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# Alcohol and Violence:
# Alcohol consumption, homicide, and completed suicide in Australia, 1979-2009

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# EXECUTIVE SUMMARY


## Background

Alcohol consumption is strongly with premature mortality. The current study aimed to determine the strength of association between national per capita alcohol consumption with homicide and suicide rates in Australia across the period 1979-2009

## Methods

Data on all Australian homicide and completed suicides that occurred between 1 January 1979 and 31 December 2009 were obtained from the Australian Bureau of Statistics (ABS). Homicides were defined by codes E960-969 from ICD9 (until 1996) and codes X85-Y09 from ICD 10 (1997-2009). Completed suicides were defined by codes E950-E959 (ICD 9) and codes X60-X84 and Y870 (ICD 10). Annual population estimates, stratified by gender, were obtained from the ABS (ABS, 2008; ABS, 2010), and used as the denominator to obtain per capita rates of homicide and suicide. Annual data on apparent consumption over the study period were obtained from the ABS (ABS, 2012a). These data present per capita estimates for total alcohol consumption of pure alcohol (L), as well as estimates for per capita beer, wine and spirits consumption. Annual mean unemployment rates for the period were obtained (Australian Government Department of Education, Employment and Workplace Relations, 2012), as well as and crude divorce rates (per $10^3$) (ABS, 2012b).

## Results

Beer consumption was positively correlated with homicide rates (r=0.70), while wine (r=-0.74) and spirits (r=-0.86) consumption rates were negatively correlated. These patterns were also true of both genders, and remained significant after controlling for unemployment and divorce rates. The relationship of alcohol consumption to suicide was narrower than that observed for homicide. Beer consumption was not significantly related to suicide rates (r=-0.20), while wine (r=-0.60) and sprits (r=-0.47) were negatively correlated. The absence of a correlation between suicide rates and beer consumption was due to a low association with male suicide (r=-0.01), compared to the significant association with female rates (r=0.64).

## Conclusions

There were significant and contrasting associations with beverage type and gender, although these associations appeared stronger for homicide than suicide. For any society, the circumstances in which a particular beverage is consumed, and by whom, would appear more important in relation to violence than the alcohol concentration of that beverage.

# 1. INTRODUCTION

Alcohol consumption is strongly associated with premature mortality (Norstrom & Ramstedt, 2005; Rehm et al., 2009). At the population level, national increases of one litre per capita alcohol consumption in European nations have been associated with a 1% increase in all-cause mortality (Norstrom, 2001; Razvodovsky, 2008). A major factor in this association is the strong link between alcohol and violence, whether that be to the self, or to others. Alcohol is strongly associated with homicide, being the most commonly reported substance amongst offenders and victims, present in a third to two thirds of offenders and 40-50% of victims (Calabria, Doran, Vos, Shakeshaft & Hall, 2010; Darke, 2010). A common scenario, for instance, is drinking together, followed by an argument, a physical altercation and a fatality. Similarly, levels of alcohol amongst completed suicides are comparable to those seen in homicides, and levels of intoxication are high (Darke, Duflou & Torok, 2009; Shields, Hunsaker, Hunsaker & Ward, 2006). Alcohol is viewed as a major factor leading to suicide attempts, particularly impulsive suicides, and is frequently used to build up the courage to make an attempt. Alcohol dependence is also strongly associated with major depression and dysthymia (Heather, Peters & Stockwell, 2001).

While a great deal of work has been conducted on the toxicology of homicide and suicide, substantially less work has been conducted on the associations between national aggregate alcohol consumption and violence. Epidemiological studies of national trends, such as those cited above, are predicated upon the assumption that the greater the amount of alcohol being consumed in a society, the greater the accompanying harm. The picture relating national consumption rates to violence, however, remains equivocal. It must be borne in mind, however, that societal factors other than alcohol consumption are known to be associated with levels of violence, in particular unemployment and divorce (Bye, 2007; Caces & Harford, 1998; Johnston, Pirkis & Burgess, 2009). At the local level, a significant association between alcohol sales and risk of hospitalisation due to assault has been demonstrated (Ray et al., 2008). At the national level, both homicide and suicide have been associated with per capita consumption levels in some European nations (but not all) and north America (Bye, 2007, Caces & Harford, 1998; Landberg, 2008, 2010; Lester, 1995; Makela, 1996; Mann, Zalcman, Smart, Rush & Suurvali, 2006; Pridemore, 2002; Rossow, 2001, 2004; Razvodovsky, 2003; Ramstedt, 2001, 2005; Strickley & Razvodovsky, 2012). The strength of these associations varies markedly

across jurisdictions. For homicide the relationship is stronger in northern Europe than in the south, where the association is weaker or not present (Rossow, 2001). It has been argued that such differences reflect the extent to which a culture that has a general pattern of drinking to intoxication (Landberg, 2010). There also appear to be large regional differences relating to beverage type. In eastern Europe, there is a consistent association of homicide with spirit consumption, with beer and wine consumption not significantly associated with rates of violence (Rossow, 2001, Razvodovsky, 2003, Strickley & Radvodovsky, 2012). In northern Europe and North America, however, the association is strongest with beer, and in southern Europe with wine, reflecting the predominant drinking patterns of these cultures (Rossow, 2001, 2004). It would not appear to be the alcohol concentration of a beverage *per se* that is of import, but the extent of use and its role in a society. Despite these differences, the strength of association between alcohol consumption and homicide is consistently stronger amongst males (Rossow, 2001, 2004; Strickley & Radvodovsky, 2012).

Similar patterns of association are seen for suicide rates (Caces & Harford, 1998; Landberg, 2008; Lester, 1995; Makela, 1996; Razvodovsky, 2003; Ramstedt, 2001, 2005). Thus, in some countries there is a positive correlation between alcohol consumption and suicide rates, while others demonstrate either no association, or even negative associations (Landberg, 2008; Lester, 1995; Ramstedt, 2001, 2005). The association appears highest in spirits dominated countries in eastern Europe or beer dominated societies (Landberg, 2008). Unlike homicide, however, the strength of association has been most commonly reported as strongest amongst females, although even this demonstrates regional differences (Landberg, 2008; Ramstedt, 2001; Ramstedt, 2005).

## 1.1 Study Aims

The current study examined the association between per capita consumption and rates of homicide and suicide in Australia across the period 1979-2009. The study aimed to determine how total estimated consumption in any one year related to levels of violence seen in that year. The drinking culture in Australia most closely resembles that of northern European nations such a Britain, or north America, in that beer is the predominant beverage (Strickley & Razvodovsky, 2012). As such, it was hypothesised that the strongest associations with violence would be seen for beer.

Specifically, the study aimed to:

1. Determine cross correlations between national per capita alcohol consumption with homicide and suicide rates over the period 1979-2009; and

2. Determine the cross correlations of consumption by beverage type with homicide and suicide rates.

# 2. METHODS

## 2.1 Data

Data on all Australian homicide and completed suicides that occurred between 1 January 1979 and 31 December 2009 were obtained from the Australian Bureau of Statistics (ABS). Homicides were defined by codes E960-969 from ICD9 (until 1996) and codes X85-Y09 from ICD 10 (1997-2009). Completed suicides were defined by codes E950-E959 (ICD 9) and codes X60-X84 and Y870 (ICD 10). Annual population estimates, stratified by gender, were obtained from the ABS (ABS, 2008; ABS, 2010), and used as the denominator to obtain per capita rates of homicide and suicide. Annual data on apparent consumption over the study period were obtained from the ABS (ABS, 2012a). These data present per capita estimates for total alcohol consumption of pure alcohol (L), as well as estimates for per capita beer, wine and spirits consumption. Annual mean unemployment rates for the period were obtained (Australian Government Department of Education, Employment and Workplace Relations, 2012), as well as and crude divorce rates (per 103) (ABS, 2012b).

## 2.2 Statistical Analysis

For continuous variables, means, standard deviations (SD) and ranges were presented. In order to determine if a relationship existed between per capita alcohol consumption, and rates of homicide and completed suicide, time series analyses were conducted. Cross correlation functions were examined of per capita alcohol consumption with both homicide and completed suicide rates over the study period. Cross correlation functions provide contemporaneous Pearson correlations between variables at time lag zero. Where series were auto-correlated, they were log transformed, and the transformed series were used to estimate cross correlations. Linear regressions were conducted on transformed variables to determine whether associations between consumption and violence were affected by unemployment and divorce rates. All analyses were conducted using IBM SPSS Statistics v.20.0 (IBM, 2011).

# 3. RESULTS

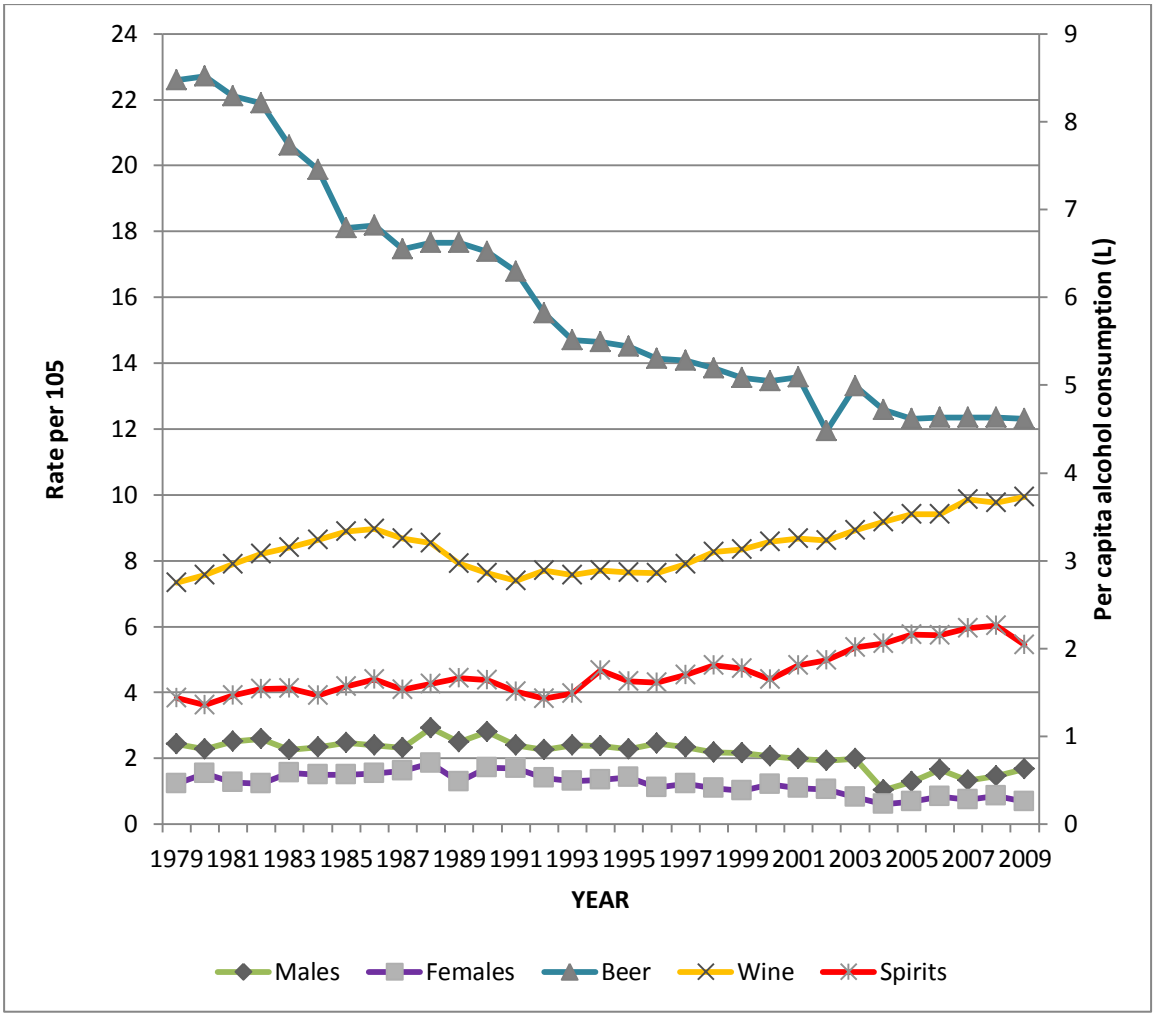
## 3.1 Estimated national alcohol consumption, 1979-2009

The mean per capita national alcohol consumption across the study period was 10.88 L of pure alcohol (SD 1.01, range 9.77-12.83 L). The most frequently consumed beverage was beer (mean 5.99 L of pure alcohol, SD 1.23, range 4.62-8.52 L), followed by wine (mean 3.16, SD 0.28, range 2.75-3.73 L) and spirits (mean 1.72 L, SD 0.26, range 1.36-2.26 L) (Figure 1). There were significant autocorrelations at time lag 1 for total consumption (r=0.91), as well as for consumption of beer (r=0.90), wine (r=0.84) and spirits (r=0.87).

## 3.2. Alcohol and homicide

There were 9,024 homicides across the study period (males 5,874, females 3,150). The mean homicide rate for the study period was 1.67 per $10^5$ (SD 0.42, range 0.76-2.39), 2.16 (SD 0.44, range 1.03-2.92) per $10^5$ for males, and 1.23 per $10^5$ (SD 0.33, 0.60-1.86) for females (Figure 1). There was significant autocorrelation at time lag 1 (r=.84) for the annual homicide rate.

**Figure 1: Estimated national per capita alcohol consumption (L) and homicide rates (per $10^5$), Australia 1979-2009**




There were significant correlations between per capita national alcohol consumption and homicide, amongst all people, males and females (Table 1). The total figures, however, masked significant and contrasting associations between beverage type and homicide. For both males and females beer consumption was positively correlated with homicide rates. In contrast, for both genders consumption rates of wine and spirits were negatively correlated with homicide rates. The strength of the associations of homicide rates with wine and spirits consumption were comparable to, or greater than, the positive association with beer consumption.

In order to determine whether these associations were confounded by variations in unemployment and divorce rates, simultaneous multiple regressions were conducted on transformed variables. As both unemployment (r=0.80) and divorce rates (r=0.71) were

auto-correlated, these distributions were log transformed. After controlling for unemployment and crude divorce rates, for both genders the associations of homicide with estimated consumption of beer (male: β=0.48, p<.001, female: β=0.53, p<.001), wine (male: β=-0.59, p<.01, female: β=0.54, p<.01) and spirits (male: β=-0.77, p<.001, female: β=-0.81, p<.001) all remained significant.

**Table 1: Zero lag cross correlation coefficients between annual per capita alcohol consumption of pure alcohol (L), homicide rates (per 105) and completed suicide rates (per $10^5$), Australia 1979-2009**

| | Males N=5,874 | Females N=3,150 | All N=9,024 |
|---|---|---|---|
| **Homicide** | | | |
| Total alcohol | 0.36* | 0.42* | 0.38* |
| Beer | 0.67*** | 0.70*** | 0.70*** |
| Wine | -0.71*** | -0.66*** | -0.74*** |
| Spirits | -0.80*** | -0.84*** | -0.86*** |
| **Suicide** | | | |
| Total alcohol | -0.35 | 0.45* | -0.20 |
| Beer | -0.01 | 0.64*** | 0.14 |
| Wine | -0.54** | -0.55** | -0.60*** |
| Spirits | -0.37* | -0.66*** | -0.47** |

*p<0.05, **p<0.01, ***p<0.001

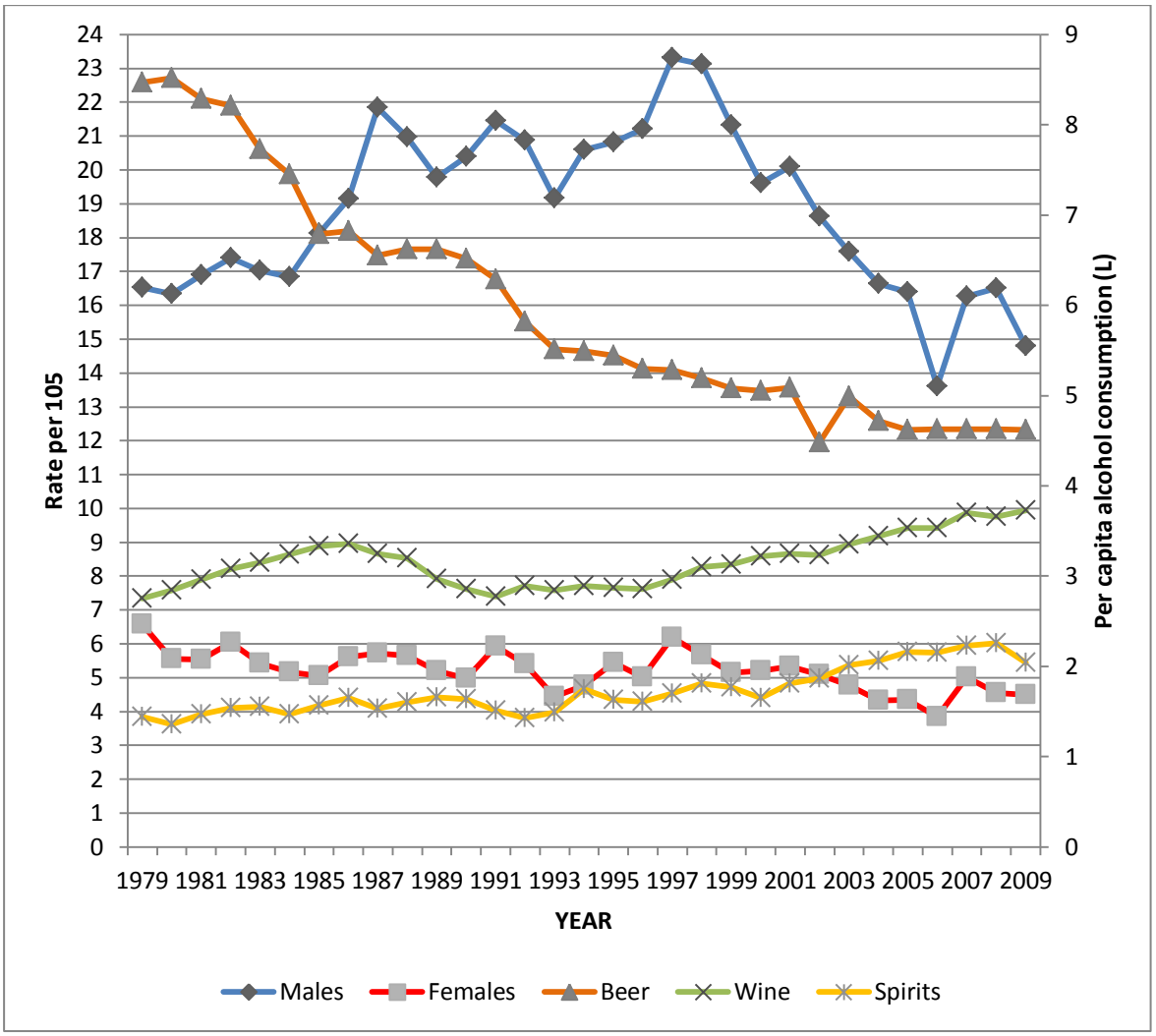
## 3.3. Alcohol and completed suicide

There were 66,322 completed suicides across the study period (males 51,918, females 14,404). The mean rate of completed suicide across the study period was 12.00 per $10^5$, 18.81 per $10^5$ (SD 2.45, range 136.60-23.31) for males, and 5.21 per $10^5$ (SD 0.60, range 3.85-6.58) for females (Figure 2). There was a significant autocorrelation at time lag 1 (r=.76) for the annual suicide rate.

There was no overall association between estimated total alcohol consumption and total population suicide rates (Table 1). This, however, masked contrasting gender and beverage associations. Beer consumption was positively correlated with female suicide rates, but unrelated to male rates. As with homicides, wine and spirits consumption were

negatively correlated with completed suicide rates amongst both genders.

**Figure 2: Estimated national per capita alcohol consumption (L) and completed suicide rates (per $10^5$), Australia 1979-2009**




In order to determine whether these associations were confounded by variations in unemployment and divorce rates, simultaneous multiple regressions were conducted on transformed variables. Amongst males, after controlling for unemployment and crude divorce rates, estimated consumption of beer ($p=.09$), wine ($p=.15$) and spirits ($p=.79$) were all non-significantly associated with the suicide rate. Amongst females, associations with beer ($\beta=0.55$, $p<.001$), wine ($\beta=-0.52$, $p<.05$) and sprits ($\beta=-0.77$, $p<.001$) all remained significant.

# 4. DISCUSSION

The relationship between alcohol consumption and violence was complex, and contrasting trends were observed for beverage types and gender. Total alcohol consumption was significantly correlated with homicide, but not suicide. Global consumption figures were misleading, however, as a more nuanced examination of the data revealed significant and contrasting trends for beer, wine and spirits. Overall, consumption showed a wider range of associations with homicide than with suicide.

Consistent with the dominant role of beer in Australian drinking patterns, there was a positive association between beer consumption and homicide rates. In contrast, both wine and spirits were *negatively* associated with homicide. Moreover, the strengths of association were similar to the positive correlations seen for beer. These findings stand in stark contrast to those reported in Eastern Europe, where it is spirits that have the strong positive association with homicide rates, and more closely resembled patterns seen in North America and Northern Europe. These patterns were consistent across both genders, and there was no suggestion of a stronger association with male rates, as has been reported elsewhere (Rossow, 2001, 2004; Strickley & Razvodovsky, 2012). Indeed, the strengths of association were virtually identical for each gender. Importantly, these associations remained significant after taking unemployment and divorce rates into account.

How are we to interpret these findings? It is clearly not the strength of a beverage that is of import, at least in terms of national consumption. Indeed, the strongest beverage (spirits) was negatively associated with violence. Rather, it is likely that the central issues concern who is drinking which beverage, what their patterns of drinking are, and where they are drinking. Beer consumption in Australia, and other beer dominant cultures, is strongly associated with binge drinking, a drinking pattern associated with an increased risk of violence (Naimi, Brewer, Miller, Okoro & Mehrotra, 2007; Siegel, Naimi, Cremeens & Nelson, 2011; Srivastava & Zhao, 2010). Moreover, beer is more frequently consumed in public bars and places than is the case or wine or sprits. It is thus more likely than other beverages to be consumed in environments where conflict might occur than a beverage such as wine, which is more like to be consumed in a home environment or a restaurant. Beer is also more likely to be consumed by males, and males commit the

overwhelming majority of homicides (Darke, 2010; Darke & Duflou, 2008). Indeed, the majority of male homicides in Australia occur in public places (Darke & Duflou, 2008). Conversely, increase in the consumption of beverages other than beer may well reflect changes in the situations in which alcohol is being consumed. In the case of spirits, the far lower levels of consumption may also mean that there are not enough heavy sprits drinkers in the Australian population, compared to beer, to exhibit the strong positive correlations with homicide seen in eastern European cultures. As noted above, it has been argued that the association between violence and alcohol relates to the extent to which a culture has a general pattern of drinking to intoxication (Landberg, 2010). It is doubtful that Australia could be classified as such a culture, yet the associations were marked. In the Australian context, it is the *beverage* that is most frequently drunk to intoxication (in this case beer) that will be most strongly associated with violence.

The associations between alcohol and completed suicide were not as consistent as those observed for homicide, particularly after unemployment and divorce was taken onto account. This may be a reflection of a more complex causality for completed suicide than for acts of violence against others. As has been noted in other cultures (Landberg, 2008; Lester, 1995; Ramstedt, 2001; Ramstedt, 2005), associations between consumption and suicide were stronger amongst females. Indeed, the associations amongst females were similar in magnitude to that seen for homicides. The patterns amongst males, however, were in contrast to those seen for homicide. Beer, so strongly associated with homicide amongst males, had no association with male suicide rates.

Again, how are we to interpret these findings? One suggestion that has been forwarded regarding gender is that the stronger association with female rates is an artefact of the lower female suicide rate, with changes in consumption having a greater relative effect compared to males (Ramstedt, 2005). The same relative patterns were not seen in relation to homicide, however, where the female rate was also far lower than that of males. Another possibility is that males are more likely to react to stress and intoxication by externalising behaviours that affect others. Females may be more likely to internalise, with increase in consumption symptomatic of higher levels of stress and depression.

As in all studies, caveats must be borne in mind. The major caution that must be extended concerns the measurement of alcohol consumption (Chikritzhs, Allsop,

Moodie & Hall., 2010). The consumption estimates published by the ABS are based upon sales, and represent the volume of alcohol *available* for consumption, rather than consumption *per se*. Care must also be exercised in imputing causality, as the analyses were, by their nature, correlational. More specifically, we must not commit the ecological fallacy in assuming a correlation observed at the population level applies at the individual level. Clearly not all homicides or suicides are attributable, in part or in whole, to alcohol consumption. The data should be viewed in the context of individual case data, which clearly show a causal role for alcohol in large proportions of both homicides and completed suicides. The epidemiological associations seen for the predominant beverage in Australia, are consistent with the clinical picture relating to the role of alcohol in individual cases of violence. Finally, these phenomena are complex and over-determined, and there may also are also other factors that may influence rates of violence that were not captured in this study, such as psychopathology.

In summary, there were significant and contrasting associations with beverage type and gender, although these associations appeared stronger for homicide than suicide. For any society, the circumstances in which a particular beverage is consumed, and by whom, would appear more important in relation to violence than the alcohol concentration of that beverage.

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