. Participants were asked if they had ever been really afraid that they might drown. If they had experienced such a situation, they were then asked to complete a supplementary question as to how they got out of difficulty (self-rescue, friends/family help, bystander help, lifeguard

rescue, or some other form of rescue aid). Finally, students were asked to report on how their experience had affected them in terms of subsequent water-related activity and whether they were now too afraid to take part, had continued to take part but with greater caution, or whether they were not affected by the experience and had continued to confidently take part in water activities.

Data Analysis

Data were analyzed using the socio-demographic variables of gender, socioeconomic status via the decile rating of the school attended, and ethnicity. For ease of interpretation, socioeconomic status is reported in three categories: low-decile, mid-decile, and high-decile school rating, a standard government evaluation based on a range of sociodemographic indicators such as average income per household, that correspond to low, middle, and high socioeconomic status. Ethnic groupings were broadly based on Statistics New Zealand classification and included European, Maori, Pacific Islands (hereafter called Pasifika), Asian, and a category for those who self-identified as of "other" ethnicities than those specified.

Data from the completed questionnaires were entered into Microsoft Excel X for statistical analysis using SPSS Version 16.0 in Windows. Frequency and percentages were used to report on the sociodemographic differences in self-reported incidence of life-threatening submersion experiences. Chi-square statistics were used to test associations between gender and frequency of drowning experience. Mann-Whitney *U* tests (for two independent samples) and Kruskal-Wallis *H* tests (for multiple samples) were used to determine significant differences between sociodemographic grouping factors (such as ethnicity and socioeconomic status) and effects of life-threatening experience on continued participation in aquatic activity.

Results

Figure 1 illustrates the iceberg metaphor using New Zealand statistics related to the youth population. In the five years from 2003–2007, a total of 41 New Zealand youth aged 15–19 years succumbed as a result of drowning. Of these, 66% of victims were male, most incidents occurred at rivers ($n = 23$; 56%) or at beaches/tidal waters ($n = 9$; 22%), and most of the fatal incidents ($n = 30$; 73%) were recreation related (Drownbase™; WSNZ, 2009). A further 65 nonfatal drowning incidents occurred in the five years from 2003–2007 where victims were hospitalized after a submersion incident (New Zealand Ministry of Health). As was the case with drowning fatalities among this age group, most nonfatal victims were males ($n = 54$; 83%).

During that same 5-year period, 1,132 incidents necessitating rescue from the surf among 16–20-year-olds were reported by SLSNZ (B. Sullivan, SLSNZ, personal communication, July 10, 2009). Males comprised the greater proportion of youth rescues ($n = 701$; 62%). In most cases ($n = 1084$; 96%), the young victims did not require medical treatment and were released from the site after the rescue details had been recorded. A small proportion ($n = 48$; 4%) required further medical attention or assistance via ambulance to hospital emergency care ($n = 29$; 3%), referral to a doctor ($n = 7$, 0.06%), or with lifeguard assistance from the beach ($n = 12$; 1%).

Evidence from the New Zealand Youth Water Safety Survey, as previously reported (Moran, 2008), indicated that in terms of exposure to risk at the base of the iceberg, almost all youth had taken part in swimming activity ($n = 2183$; 98%) or other aquatic activity such as surfing, boating, and fishing ($n = 2079$; 94%) in the previous year (see Figure 1). Table 1 shows that more than one-third of youth reported having had a life-threatening submersion experience ($n = 810$; 37%). Of these, more than half reported self-rescue ($n = 431$; 53%), friends had been involved in one third of the rescues ($n = 270$; 33%), and bystanders, lifeguards, or others ($n = 109$; 14%) had effected the remainder of the rescues (see Table 1).

Significant differences were found when the incidence of life-threatening submersion experience was analyzed against gender, $\chi^2(1) = 11.777$, $p = < .001$, but not against socioeconomic status and ethnicity. More females reported having had a life-threatening submersion experience (females 41%, males 34%). More males reported self-rescue from the life-threatening situation (males 60%, females 46%), while more females reported being rescued by friends/family members (females 39%, males 28%) and by bystanders, lifeguards, or others (females 15%, males 12%).

Table 2 shows the effect of the life-threatening submersion experience on subsequent participation in aquatic activity. A small proportion of students were too afraid to take part in water-based activities ($n = 31$; 4%), while almost a third still took part but with caution ($n = 245$; 30%). Two thirds ($n = 534$; 66%) of students

Table 1 Incidence of Life-Threatening Submersion Experience and Mode of Rescue by Gender, Socioeconomic Status via Decile Rating of School Attended, and Ethnicity

	Life-Threatening Submersion Experience		Mode of Rescue					
			Self-Rescue		Friends		Others	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Male	393	33.6	237	60.3	109	27.7	47	11.9
Female	417	40.4	194	46.5	161	38.6	62	14.9
Low-decile	233	37.0	119	51.1	80	34.3	34	14.5
Mid-decile	246	38.6	113	45.9	97	39.4	36	14.6
High-decile	331	35.5	199	60.1	93	28.1	39	11.8
European	490	36.6	281	57.3	149	30.4	60	12.2
Maori	140	34.5	62	44.3	53	37.9	25	17.8
Pasifika	90	44.1	44	48.9	33	36.7	13	14.5
Asian	70	34.0	37	52.9	25	35.7	8	11.4
Other	20	43.4	7	35.0	10	50.0	3	15.0
Total	810	36.8	431	53.2	270	33.3	109	13.5

Table 2 Effect of Life-Threatening Submersion Experience on Subsequent Aquatic Activity by Gender, Socioeconomic Status via Decile Rating of School Attended, and Ethnicity

Groups Affected by Life-Threatening Submersion Experience	Too Afraid to Take Part <i>n</i> (%)	Take Part With Caution <i>n</i> (%)	Take Part Confidently <i>n</i> (%)
Male	16 (4.1)	104 (26.5)	273 (69.5)
Female	15 (3.6)	141 (33.8)	261 (62.6)
Low-decile	18 (7.7)	71 (30.3)	144 (61.8)
Middecile	7 (2.8)	73 (29.6)	166 (67.5)
High-decile	6 (1.8)	101 (30.4)	224 (67.7)
European	13 (1.5)	127 (25.9)	350 (71.4)
Maori	5 (3.6)	40 (28.6)	95 (67.9)
Pasifika	6 (6.7)	36 (40.0)	48 (53.3)
Asian	6 (8.6)	32 (45.7)	32 (45.7)
Other	1 (5.0)	10 (50.0)	9 (45.0)
Total	31 (3.8)	245 (30.2)	534 (65.9)

reported that they had not been seriously affected by the experience and continued to take part confidently in aquatic activity. Mann-Whitney *U* testing found no significant differences when the impact of the life-threatening experience on continued participation in aquatic activity was analyzed against gender ($U = 76654.5$, $p = 0.055$). More females indicated they were cautious as a result of the experience (females 34%; males 27%), whereas more males reported that they continued to participate unaffected by the experience (male 70%; females 63%).

Kruskall-Wallis nonparametric statistical tests found no significant differences between socioeconomic status and the impact of the experience on continued aquatic activity: $\chi^2(2) = 4.023$, $p = 0.134$. Significant differences were found when the impact of these life-threatening experiences was analyzed by ethnicity: $\chi^2(4) = 27.53$, $p = \leq .001$). Table 2 shows that proportionally more Pasifika and Asian students than European and Maori students reported that the experience had had a cautionary effect on their subsequent aquatic activity (40% and 46% compared with 26% and 29%, respectively). In contrast to this, more European and Maori students than Pasifika and Asian students reported that the experience had not affected their current aquatic practice (71% and 68% compared with 53% and 46%, respectively).

Discussion

By utilizing the visual metaphor of the risk of drowning originally conceived by Schuman et al. (1977) and adopting a more comprehensive view of the risk of drowning than that portrayed by mortality and morbidity data alone, this study has

found that the magnitude of that risk among youth may be considerably greater than anticipated. An average loss of 8 young lives and 12 hospitalizations per annum through drowning is, in itself, a stark indicator of the magnitude of the risk of drowning in a small aquatically-oriented country such as New Zealand. The inclusion of other data beneath the surface of this visible tip of the risk iceberg makes the need for further drowning prevention interventions even more compelling. The inclusion of surf rescue data in the risk iceberg (see Figure 1), while not inclusive of all aquatic rescue data (such as coastguard and police rescues), revealed that 27 times as many youth had been rescued from the surf alone as had drowned or had been hospitalized in all drowning-related incidents from 2003–2007. While only a small proportion (4%) of rescues from the surf required further medical intervention, that more than 1,000 youth were extricated from a situation considered serious enough by lifeguards to warrant their direct intervention is further grounds to consider that the risk of drowning among youth is a cause for concern. Furthermore, the prevalence of males in fatal drowning (66%), drowning-related hospitalizations (83%), and rescue statistics (62%) suggests that drowning prevention interventions might be best targeted at young men.

In addition to the official mortality, morbidity, and rescue statistics contained within the upper echelons of the risk iceberg, self-reported survey data reported in this study found that more than a third (37%) of youth had had a life-threatening submersion experience, reaffirming earlier claims by Schuman et al. (1977) that actual drowning figures are only the tip of the drowning iceberg. Recent evidence from a survey of 1,000 adults in the U.S. also found that the magnitude of the problem may be greater than imagined, with one in every two adults (48%) having reported a life-threatening submersion experience (American Red Cross, 2009). In addition, this survey also found that almost half (46%) of these experiences occurred between the ages of 11–20 years reiterating the findings of the present study that adolescence is indeed a high risk time for many youth around water.

When analyzed by gender, more females than males reported having had a life-threatening submersion experience (females 40% vs. males 33%). Previous analysis by the author (Moran, 2008) found no significant association between the higher incidence of near misses among females and possible greater exposure to risk environments, increased at-risk behaviors, or poorer protective abilities (such as swimming, rescue, and CPR skills). Gulliver and Begg (2005) found that a greater proportion of males reported higher levels of life-threatening submersion experiences among Dunedin 21-year-olds (males 63%; females 37%). Similarly, a study of 3,371 adult Auckland beachgoers also found significantly more males than females (males 53%; females 47%) reported having experienced a life threatening incident (McCool et al., 2006). Two age-related reasons might account for this gender-related difference in findings. First, unlike the 15–19-year-old youth in this present study, older male youth in the Dunedin study (21-year-olds) may have made more use of high-risk environments and thereby experienced more life-threatening incidents. Secondly, a heightened sense of vulnerability to harm reported among 15–19-year-old females (Moran, 2008) may reflect greater emotional immaturity when compared with the slightly older females in the Dunedin young adult study (21-year-olds) and the Auckland adult beachgoers study (16–19-year-olds). Other studies on youth risk that relate to drug/alcohol use, sexual behavior (Parsons, Siegel, & Cousins, 1997), and driv-

ing (Mundt, Ross, & Harrington, 1992) also have reported heightened sense of risk among 15–19-year-old females.

When youth were asked to describe how they were extricated from the life-threatening submersion experience, most (53%) reported that they managed to get out of difficulty on their own. One third (33%) reported that they had been rescued by friends and relatively few had been rescued by lifeguards or bystanders (14%). Similarly small proportions of rescues by lifeguards or trained personnel have been reported in other studies. Of 1,000 adult respondents in an American Red Cross water safety poll (2009), more than one third (37%) of rescues were self-effected, 48% involved family or friends, and only 10% involved lifeguards. In a study of surf beach users along the south-east Australian coastline, Morgan, Ozanne-Smith, and Triggs (2009) also found few self-reported incidences of rescues and no significant difference in the number of males and females reporting being rescued by surf lifeguards (males 6%; females 5%). That so many rescues appear to involve people other than trained lifeguards is a cause for concern given that those assisting may be placing themselves and the victim at even greater risk of drowning. In light of this evidence, current advocacy by lifesaving and water safety organizations of safe bystander rescue techniques appear to be very prudent.

Contrary to popular belief about the likely effects of life-threatening submersion experiences on water phobia, experience of such an incident did not appear to have any substantial aversive effect on continued aquatic activity. Relatively few (4%) were too fearful to take part in any further aquatic activity. Poulton et al. (1999) found that only 5% of Dunedin 18-year-olds with water phobias had experienced difficulties in water that necessitated rescue. They concluded that specific aversive experiences were not of major importance in the genesis of fear of water. Similar conclusions could be drawn from the present study, given that the incidence of experiencing dangerous aquatic situations was relatively common among youth, yet the fear of further participation affected so few.

In addition to having a minimal aversive impact on continued participation, previous experience of a life-threatening incident did not appear to result in a more cautious approach to water activity. Two-thirds (66%) of youth continued to take part in aquatic activity with confidence, while less than a third of students reported that the experience had made them more cautious (30%). More female than male students reported that the experience had made them more cautious (females 34%, males 27%), the possible consequence of heightened sensitivity toward drowning risk among females and/or male underestimation of risk as reported in other studies (Howland, Hingson, Mangione, Bell, & Bak, 1996; McCool, Ameratunga, Moran, & Robinson, 2009; McCool, Moran et al., 2008).

Limitations

Results from this study should be interpreted with some caution in light of several methodological limitations. First, using data from varied sources to extrapolate the risk of death by drowning of a specific age group has limitations, especially when databases use different demographic variables. For example, surf rescue statistics classify youth as being aged 16–20 years, whereas the New Zealand Water Safety Survey (Moran, 2003) identified youth as being aged 15–19 years. In addition, while “official” drowning-related statistics used in this study have been aggregated

over the same time period (2003–2007), the data on self-reported life-threatening submersion experiences and exposure to risk relate only to the year prior to the cross-sectional survey (in 2003). These limitations notwithstanding, Figure 1 provides a comprehensive image of the risk of drowning among youth in a New Zealand context.

Second, the use of self-reported health behaviors (such as exposure to risk and life-threatening submersion experiences) may not accurately reflect the true incidence of such events (Robertson, 1992). Furthermore, the possibility of varied interpretation as to what constitutes a life-threatening submersion experience, especially among an immature age group such as youth, may also limit the application of findings. Further research is required to confirm whether the apparently extensive occurrence of incidents where youth are subjected to serious risk of drowning is an accurate reflection of the true risk of drowning and whether the magnitude of that risk is replicated among other demographic groups.

Third, the use of surf rescue statistics as a proxy measure of no-morbidity drowning episodes may not adequately reflect the true extent of drowning risk via rescue at other sites (for example, lakes and rivers) or other activities (for example, boating and sailing). Finally, given the cross sectional nature of the survey that provided the evidence of submersion experiences and exposure to risk of drowning, the associations observed in this study cannot be assumed to be either causal or predictive but only relational.

Conclusion

In an early attempt to describe the magnitude of the risk of drowning in society, Schuman and colleagues employed the visual metaphor of an iceberg to estimate the frequency of what was then referred to as *near-drowning*, using the term in its broadest sense to signify a life-threatening submersion experience (Schuman et al., 1977). Their epidemiological findings provided baseline information on risk of drowning not previously available and in the process revealed a problem of unsuspected magnitude.

The application of the iceberg metaphor to the risk of drowning among New Zealand youth using additional evidence of surf rescue statistics, self-reported, life-threatening submersion incidents, and evidence of the high risk of exposure as a consequence of frequent aquatic recreation, suggests that the true risk of drowning may be greater than previously estimated from mortality and morbidity statistics alone. Surprisingly, even though one-third of youth reported experiencing a life-threatening incident in water, the experience did not appear to have a strong aversive affect on subsequent participation in aquatic recreation. Some, notably females and Asian students, thought that they were more cautious as a consequence of the experience, but most continued to participate confidently in aquatic activity. Fewer males reported similar caution, reinforcing previous suggestions that changing the mindset of male youth will continue to be the most challenging of all drowning prevention initiatives.

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