Accident Analysis and Prevention 98 (2017) 259–265

Contents lists available at ScienceDirect

Accident Analysis and Prevention

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

Alcohol and its contributory role in fatal drowning in Australian rivers, 2002–2012

Amy E. Peden[a,b,*], Richard C. Franklin[a,b], Peter A. Leggat[b,c]

[a] Royal Life Saving Society – Australia, PO Box 558, Broadway, NSW, 2007, Australia
[b] College of Public Health, Medical and Veterinary Sciences, Division of Tropical Health and Medicine, James Cook University, Townsville, QLD, 4811, Australia
[c] Research School of Population Health, College of Medicine, Biology and Environment, Australian National University, Canberra, ACT, 2601, Australia

ARTICLE INFO

Article history:
Received 26 June 2016
Received in revised form 3 October 2016
Accepted 7 October 2016

Keywords:
Drowning prevention
Alcohol
Rivers
Epidemiology
Risk factors
Injury prevention

ABSTRACT

Objective: Examine the prevalence of alcohol and its contributory role in unintentional fatal river drowning in Australia to inform strategies for prevention.
Methods: Cases of unintentional fatal river drowning in Australia, 1-July-2002 to 30-June-2012, were extracted from the National Coronial Information System. Cases with positive alcohol readings found through autopsy or toxicology reports were retained for analysis. Discrete analysis was conducted on cases with a Blood Alcohol Content (BAC) of ≥0.05% (0.05 grams of alcohol in every 100 millilitres of blood).
Results: Alcohol was known to be involved in 314 cases (40.8%), 279 recorded a positive BAC, 196 (70.3%) recorded a BAC of ≥0.05%. 40.3% of adult victims had a BAC of ≥0.20%. Known alcohol involvement was found to be more likely for victims who drowned as a result of jumping in ($\chi^2 = 7.8$; $p < 0.01$), identify as Aboriginal and Torres Strait Islander ($\chi^2 = 8.9$; $p < 0.01$) and drowned in the evening ($\chi^2 = 7.8$; $p < 0.01$) and early morning ($\chi^2 = 16.1$; $p < 0.01$) hours.
Discussion: The number of people who drown with alcohol in their bloodstream is concerning and challenging for prevention. To assist with the prevention of alcohol related river drowning improved data quality, as well as a greater understanding of alcohol's contribution and consumption patterns at rivers (especially those <18 years of age) is required.
Conclusion: Alcohol contributes to fatal unintentional drowning in Australian rivers. Although prevention is challenging, better data and exposure studies are the next step to enhance prevention efforts.

1. Introduction

Internationally, alcohol has been identified as a risk factor for injuries (Smith and Kraus, 1988) including drowning (Wentworth et al., 1993; Kauffman, 1992; Lasbeur et al., 2010; Howland et al., 1990; Lunetta et al., 2004; Patetta and Biddinger, 1988). Drinking whilst engaging in activities in or near the water is common (Hingson and Howland, 1993) and alcohol use is known to result in a lack of coordination, greater risk taking behaviour, impaired reaction time and impaired judgement among other effects (Chellew and Franklin, 2009).

Alcohol has been identified as a key challenge for the prevention of drowning, particularly drowning deaths as a result of recreational activities (David et al., 2010) (Driscoll et al., 2004a). Estimates of the proportion of drowning cases known to involve alcohol vary from 22 to 25% of recreational aquatic activity related drownings in Australia (Driscoll et al., 2004b) (Franklin et al., 2010), 30–40% of unintentional fatal drowning in New Zealand (Warner et al., 2000), 47% of cases in an alcohol study group in Maryland, United States (Dietz and Baker, 1974) and 63% of water traffic accident fatalities in Finland (Lunetta et al., 1998).

In Australia an average of 293 people per annum die due to unintentional drowning (Australian Water Safety Council, 2016). Alcohol has been previously identified as being present in 21.6% of cases of unintentional drowning in Australia between 2002 and 2007 (Franklin et al., 2010) and its involvement in drowning has prompted the Australian Water Safety Council (AWSC) to identify the reduction of alcohol and drug related deaths as a key priority for achieving an overall 50% reduction in drowning by the year 2020 (Australian Water Safety Council, 2016, 2012).

* Corresponding author at: Royal Life Saving Society – Australia, PO Box 558, Broadway NSW 2007, Australia.
E-mail address: apeden@rlssa.org.au (A.E. Peden).

http://dx.doi.org/10.1016/j.aap.2016.10.009
0001-4575/

More broadly, alcohol related harm is a public health issue, with consumption a known risk factor for a range of health conditions (Ogeil et al., 2015), as well as mortality and morbidity due to injuries from falls, poisoning (Girasek et al., 2002), suicide (particularly among Indigenous people) (Calabria et al., 2010) and road traffic incidents (Chikritzhs et al., 2000). The total cost per annum to the Australian society of alcohol related problems in 2010 was estimated to be $14.352 billion (Manning et al., 2013), placing a huge strain on the health system (Gao et al., 2014). To address this, public health approaches to prevention have been incorporated into several strategies including the *National Binge Drinking Strategy* which aims to address Australia's harmful binge drinking culture (with a particular focus on young people), through education, restricting availability and age or intoxication based restrictions on entering licensed venues (Lam et al., 2015; Australian Government DoH, 2013). Similarly, the *National Drug Strategy 2010–2015* aims to reduce harm as a result of alcohol and other drugs through demand, supply and harm reduction (Ministerial Council on Drug Strategy, 2011). These strategies may have an impact on drowning prevention through reduced supply and the promotion of a more responsible drinking culture, although to date this impact is unproven.

The involvement of alcohol poses challenges for the prevention of drowning such as: accessing quality data on the involvement of alcohol; the impact of decomposition and determining true levels of alcohol consumed prior to death (Wintemute et al., 1990); exposure; risk factors; and effectiveness of prevention strategies (Driscoll et al., 2004a, 2004c; Warner et al., 2000; Hadley and Smith, 2003; Peden et al., 2016a).

Studies to date on alcohol and drowning have focused on Blood Alcohol Content (BAC) levels ranging from 0.05% to 0.10% as markers of a contributory role in fatal drowning (Driscoll et al., 2004a). This study examines all river drowning deaths with positive readings for alcohol, with a particular focus on those deaths with a BAC of ≥0.05%. As a BAC of ≥0.05% has been shown to impact concentration, reaction times and risk-taking behaviour, as well as being legislated as the upper legal limit for driving a motor vehicle (Health NSW, 2013) in all Australian states and territories, this level has been deemed to be contributory to drowning for this study.

To develop more effective drowning prevention strategies, an understanding of the risk factors at specific aquatic locations and the role of alcohol is required (Peden et al., 2016a). Although rivers are known to be the location with the largest numbers of fatal drowning in Australia (Peden et al., 2016b), this study represents the first population level analysis of the prevalence of alcohol involvement in river drowning (Peden et al., 2016a).

This paper aims to:

- Identify the burden of alcohol related unintentional fatal drowning in Australian rivers, creeks and streams between 2002 and 2012.
- Explore the circumstances of drowning in rivers where alcohol was deemed to have been a contributory factor.
- Propose strategies for the prevention of alcohol related drowning deaths.

2. Methods

Data on unintentional fatal drowning in Australian rivers, creeks and streams (henceforth referred to as rivers), was collected for a 10 Australian financial year period (1 July to 30 June). The data in this study spans 1 July 2002 to 30 June 2012 and was sourced from the Australian National Coronial Information System (NCIS). The NCIS is an online registry which records information on all sudden and unexpected deaths in Australia. Due to a lack of specificity within ICD location codes (Peden et al., 2016a), cases of unintentional fatal drowning in rivers were determined by using the location coding of 'stream of water' within the NCIS. Cases were also included if the location as discussed in the police report and/or finding document satisfied the following definition: "...a natural waterway that may be fed from other rivers or bodies of water draining water away from a 'catchment area' to another location..." and "...can vary in water flow, length, width and depth..." (Peden et al., 2016a; Royal Life Saving Society – Australia, 2014).

Variables collected included age, sex, activity prior to drowning, time of day, day of the week, month and season of drowning, pre-existing medical conditions, involvement of alcohol and drugs, geographical location of residence and incident, tourist status and Indigenous status (Royal Life Saving Society, 2014). Indigenous status refers to those known to be Aboriginal, Torres Strait Islander or both Aboriginal and Torres Strait Islander.

Within the 'activity prior to drowning' variable; 'swimming and recreating' includes both competitive and unstructured swimming, wading, floating and paddling in water; and 'non-aquatic transport' relates to vehicles not intended to be used in the water, such as cars, trucks, motorbikes, and bicycles etc.

Information on alcohol involvement was sourced from the toxicology and/or autopsy reports (where available) within the NCIS. Where a victim recorded a positive BAC reading, a 'yes' was recorded for alcohol involvement. Where known, the BAC level was recorded in a second variable. BAC readings were coded to two decimal places (rounding up at five – e.g. 0.015% was recoded as 0.02%). Alcohol involvement was deemed contributory to the drowning where the victim recorded a BAC of ≥0.05% (that is 0.05 grams of alcohol in every 100 millilitres of blood) (Australian Drug Foundation, 2016).

The season in which the drowning death occurred was categorised as: Summer (December, January, February), Autumn (March, April, May), Winter (June, July, August) and Spring (September, October, November). The time of drowning incident was coded into four broad groupings for analysis: early morning (12:01a.m.–6a.m.), morning (6:01a.m.–12p.m.), afternoon (12:01p.m.–6p.m.) and evening (6:01p.m.–12a.m.). Drowning rates per 100,000 population were calculated using population data from the Australian Bureau of Statistics (ABS) (Australian Bureau of Statistics., 2014).

Visitor status was calculated by determining the distance, in kilometres, between the residential and drowning incident postcodes. Distance was determined using Google Maps (Google, 2016). A distance of 100 km or less was classified as 'Not A Visitor'; those who resided within the same State or Territory with a distance greater than 100 km were classified as an 'Intrastate Visitor'; those who drowned in a different State or Territory from where they resided were classified as 'Interstate Visitors' and overseas residents were classified as 'International Tourists'.

The remoteness classification of an incident postcode is calculated based on a range of factors including distance and isolation from major services. Remoteness classification was coded using the Australian Standard Geographical Classifications (ASGC) and calculated using the Doctor Locator website, which provides ASGC classifications by inputting a postcode (Australian Government Department of Health, 2010).

For the analysis of children and adult river drowning deaths, children were defined as those aged 0–17 years and adults were defined as being aged 18 years and over. When examining the role of alcohol in victims with BACs of 0.05% or higher, only cases of adult drowning victims were utilised for analysis. For cases where children recorded positive readings for alcohol, case files were interrogated to record, in a new variable, whether alcohol was known to have been consumed or was likely to have been as a result of decomposition.