

# Acute alcohol use and suicide deaths: an analysis of New Zealand coronial data from 2007–2020

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## ABSTRACT

**AIMS:** Acute alcohol use is a proximal risk factor for suicide. However, the proportion of suicide deaths involving acute alcohol use has not been quantified in New Zealand. We sought to quantify and characterise the association between acute alcohol use and suicide.

**METHODS:** Data for all suicides ( $\geq 15$  years) between July 2007 and December 2020 were drawn from the National Coronial Information System. Acute alcohol use was defined as blood alcohol concentration (BAC)  $>50\text{mg}/100\text{mL}$ . Logistic regression was used to compare characteristics between suicide deaths with and without acute alcohol use.

**RESULTS:** Twenty-six point six percent of suicide deaths involved acute alcohol use. No difference in the association was found by sex (male AOR: 0.87 (95%CI: 0.74,1.02)). Ethnicity differences were identified (Māori AOR: 1.20 (95%CI: 1.01,1.42), Pacific AOR: 1.46 (95%CI: 1.10,2.00)). Those aged 15–54 years had similar risks of suicide involving acute alcohol use, with a lower association in older age groups.

**CONCLUSIONS:** Acute alcohol use was identified in approximately one quarter of suicides, with stronger associations in those of Māori and Pasifika ethnicity, and those aged  $<55$  years. Acute alcohol use is a significant but modifiable risk factor for suicide in New Zealand.

Acute alcohol use is a known proximal risk factor for suicide,<sup>1</sup> and has been shown to significantly increase risk of suicide attempt, particularly at high levels of acute consumption.<sup>2</sup> For suicide deaths, reviews find the prevalence of acute alcohol use range from 10% to 69%, differing by population demographics including age and sex.<sup>3</sup> Alcohol may neurocognitively trigger suicide attempts by increasing impulsivity and disinhibition,<sup>4</sup> weakening psychological barriers to suicide attempts,<sup>5</sup> or by increasing despair, and cognitively impairing efforts to mitigate despair.<sup>6</sup> Acute use of alcohol is associated with use of more lethal suicide means,<sup>4,5</sup> and may potentiate the effects of other drugs consumed in overdose,<sup>3</sup> thereby reducing the likelihood of surviving an attempt. These findings suggest that acute alcohol use should be a focus for suicide prevention.

Recent coronial data studies in Australia and South Korea provide data about characteristics of acute alcohol use in suicide.<sup>7–9</sup> In Australia, around one quarter (26.7%) of suicide decedents had a blood alcohol concentration (BAC) of  $\geq 0.05\text{g}/100\text{mL}$  (the legal drink-driving limit in Australia); alcohol use prior to suicide was associated with male sex and use of more lethal means.<sup>7</sup> In South Korea, a study of 683 suicide decedents

found that almost one third (28.7%) had a BAC  $\geq 0.08\text{g}/100\text{mL}$  (the legal drink-driving limit in that country, and defined as “intoxication”); acute alcohol intoxication was associated with having no underlying medical or psychiatric diagnosis.<sup>8</sup> This negative association between intoxication and psychiatric history has also been identified in Australia: alcohol use prior to suicide was associated with acute stress (e.g., relationship breakdown), but not with psychiatric illness.<sup>9</sup> These studies suggest that acute alcohol use may increase impulsive suicide risk in those without psychiatric risk factors but who are exposed to an acute stressor.

Suicide is a significant public health issue in New Zealand. The suicide rate in June 2021 was 11.6/100,000 population.<sup>10</sup> This rate is higher for Māori (15.8/100,000), and for those aged 15–24 (11.4 and 22.2 per 100,000 for females and males, respectively).<sup>10</sup> The World Health Organization emphasises that almost one in five of all suicides can be attributed to alcohol use,<sup>11</sup> highlighting alcohol policy as a point of intervention for reducing suicide.<sup>12</sup> Not targeting alcohol represents a missed opportunity for suicide prevention efforts.<sup>13</sup> This is pertinent, as New Zealand has high levels of alcohol use; 80% of New Zealanders  $\geq 15$  years have drunk alcohol in the past year;

20% drink at hazardous levels.<sup>14</sup> However, the relationship between alcohol and suicide has not been examined systematically in New Zealand, and the national Suicide Prevention Strategy fails to identify alcohol harm reduction strategies as a means of suicide prevention.<sup>15</sup>

We sought to inform suicide prevention by improving understanding of a potentially significant and modifiable risk factor, using New Zealand-specific data. The objective of this research was to quantify and characterise the association between acute alcohol use and suicide death in New Zealand, to provide a baseline against which future interventions or trends can be assessed. Specifically, we asked: 1) how prevalent is acute alcohol use within suicide deaths in New Zealand; 2) has the proportion of suicides involving acute alcohol use changed over time, and 3) what are the characteristics of suicides involving acute alcohol use?

## Methods

Data were drawn from the National Coronial Information System (NCIS), which compiles cases from the Coronial Service of New Zealand. This project was approved by the University of Otago Human Research Ethics Committee (HD20/102) with a second level of review and approval by NCIS (NZ019).

### Case identification and inclusion criteria

New Zealand suicide data are available from NCIS for 1 July 2007 onwards. Cases were extracted from this date to 31 December 2020, with the search last run on 7 September 2021. Eligibility criteria were closed cases, coded in NCIS as intentional self-harm (i.e., suicide), where the person was  $\geq 15$  years at death. The rationale for this age cut-off recognises that suicidal intent differs in individuals, and while intent may be determined in children as young as 12,<sup>16</sup> the World Health Organization uses 15 as the lower age group in global statistics and reporting. As cases can take up to two years to be closed, not all suicide deaths from 2019 and 2020 were included in the sample of eligible cases. NCIS reports quarterly on case closure percentages across all deaths,<sup>17</sup> based on information provided by the Coronial Services of New Zealand; the report for all deaths (not specific to suicide) that most closely matches the data collection period of this study was published on 1 October 2021, and it indicated that case closure percentages for 2019 and 2020 at that time were

70.5% and 55.8%, respectively. Inclusion criteria were then applied in the following sequence:

1. Is toxicology data available?
2. Was alcohol measured in blood post-mortem in toxicological analysis?
3. If an additional ante-mortem blood sample was taken, post-mortem and ante-mortem samples must concur.
4. If decomposition was noted, alcohol concentration must also have been confirmed through measurement in vitreous humour.

The rationale for criterion 4 (above) is that alcohol can be produced endogenously through decomposition; however, vitreous humour is less prone to microbial invasion and post-mortem effects.<sup>18</sup> These criteria are consistent with those of a recent Australian study,<sup>7</sup> and facilitate comparison of results.

### Characteristics of suicide deaths

The following characteristics were extracted, primarily using NCIS-coded data with any missing data searched for in the linked coronial reports:

- Age – age in years at death, subsequently grouped into ten-year intervals
- Sex – female, male
- Employment status – employed, unemployed, student, retired/pensioned, other (including categories of home duties, prisoner, still enquiring, child not at school), unknown
- Marital status – Never married, widowed, divorced/separated, married/de facto, unknown
- Ethnicity – European, Māori, Pacific peoples, Asian, Middle Eastern/Latin American/African, other ethnicity (consistent with 2018 Census ethnic group summaries)<sup>19</sup>
- Method of death – as follows, based on International Classification of Diseases ICD-10-AM code;
  - Poisoning – X40-X49, X60-X69, X85-X90, Y10-Y19
  - Hanging – W75-W84, X70, X91, Y20
  - Drowning – W65-W74, X71, X92, Y21
  - Firearm – W32-W34, X72-X74, X93-X95, Y22-Y24
  - Sharp object – W25-W29, X78, X99, Y28
  - Falls – W00-W19, X80, Y01, Y30

- Other – W22-W23, X00, X30-X31, X75-X79, X81-X84, Y23, Y31
- Year of death.

Risk factors such as mental health history, chronic pain, or financial problems are not coded in NCIS. These factors were therefore excluded from analyses, because it cannot be assumed that the absence of these factors in Coronial or police reports means that they were not present.

Post-mortem BAC was extracted from toxicological and coronial reports and then dichotomised as:

- No acute alcohol use – BAC  $\leq$ 50mg/100mL of blood
- Acute alcohol use – BAC  $>$ 50mg/100mL of blood.

This categorisation is consistent with the current legal BAC for adults (20 years and older) when driving in New Zealand (i.e., 0.05%). As a sensitivity test, analyses were run using two additional BAC levels to define acute alcohol use:  $>$ 30mg/100mL (where some individuals may show signs of impairment) and  $>$ 80mg/100mL (New Zealand's legal driving limit until December 2014). Whether alcohol was identified in NCIS records as a contributory cause of death was also determined by use of ICD-10-AM codes (F10.0, F10.1–10.9, R78.0, T51, X45 or X65) and searching for the word “alcohol” at all levels of the cause of death fields. If any one of these codes was identified, we deemed alcohol had been identified as a contributory cause of death. In many instances, blood alcohol was the only toxicological test on record. Therefore, data on other psychoactive substances were not extracted.

### Statistical analysis

Statistical analysis was conducted in Stata (version 16.1 for Windows).<sup>20</sup> Fields with  $n < 5$  were blinded to minimise risk of individuals being identified, with associated cell counts suppressed to prevent blinded cells from being calculated.

For each year of the study period, the proportion of suicide deaths involving acute alcohol use was calculated, to avoid the effects of population change over that time. Data are presented visually, without statistical analysis. These data are included to enable assessment of any future intervention relative to baseline trends.

To test for differences between included and excluded cases, and to compare characteristics of suicide deaths with and without acute alcohol use,

logistic regression modelling was undertaken. Multivariate logistic regression models were used to compute unadjusted and adjusted odds ratios (OR, AOR; 95% CIs) controlling for the effects of all other significant variables (age, sex, employment status, marital status, ethnicity and method of death).

### Results

Between 1 July 2007 and 31 December 2020, 6,072 New Zealanders aged  $\geq$ 15 years died by suicide and had NCIS records. No toxicology data were available for 651 cases (10.7%); no measurement of BAC was undertaken post-mortem ( $n=235$ ; 3.9%); ante-mortem and post-mortem BAC levels did not concur ( $n=4$ ; 0.1%); and decomposition was noted but alcohol concentration was not confirmed in vitreous humour ( $n=524$ ; 8.6%). These 1,414 cases were, therefore, excluded leaving a total sample of 4,658 cases (76.7%) eligible for inclusion. The percentage of cases excluded per year of the study period are shown in Supplementary Table 1.

Table 1 compares characteristics of excluded and included cases. There was no significant difference between excluded and included cases in relation to sex. Older age groups were less likely to be included than those aged 15–24. Those who were widowed were less likely to be included than those who were never married, while those who were married were more likely to be included.

Of included suicides, 1,238 (26.6%) involved acute alcohol use, BACs are shown in Table 2.

Figure 1 shows the proportion of suicides involving acute alcohol use across the 14-year study period. This fraction ranged from 21.7% to 33.3% across the 14 years (2007–2020), with no clear trend over time.

Of the 1,238 suicides involving acute alcohol use, 416 (33.6%) were coded in NCIS as alcohol being a contributory cause of death (the most commonly identified codes were F10.0 (acute alcohol intoxication) and F10.1 (harmful use of alcohol)). In addition, 154 suicides where acute alcohol use was not identified (BAC  $\leq$ 50mg/100mL) also had alcohol coded as a contributory cause of death, occurring predominantly in the context of alcohol dependence and/or a low level of BAC considered contributory to a poly-drug overdose.

The characteristics of suicides without and with acute alcohol use are described in Table 3. The proportion of suicides involving acute alcohol use declined with increasing age; however,

**Table 1:** Descriptive characteristics of included cases compared to excluded cases and results of logistic regression modelling showing characteristics associated with inclusion.

Characteristic		Excluded n (%)	Included n (%)	OR (95% CI)	AOR (95% CI)
Age	15–24	240 (18.2)	1,081 (81.8)	REF	REF
	25–34	236 (22.0)	836 (78.0)	0.79 (0.64–0.96) *	0.73 (0.59–0.91) **
	35–44	239 (23.0)	802 (77.0)	0.75 (0.61–0.91) **	0.67 (0.54–0.85) **
	45–54	279 (23.7)	897 (76.3)	0.74 (0.59–0.87) **	0.64 (0.51–0.81) ***
	55–64	208 (26.7)	571 (73.3)	0.61 (0.49–0.75) ***	0.56 (0.43–0.72) ***
	65–74	7 (25.9)	20 (74.1)	0.63 (0.27–1.52)	0.62 (0.25–1.54)
	75+	205 (31.3)	451 (68.8)	0.49 (0.39–0.61) ***	0.61 (0.42–0.90) *
	<b>Sex</b>	<b>Female</b>	<b>360 (22.9)</b>	<b>1,211 (77.1)</b>	<b>REF</b>
	Male	1,054 (23.4)	3,447 (76.6)	0.97 (0.85–1.11)	0.97 (0.84–1.12)
<b>Employment status</b>	<b>Employed</b>	<b>602 (22.3)</b>	<b>2,101 (77.7)</b>	<b>REF</b>	<b>REF</b>
	Unemployed	377 (23.2)	1,248 (76.8)	0.95 (0.82–1.10)	1.01 (0.87–1.17)
	Student	83 (18.2)	372 (81.8)	1.28 (1.00–1.66)	1.11 (0.84–1.49)
	Retired/ pensioner	240 (32.3)	504 (67.7)	0.60 (0.50–0.72) ***	0.71 (0.52–0.96) *
	Other	47 (16.8)	233 (83.2)	1.42 (1.03–1.97) *	1.48 (1.06–2.06) *
	Unknown	65 (24.5)	200 (75.5)	0.88 (0.66–1.18)	0.95 (0.71–1.29)
<b>Marital status</b>	<b>Never married</b>	<b>610 (24.0)</b>	<b>1,930 (76.0)</b>	<b>REF</b>	<b>REF</b>
	Widowed	82 (34.3)	157 (65.7)	0.61 (0.46–0.80) ***	1.07 (0.77–1.49)
	Divorced/ separated	224 (25.8)	646 (74.3)	0.91 (0.76–1.09)	1.20 (0.99–1.46)
	Married/ de facto	410 (19.5)	1,695 (80.5)	1.31 (1.13–1.50) ***	1.66 (1.41–1.95) ***
	Unknown	88 (27.7)	230 (72.3)	0.83 (0.64–1.07)	0.97(0.74–1.27)

**Table 1 (continued):** Descriptive characteristics of included cases compared to excluded cases and results of logistic regression modelling showing characteristics associated with inclusion.

Characteristic		Excluded n (%)	Included n (%)	OR (95% CI)	AOR (95% CI)
<b>Ethnicity</b>	<b>European</b>	<b>1,023 (24.4)</b>	<b>3,174 (75.6)</b>	<b>REF</b>	<b>REF</b>
	Māori	258 (20.8)	983 (79.2)	1.23 (1.05–1.43) **	0.93 (0.78–1.10)
	Pacific peoples	61 (23.3)	201 (76.7)	1.06 (0.79–1.43)	0.79 (0.58–1.07)
	Asian	62 (19.8)	252 (80.3)	1.31 (0.98–1.74)	1.14 (0.85–1.53)
	Middle Eastern/Latin American/African	5 (19.2)	21 (80.8)	1.35 (0.51–3.60)	1.18 (0.44–3.18)
	Other ethnicity	5 (15.6)	27 (84.4)	1.74 (0.67–4.53)	1.74 (0.66–4.62)
<b>Method of death</b>	<b>Poisoning</b>	<b>369 (28.4)</b>	<b>932 (71.6)</b>	<b>REF</b>	<b>REF</b>
	Hanging	746 (20.4)	2,911 (79.6)	1.55 (1.34–1.79) ***	1.34 (1.15–1.57) ***
	Drowning	33 (28.7)	82 (71.3)	0.98 (0.65–1.50)	1.02 (0.67–1.57)
	Firearm	119 (25.0)	358 (75.1)	1.19 (0.94–1.51)	1.13 (0.88–1.45)
	Sharp object	38 (31.2)	84 (68.9)	0.86 (0.59–1.31)	0.83 (0.55–1.25)
	Falls	38 (22.8)	129 (77.3)	1.34 (0.92–1.97)	1.24 (0.84–1.83)
	Other	71 (30.5)	162 (69.5)	0.90 (0.67–1.22)	0.83 (0.61–1.13)

NB: Multivariate logistic regression models were used to compute both unadjusted odds ratios (OR), and adjusted odds ratios (AOR) controlling for the effects of all other significant variables (age, sex, employment status, marital status, ethnicity and method of death). Data are reported with 95% confidence intervals (CI). REF – reference group. \* p<0.05, \*\* p<0.01, \*\*\* p<0.001.

the 65–74 age group data could not be reported due to small numbers. The fraction of male and female suicides involving acute alcohol use were almost identical. Of these, males were 26.5%; median BAC 142mg/100mL; interquartile range 101–188mg/100mL); and females were 26.7%; median BAC 155mg/100mL; interquartile range 109–203mg/100mL). Māori (32.3%) and Pacific peoples (35.3%) had higher proportions of suicides involving acute alcohol use than Europeans (25.4%) and Asians (11.9%).

Table 4 summarises the logistic regression model comparing suicide deaths with and without acute alcohol use, and shows ORs for each independent variable, unadjusted and adjusted

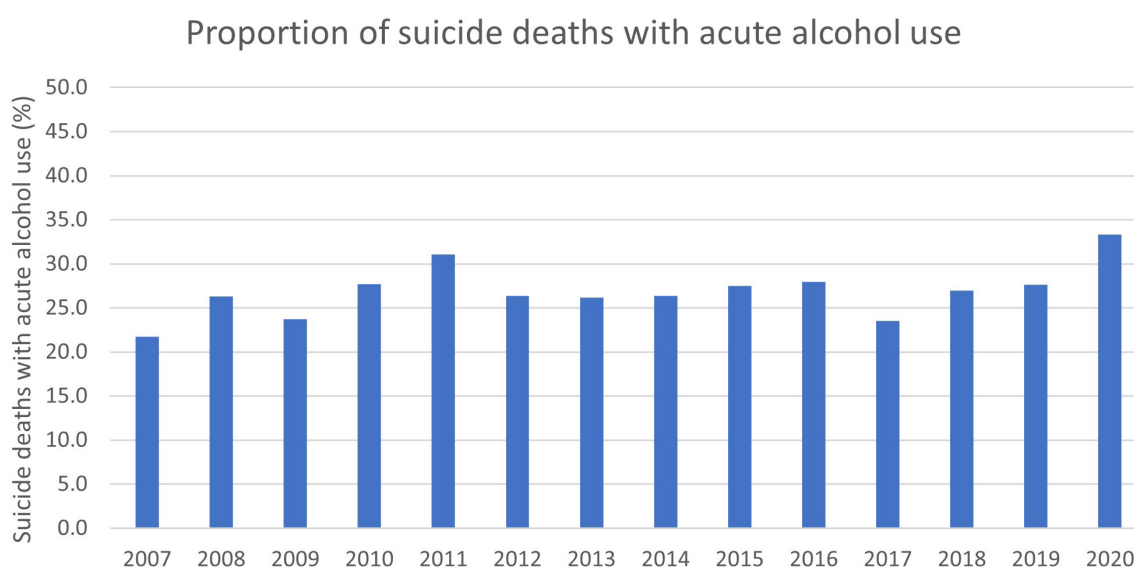
(for age, sex, employment status, marital status, ethnicity, suicide means). This analysis confirms the association between suicide involving acute alcohol use, and between being young/middle aged (<55 years), employed, of Māori or Pacific ethnicity, and using hanging as the suicide method. Overall, there was minimal effect on the ORs after adjustment, except for being widowed (120 (76.4%) of those who were widowed were aged 75+). Sensitivity tests of the two additional BACs utilised for logistic regression modelling are presented in the Supplementary File; there was a minimal impact on the ORs; however, some covariates showed an alteration in significance level.

**Table 2:** Identified blood alcohol concentrations (BAC) in included suicide deaths.

BAC range	n	%
≤50mg/100mL	3,420	73.4%
51–100mg/100mL	289	6.2%
101–150 mg/100mL	363	7.8%
151–200 mg/100mL	322	6.9%
mg/100mL	175	3.8%
> 250mg/100mL	89	1.9%

NB: BAC – blood alcohol concentration reported in milligrams per 100 millilitres of blood.

**Figure 1:** The proportion of suicide deaths with acute alcohol use from 2007–2020 (shown as a percentage by year) show no consistent increasing or decreasing trend over the study period.



**Table 3:** Characteristics comparison between suicide deaths without and with acute alcohol use (AAU).

Characteristic		No AAU n (%)	AAU n (%)	Total
Age	15–24	771 (71.3)	310 (28.7)	1,081
	25–34	572 (68.4)	264 (31.6)	836
	35–44	553 (69.0)	249 (31.0)	802
	45–54	656 (73.1)	241 (26.9)	897
	55–64	448 (78.5)	123 (21.5)	571
	65–74	Blinded for confidentiality	n<5	20
	75+	404 (89.6)	47 (10.4)	451
<b>Sex</b>	<b>Female</b>	<b>888 (73.3)</b>	<b>323 (26.7)</b>	<b>1,211</b>
	Male	2,532 (73.5)	915 (26.5)	3,447
<b>Employment status</b>	<b>Employed</b>	<b>1,439 (68.5)</b>	<b>662 (31.5)</b>	<b>2,101</b>
	Unemployed	911 (73.0)	337 (27.0)	1,248
	Student	296 (79.6)	76 (20.4)	372
	Retired/pensioner	448 (88.9)	56 (11.1)	504
	Other	185 (79.4)	48 (20.6)	233
	Unknown	141 (70.5)	59 (29.5)	200
<b>Marital status</b>	<b>Never married</b>	<b>1,393 (72.2)</b>	<b>537 (27.8)</b>	<b>1,930</b>
	Widowed	125 (79.6)	32 (20.4)	157
	Divorced/separated	467 (72.3)	179 (27.7)	646
	Married/de facto	1,272 (75.0)	423 (25.0)	1,695
	Unknown	163 (70.9)	67 (29.1)	230

**Table 3 (continued):** Characteristics comparison between suicide deaths without and with acute alcohol use (AAU).

Characteristic		No AAU n (%)	AAU n (%)	Total
<b>Ethnicity</b>	<b>European</b>	<b>2,368 (74.6)</b>	<b>806 (25.4)</b>	<b>3,174</b>
	Māori	665 (67.7)	318 (32.3)	983
	Pacific peoples	130 (64.7)	71 (35.3)	201
	Asian	222 (88.1)	30 (11.9)	252
	Middle Eastern/ Latin American/African	Blinded for confidentiality	n<5	21
	Other ethnicity	17 (63.0)	10 (37.0)	27
<b>Method of death</b>	<b>Poisoning</b>	<b>722 (77.5)</b>	<b>210 (22.5)</b>	<b>932</b>
	Hanging	2,044 (70.2)	867 (29.8)	2,911
	Drowning	67 (81.7)	15 (18.3)	82
	Firearm	272 (76.0)	86 (24.0)	358
	Sharp object	71 (84.5)	13 (15.5)	84
	Falls	110 (85.3)	19 (14.7)	129
	Other	134 (82.7)	28 (17.3)	162

NB: Results are not shown when numbers are less than five (n<5) and related cells are blinded to prevent calculation of suppressed cells (which would increase the likelihood that individual cases could be identified).



**Table 4:** Summary of logistic regression modelling for risk of suicide death involving acute alcohol use (AAU) by case characteristics.

Characteristic		OR	95% CI	p value	AOR	95% CI	p value
<b>Age</b>	<b>15–24</b>	<b>REF</b>			<b>REF</b>		
	25–34	1.15	0.94, 1.40	0.169	1.11	0.90, 1.38	0.325
	35–44	1.12	0.92, 1.37	0.266	1.11	0.88, 1.40	0.370
	45–54	0.91	0.75, 1.11	0.371	0.93	0.73, 1.19	0.575
	55–64	0.68	0.54, 0.87	0.002	0.74	0.56, 0.99	0.041
	65–74	0.62	0.21, 1.87	0.399	0.90	0.29, 2.86	0.863
	75+	0.29	0.21, 0.40	<0.001	0.42	0.25, 0.72	0.002
<b>Sex</b>	<b>Female</b>	<b>REF</b>			<b>REF</b>		
	Male	0.99	0.86, 1.15	0.931	0.87	0.74, 1.02	0.087
<b>Employment</b>	<b>Employed</b>	<b>REF</b>			<b>REF</b>		
	Unemployed	0.80	0.69, 0.94	0.006	0.73	0.62, 0.85	<0.001
	Student	0.56	0.43, 0.73	<0.001	0.49	0.36, 0.66	<0.001
	Retired/pensioner	0.27	0.20, 0.36	<0.001	0.49	0.31, 0.76	0.002
	Other	0.56	0.41, 0.78	0.001	0.51	0.36, 0.71	<0.001
	Unknown	0.91	0.66, 1.25	0.559	0.86	0.62, 1.20	0.375
<b>Marital status</b>	<b>Never married</b>	<b>REF</b>			<b>REF</b>		
	Widowed	0.66	0.44, 0.99	0.045	1.79	1.10, 2.90	0.019
	Divorced/separated	0.99	0.81, 1.21	0.955	1.05	0.84, 1.31	0.654
	Married/de facto	0.86	0.74, 1.00	0.051	0.92	0.77, 1.10	0.329
	Unknown	1.07	0.79, 1.44	0.676	1.19	0.86, 1.63	0.289

**Table 4 (continued):** Summary of logistic regression modelling for risk of suicide death involving acute alcohol use (AAU) by case characteristics.

Characteristic		OR	95% CI	p value	AOR	95% CI	p value
<b>Ethnicity</b>	<b>European</b>				<b>REF</b>		
	Māori	1.40	1.20, 1.64	<0.001	1.20	1.01, 1.42	0.043
	Pacific peoples	1.60	1.19, 2.17	0.002	1.46	1.10, 2.00	0.018
	Asian	0.40	0.27, 0.59	<0.001	0.42	0.28, 0.63	<0.001
	Middle Eastern/Latin American/African	0.49	0.14, 1.67	0.253	0.45	0.13, 1.56	0.208
	Other ethnicity	1.73	0.79, 3.79	0.172	1.68	0.75, 3.77	0.209
<b>Method of death</b>	<b>Poisoning</b>	<b>REF</b>			<b>REF</b>		
	Hanging	1.46	1.23, 1.73	<0.001	1.30	1.07, 1.56	0.007
	Drowning	0.77	0.43, 1.38	0.377	1.04	0.57, 1.89	0.891
	Firearm	1.09	0.82, 1.45	0.569	1.10	0.81, 1.48	0.544
	Sharp object	0.63	0.34, 1.16	0.138	0.65	0.35, 1.21	0.174
	Falls	0.59	0.36, 0.99	0.045	0.58	0.34, 0.98	0.040
	Other	0.72	0.46, 1.11	0.136	0.67	0.43, 1.05	0.078

NB: Multivariate logistic regression models were used to compute both unadjusted odds ratios (OR), and adjusted odds ratios (AOR) controlling for the effects of all other significant variables (age, sex, employment status, marital status, ethnicity and method of death). Data are reported with 95% confidence intervals (CI). REF – reference group.

## Discussion

We quantified and characterised the association between acute alcohol use and suicide in New Zealand, by analysing coronial data from 2007 to 2020, in order to provide a baseline dataset for the association. We found that around one quarter (26.6%) of all suicides over the study period involved acute alcohol use. While this is the first time that the proportion of suicide deaths involving acute alcohol use has been quantified in New Zealand, these findings are consistent with international studies: meta-analytic findings show the prevalence of acute alcohol use in suicides internationally ranged from 26.5% to 44.4%,<sup>2</sup> and a recent Australian study found 26.7% of suicides between 2010 and 2015 involved acute alcohol use.<sup>7</sup> The proportion of New Zealand suicides involving acute alcohol use was stable over the 14-year study period, indicating that acute alcohol use has a strong, persistent and long-standing association with suicide.

While the overall proportion of suicides involving acute alcohol use in New Zealand was comparable with other similar countries, we found key differences in demographic characteristics. Equal fractions of male and female suicides in New Zealand involved acute alcohol use, in contrast to international studies which have consistently identified males as having a higher fraction of suicides involving acute alcohol use.<sup>7-9</sup> This difference may reflect New Zealand's alcohol culture, but is difficult to explain given that data from the New Zealand Health Survey shows that hazardous drinking rates in males are approximately double those of females.<sup>14</sup> However, New Zealand has rates of foetal alcohol spectrum disorder substantially higher than the global prevalence estimate,<sup>21</sup> which suggests that female alcohol consumption may be higher than found in current data sources. In a number of OECD countries, including Australia and New Zealand, suicides in young females have increased, particularly among young indigenous females.<sup>22</sup> Given that risk factors for binge drinking differ between males and females,<sup>23</sup> there is a need for further research focussed on female alcohol use, ethnicity, drinking patterns and suicidal behaviour, in order to inform development of interventions specific to female needs, and which are culturally appropriate and responsive.

We found that those aged between 15 and 54 years had similar risks of suicide involving acute alcohol use, in contrast to the Australian study

that found middle age groups (ages 35–44) had increased risk.<sup>7</sup> This finding is of concern given New Zealand's high teenage suicide rate,<sup>24</sup> and points to alcohol use being an important point of intervention in reducing teenage suicide. However, these findings were pooled across the study period, and adolescent hazardous drinking declined overall in New Zealand between 2001 and 2012,<sup>25</sup> while hazardous drinking in older people is of increasing concern.<sup>26</sup> These time-dynamic changes suggest the need to monitor consumption patterns in different demographic groups, as well as the relationship between acute alcohol use and suicide. We also found significant ethnicity differences, with Māori and Pacific peoples more likely to die by suicide involving acute alcohol use than European and Asian ethnicities. This observation is a substantial health equity issue, and may reflect multiple risk factors for hazardous alcohol use that disproportionately impact Māori and Pacific peoples, including; neighbourhood availability of alcohol,<sup>27</sup> experiences of discrimination,<sup>28</sup> and the effects of trauma.<sup>29</sup> There are well-established inequities in New Zealand for both alcohol-related harm<sup>30</sup> and suicide;<sup>10</sup> this study adds to that body of knowledge and supports the need for addressing alcohol as a contributor to health inequities.

This study provides the first known quantification of acute alcohol use in New Zealand suicides, but limitations need to be acknowledged. Some differences in the characteristics of included and excluded cases may be a potential source of bias. In particular, older age groups were more likely to be excluded from the final sample of cases, with almost half of exclusions due to a lack of toxicology data. Reasons for this are unclear but the characteristics of the decedent may influence testing decisions and contribute to possible bias. Additionally, BAC was the only toxicological test ordered in many cases, which means that the contribution of other psychoactive substances could not be evaluated. We recommend that toxicology should be ordered, and BAC analysed, for every suspected suicide. This recommendation is important, since NCIS-coding of alcohol as a contributory cause of death cannot be solely relied upon as a definition of alcohol's contribution to suicide. We found that only one third of suicides involving acute alcohol use (as defined by BAC results) in New Zealand had alcohol coded as contributory only. A comparable Australian study found that half of suicides involving acute alcohol use had alcohol coded as a contributory cause of death.<sup>31</sup> We acknowledge that defining acute alco-

hol use at a set BAC does not reflect that alcohol's effects may differ by individual. However, our approach was consistent with previous studies,<sup>7,8</sup> and our sensitivity testing suggests that the presence of alcohol is more relevant than the cut-off used to define acute alcohol use. Results are current, as at 7 September 2021, acknowledging that cases may still be closed and added after this date given that there is a lag between year of death and coronial cases being closed, particularly for the years of 2019 and 2020. As such, it would be beneficial to re-run this study a few years in the future, to add to long-term trends, and to identify any pandemic-related impacts.

The design of this study does not allow consideration of the mechanism of association between acute alcohol use and suicide,<sup>3</sup> nor can we determine whether alcohol was used as a deliberate, facilitatory means of suicide.<sup>32</sup> Another limitation is that not all relevant variables are consistently available within the NCIS dataset e.g., socio-economic status, co-morbid mental disorders (particularly alcohol use disorder and other substance use disorders), and acute stressors prior to death. Based on

international findings, we hypothesise that those who die by suicide involving acute alcohol use are more likely to die impulsively following acute stressful events, rather than having psychiatric or physical co-morbidities.<sup>8,9</sup> Future New Zealand research should investigate prior service contact for those who die by suicide involving acute alcohol use.

We have identified that just over a quarter of suicide deaths in New Zealand involve acute alcohol use, and this is particularly prevalent in population groups known to have higher suicide rates (including young people and Māori). Thus, we conclude that alcohol use is a significant but modifiable risk factor for a substantial group of suicide deaths in New Zealand. International evidence shows that actions taken to reduce alcohol consumption at a population-level are associated with reduced suicidal behaviour.<sup>33</sup> Therefore, we recommend that interventions targeted at alcohol be included in New Zealand's suicide prevention strategy. Our findings provide baseline data for the development of interventions targeting suicide associated with acute alcohol use in New Zealand.

#### Appendix:

[https://uploads-ssl.webflow.com/5e332a62c703f6340a2faf44/62ccec35b92a363774f0311\\_5693%20-%20appendix-final.pdf](https://uploads-ssl.webflow.com/5e332a62c703f6340a2faf44/62ccec35b92a363774f0311_5693%20-%20appendix-final.pdf)

**COMPETING INTERESTS**

Nil.

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