**Title:** Time of year effects on self-reported estimates of past-year alcohol consumption

**Authors:** Yvette Mojica-Perez1, Sarah Callinan1, Michael Livingston1,2

1. Centre for Alcohol Policy Research, La Trobe University, Australia
2. Department of Neuroscience, Karolinska Institutet

Corresponding author contact details:

Yvette Mojica-Perez

Centre for Alcohol Policy Research, La Trobe University

Bundoora, Victoria, 3086

Email: y.mojicaperez@latrobe.edu.au

Ph: 61 3 9479 5914

This article has been accepted for publication and undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1093/alcalc/agz039.

**Abstract:**

**Aims:** This study examines the relationship between survey month completion and self-reported alcohol consumption in the last 12 months. It is hypothesised that respondents that complete the survey in the warmer months of the year will report greater alcohol consumption over the last 12 months compared with surveys completed in the colder months**.**

**Methods:** The alcohol consumption data was obtained from three waves of the National Drug Strategy Household Survey (NDSHS) from 2010, 2013, and 2016, between May and November each year (n=74,252). The associations between month of survey completion and three measures of past-year alcohol consumption were examined using a mix of linear and logistic regression. All models were adjusted for survey year, mode of administration, state of residence, rurality, Socio-Economic Indexes for Areas (SEIFA), sex and age.

**Results:** Results varied by drinking measure. In general, there were higher estimates for respondents completing the survey in November and lower estimates in August and September.

**Conclusions:** The results in this study demonstrate the significant relationship between month of survey completion and alcohol consumption in the last 12 months. Seasonal variations in alcohol consumption have the potential to impact respondents’ accurate recall of alcohol consumption in the last 12 months and changes to survey timing have the potential to bias trend estimates of drinking behaviour.

**Short Summary**

There were higher estimates of alcohol consumption for respondents completing the survey in November (late spring) and lower estimates in August and September (late winter/early spring). Seasonal variations in alcohol consumption have the potential to impact respondents’ accurate recall of alcohol consumption in the last 12 months.

**Introduction**

Population surveys are widely used to estimate trends and patterns of alcohol consumption, however there are a range of biases that can reduce the accuracy of survey estimates of drinking. Previous researchers have comprehensively examined these issues (Greenfield and Kerr, 2008), which include non-response bias, incomplete sampling frames, recall bias, mis-estimation of ‘standard drinks’ and more. For these reasons, surveys typically capture less alcohol than is consumed by the population in question (as measured by sales data; Gmel and Rehm, 2004; Nelson et al., 2010), although recent studies have shown that trends in survey estimates at least broadly mirror trends in more objective consumption measures (Livingston et al., 2018).

Thus, despite underestimating consumption, alcohol surveys are a useful tool for monitoring trends in alcohol consumption. Given this is a primary motivation of many survey series, any changes to design or methods that might bias estimates of trends over time need to be carefully considered.

There is some evidence that the timing of survey administration within a year might influence estimates of alcohol consumption due to the influence of recent drinking patterns on respondent’s estimates of their past-year drinking. In general, alcohol consumption has been found to vary throughout the year, with greater alcohol consumption reported during the summer months and at the end of year holiday period. Helzer, et al. (2002) examined daily alcohol consumption of 33 males in the USA over two years, finding a consistent increase of alcohol consumption during the summer and during the weeks that contained a major holiday (including the week of New Year’s Eve, St. Patrick’s Day, and the 4th of July). Seasonal variations of alcohol consumption have also been reported among university students, with Del Boca, et al. (2004) reporting greater alcohol consumption during Spring Break, Guavaween (an annual festival held in Florida in conjunction with Halloween), Thanksgiving, Christmas and New Year’s. A number of other survey studies from the US have shown that drinking varies markedly across the year, with peaks in summer and around holidays (e.g. Carpenter, 2003; Cho et al., 2001)

These seasonal variations have the potential to bias past-year estimates of alcohol consumption as recall bias appears to increase as the recall period increases (Ekholm, 2004; Ekholm et al., 2011; Gmel and Daeppen, 2007). In theory, estimates of yearly alcohol consumption should not be influenced by the time of year the survey is administered, with respondents asked to average their responses to cover an entire 12 month period. However, respondents’ estimates of their past-year alcohol consumption may be influenced by their recent patterns of alcohol consumption, which change across the year. This is supported by a Norwegian study (Knudsen and Skogen, 2015), which asked participants about their alcohol consumption during two different reference periods (last 4 weeks and last 12 months). Participants reported greater alcohol consumption over both reference periods when they were assessed during the summer months (August and September) and in April (during Easter) when compared to the overall average.

Most of the research into seasonal variation in alcohol consumption has been conducted in the northern hemisphere. In Australia the end of year festive period occurs during the summer (December-February) so it is likely alcohol consumption is highest at this time. This is supported by studies of alcohol-related harms, which show peaks in summer (Lloyd et al., 2011; Lloyd et al., 2013).

The aim of this study is to explore the relationship between survey month completion and self-reported alcohol consumption in the last 12 months. There has been no previous study looking at this topic using Australian data. Based on the single Norwegian study discussed above, it is hypothesised that respondents that complete the survey in the warmer months of the year will report greater alcohol consumption over the last 12 months compared with surveys completed in the colder months**.** The survey we use has been conducted between May (the last month of autumn) and November (the last month of spring), giving us a reasonable (although incomplete) spread across the year.

**Method**

**Participants and procedure**

Data were obtained from three waves of the National Drug Strategy Household Survey (NDSHS) from 2010 (April to September; Australian Institute of Health and Welfare [AIHW], 2011), 2013 (July to December; AIHW, 2014), and 2016 (June to November; AIHW, 2017). The NDSHS is a survey of licit and illicit drug use in Australia conducted every three years. Data collection during the three waves used in this study changed slightly, with the 2010 and 2013 surveys administered through drop-and-collect paper forms, whilst the 2016 survey was a mixture of drop-and-collect paper forms (78%), online forms (22%), and telephone interviews (0.3%; AIHW, 2017). Sampling for the NDSHS was stratified by geographical area (15 strata - capital city and the rest of the state for each of the six Australian states and the Northern Territory, and a single stratum for the Australian Capital Territory) and involved multistage random sampling (AIHW, 2011; AIHW, 2014; AIHW, 2017). Households were selected within each region and then a respondent who is aged 12 or older is selected within each household. The response rates were broadly consistent – from a low of 49.1% in 2013 to a high of 51.1% in 2016. Due to the small number of surveys completed in February (n = 1), March (n = 12), April (n = 86), and December (n = 115), this study focused on the surveys completed between May and November over the 3 waves. With these exclusions, a total of 74,252 surveys were available for analysis over the 3 waves: 2010 (n = 26,648), 2013 (n = 23,855), and 2016 (n = 23,749). A demographic summary of the sample is displayed in Table 1. Full details of the three survey waves are available in the survey reports (AIHW, 2011; AIHW, 2014; AIHW, 2017).

**Measures**

Respondents who had consumed any alcohol in the past 12 months were asked a series of questions using a standard graduated quantity frequency method that asked respondents to report how often (every day, 5-6 days a week, 3-4 days a week, 1-2 days a week, 2-3 days a month, about 1 day a month, less often or never) they had consumed a certain amount of alcohol measured by standard drinks (10g pure alcohol) per day (20 or more, 11-19, 7-10, 5-6, 3-4, 1-2, less than 1, or none).

An annual estimate of total alcohol consumption (in standard drinks) was calculated by multiplying the mid-point of each volume category (e.g. for the 11-19 drinks category, a volume of 15 is used) by the mid-point of each frequency category (e.g. for 5-6 days per week, a frequency of 5.5\*52 = 286 is used). If a respondent reported more than 365 drinking occasions in the last 12 months, then their heaviest 365 occasions were used (please see Greenfield, 2000 for more information about this standard approach to estimating volume from categorical alcohol survey items). Two further alcohol consumption variables were created: number of drinking occasions of 5 or more standard drinks in the past year and long-term risky drinking, which measured whether or not a respondent consumed an average of more than two standard drinks per day in the past year. The final measure reflects the Australian low-risk drinking guidelines (National Health and Medical Research Council, 2009). Due to the skewness of the variables, we took the natural logarithm of the total alcohol consumption and 5+ drinking occasions variables after adding 0.5 standard drinks to each total volume figure to account for the undefined log of zero.

Month of completion and administration mode was provided by the AIHW. Where month of completion was missing (n=3715, 5.1%), month of survey drop-off was used instead (drop-off and completion month were the same for the 82% of respondents for whom both variables were available – thus potentially 1% of our sample have their completion month misclassified). State of residence and rurality were derived from postcodes and respondents were asked questions on a range of demographics including age and sex.

**Analysis**

All figures presented in this paper have been weighted to account for disproportionate representation in the sample compared to population benchmarks based on age, sex and location. Regression analyses were conducted using Stata version 15.1 (StataCorp) to examine the relationship between month of survey completion and our alcohol measures. Logged total volume and 5+ occasions were analysed using linear regression, while logistic regression was used for the long-term risky drinking variable. To control for potentially systematic variation in the month of administration and a range of other variables, all regression analyses controlled for survey year, mode of administration, state of residence, rurality, Socio-Economic Indexes for Areas (SEIFA), sex and age. SEIFA is a socioeconomic status variable which is derived from Census data and is based on the respondent’s neighbourhood of residence. A sensitivity analysis was conducted excluding the 5% of respondents with missing data for their survey completion month. The results of the sensitivity analysis were compared with the overall results. In our analyses the deviation from means coding (Hosmer Jr et al., 2013) was used to compare the alcohol consumption for each survey month with an overall average mean, which has been implemented in previous studies (Carpenter, 2003; Cho et al., 2001; Knudsen and Skogen, 2015).

**Results**

A demographic summary of the sample is shown in Table 1.

<INSERT TABLE 1 HERE>

The means and proportions for each of our three alcohol measures are shown in Table 2. Across all variables in the unadjusted descriptive data, drinking appeared higher at the start and end of the study period and lower in the middle months, winter in Australia.

<INSERT TABLE 2 HERE>

These apparent differences in consumption by month of administration were formally tested in regression models (Table 3).

<INSERT TABLE 3 HERE>

Respondents completing the survey in November reported more total alcohol consumption in the last 12 months and drinking occasions of at least 5 drinks compared with the overall average. Those completing the survey in August and September significantly reported less total alcohol consumption and fewer drinking occasions of at least 5 drinks compared with the overall average. The parameters of the logged regression can roughly be treated as proportional effects. Thus, respondents who answered their survey in August reported 15% lower total consumption and 9% fewer 5+ occasions than the overall sample, while those who responded in November reported 11% higher total consumption and 7% more 5+ occasions.

For the long-term risky drinking measure, respondents who completed the survey in October and November had significantly higher odds of reporting long-term risky drinking than the overall sample.

A sensitivity analysis was conducted excluding the respondents with missing data for month of survey completion. The results were similar with only one exception, lower odds of long-term risky drinking is now significant for August with a very similar effect size to our main analysis.

**Discussion**

These results show that the month in which a survey is conducted can significantly influence even estimates of past-year alcohol consumption. As predicted, reported yearly consumption appeared to be significantly higher in Spring and lower in Winter. In particular, we found that respondents that completed the survey in August and September reported less total alcohol consumption and fewer drinking occasions with 5 or more standard drinks in the last 12 months compared with the overall average. In addition, respondents who completed the survey in July reported lower odds of long-term risky drinking compared with the average odds. In contrast, respondents who completed the survey in November reported more total consumption, drinking occasions with 5 or more standard drinks, and greater odds of long-term risky drinking compared with the overall average. Furthermore, those respondents who completed the survey in October also reported greater odds of long-term risky drinking compared with the average.

These findings are broadly as expected, with higher reports of drinking in the warmer months (October and November) and lower reports in winter (August). The only exception is the lower reports found in September – respondents may be recalling their July and August consumption when answering the question for the past year, slightly lagging the seasonal effects. This would imply even larger differences if respondents completed this survey in January and February, when their short-term recall period would include the peak drinking period of the Australian year.

Due to the difference between the northern and southern hemisphere it is hard to compare the results found in previous studies, particularly during their winter months as this coincides with the end of year festive period where alcohol consumption has been found to increase at this time (Del Boca et al., 2004; Helzer et al., 2002). Nevertheless, the one Norwegian study (Knudsen and Skogen, 2015) that looked at how annual drinking measures varied by month of survey found similar patterns, with higher drinking levels reported during their warmer months (July-September) and lower levels in winter (October-January).

 The administration effects found in our study were substantial – more than 10% variation in either direction – and are likely under-estimated if the entire year is considered rather than the subset of months we examined. Therefore, seasonal variations in alcohol consumption should be considered when administrating surveys, specifically surveys that are administered repeatedly/consistently over many years, as any changes to the month of administration can lead to potential bias in the overall trends observed in the data, even where questions aim to cover a full 12 month period. This is particularly important for researchers and policy makers that utilise repeated surveys to influence or introduce changes to alcohol policies or laws.

There were a few limitations in this study which may have influenced the results. This study utilised the 2010, 2013, and 2016 NDSHS alcohol consumption data. NDSHS surveys have not been administered over all months of the year and as such we were only able to assess consumption reported in May to November. It is likely that even sharper variations would be observed if survey data was collected in December and January, as they are the peak months for alcohol-related harm in Australia (Lloyd et al., 2011; Lloyd et al., 2013). If possible, future research should examine survey completion throughout the whole year.

There were slight differences between our main model results and a sensitivity analysis with missing data excluded. This raises some concerns about the robustness of our results, but the differences were relatively minor and the general implications of the results were consistent.

This is the first Australian study to examine how self-reports of drinking behaviour vary by time of year. Importantly, we focussed on past-years measures of drinking which, if reported accurately, should not be affected by season. However, we found significant variation in all measures of drinking based on the month of survey completion, suggesting recall bias differentially impacts drinking reports across the year. These findings have important implications for people who run alcohol surveys, particularly surveys that are administered periodically to investigate alcohol trends in the population. Our findings show that changing the time of year that a survey is conducted will likely result in changes to estimates of drinking, even when past-year measures are used. Thus, repeated surveys should be administered during the same season across waves to decrease any impacts on estimates of trends in drinking that would otherwise occur.

**Acknowldegements**

The Australian Institute of Health and Welfare manage the data collection and dissemination of the National Drug Strategy Household Survey and we are grateful to them for facilitating access to the data via the Australian Data Archive. This research was part supported under Australian Research Council's Discovery Projects funding scheme (project number DP150101024). ML is supported by an NHMRC Career Development Fellowship (1123840) and SC is supported by an ARC Discovery Early Career Research Award (DE180100016). The Centre for Alcohol Policy Research is co-funded by the Foundation for Alcohol Research and Education, an independent, charitable organization working to prevent the harmful use of alcohol in Australia (<http://www.fare.org.au>).

**References**

Australian Institute of Health and Welfare. 2011. 2010 National Drug Strategy Household Survey - Report. Canberra, AIHW.

Australian Institute of Health and Welfare. 2014. 2013 National Drug Strategy Household Survey - Detailed Report. Canberra, AIHW.

Australian Institute of Health and Welfare. 2017. 2016 National Drug Strategy Household Survey - Detailed Findings. Canberra, AIHW.

Carpenter C, 2003. Seasonal variation in self-reports of recent alcohol consumption: Racial and ethnic differences. J. Stud. Alcohol. 64, 415-418.

Cho YI, Johnson TP and Fendrich M, 2001. Monthly variations in self-reports of alcohol consumption. J. Stud. Alcohol. 62, 268-272.

Del Boca FK, Darkes J, Greenbaum PE and Goldman MS, 2004. Up close and personal: Temporal variability in the drinking of individual college students during their first year. J. Consult. Clin. Psychol. 72, 155.

Ekholm O, 2004. Influence of the recall period on self-reported alcohol intake. Eur. J. Clin. Nutr. 58, 60-63.

Ekholm O, Strandberg-Larsen K and Grønbæk M, 2011. Influence of the recall period on a beverage-specific weekly drinking measure for alcohol intake. Eur. J. Clin. Nutr. 65, 520–525.

Gmel G and Daeppen J-B, 2007. Recall bias for seven-day recall measurement of alcohol consumption among emergency department patients: implications for case-crossover designs. J. Stud. Alcohol Drugs 68, 303-310.

Gmel G and Rehm J, 2004. Measuring alcohol consumption. Contemp. Drug Probl. 31, 467-540.

Greenfield TK, 2000. Ways of measuring drinking patterns and the difference they make: experience with graduated frequencies. Journal of Substance Abuse 12, 33-49.

Greenfield TK and Kerr WC, 2008. Alcohol measurement methodology in epidemiology: Recent advances and opportunities. Addiction 103, 1082-1099.

Helzer JE, Badger GJ, Rose GL, Mongeon JA and Searles JS, 2002. Decline in alcohol consumption during two years of daily reporting. J. Stud. Alcohol. 63, 551-558.

Hosmer Jr DW, Lemeshow S and Sturdivant RX. 2013. Applied Logistic Regression. In: Hosmer Jr DW, Lemeshow S and Sturdivant RX (eds) *Interpretation of the Fitted Logistic Regression Model.* Hoboken, New Jersey: John Wiley & Sons, 49-88.

Knudsen AK and Skogen JC, 2015. Monthly variations in self-report of time-specified and typical alcohol use: The Nord-Trøndelag Health Study (HUNT3). BMC Public Health 15, 172-183.

Livingston M, Callinan S, Raninen J, Pennay A and Dietze PM, 2018. Alcohol consumption trends in Australia: comparing surveys and sales‐based measures. Drug Alcohol Rev. 37, S9-S14.

Lloyd B, Matthews S, Livingston M and Jayasekara H. 2011. Drinking cultures and social occasions: Alcohol harms in the context of major sporting events*,* Fitzroy, Victoria: Turning Point Alcohol and Drug Centre.

Lloyd B, Matthews S, Livingston M, Jayasekara H and Smith K, 2013. Alcohol intoxication in the context of major public holidays, sporting and social events: A time–series analysis in Melbourne, Australia, 2000–2009. Addiction 108, 701-709.

National Health and Medical Research Council. 2009. Australian Guidelines to Reduce Health Risks from Drinking Alcohol. Canberra: NHMRC.

Nelson DE, Naimi TS, Brewer RD and Roeber J, 2010. US state alcohol sales compared to survey data, 1993–2006. Addiction 105, 1589-1596.

StataCorp, (2017). Stata/MP 15.0 for Windows. College Station TX 77845: StataCorp LP.

*Table 1. Demographic statistics*

|  |  |  |
| --- | --- | --- |
|  | Frequency | Proportion using survey weights (%) |
| **Sex** |
| Male | 33,410 | 49.5 |
| Female | 40,842 | 50.5 |
| **Year** |
| 2010 | 26,648 | 31.9 |
| 2013 | 23,855 | 33.0 |
| 2016 | 23,749 | 35.0 |
| **State** |
| NSW | 20,580 | 32.3 |
| VIC | 16,390 | 25.0 |
| QLD | 13,658 | 20.0 |
| WA | 7,664 | 10.6 |
| SA | 6,249 | 7.3 |
| TAS | 3,291 | 2.2 |
| ACT | 3,169 | 1.6 |
| NT | 3,251 | 1.0 |
| **Age group** |
| 12-17 | 3,855 | 8.8 |
| 18-24 | 5,372 | 11.8 |
| 25-29 | 4,963 | 8.5 |
| 30-39 | 12,497 | 16.6 |
| 40-49 | 12,044 | 16.3 |
| 50-59 | 12,017 | 14.9 |
| 60-69 | 12,388 | 11.6 |
| 70+ | 11,116 | 11.6 |
| **Rurality** |
| Major cities | 48,721 | 69.9 |
| Inner regional | 14,318 | 18.8 |
| Outer regional/remote | 11,213 | 11.3 |
| **SEIFA** |  |  |
| Lowest | 13,399 | 18.9 |
| 2 | 14,538 | 19.4 |
| 3 | 14,507 | 19.7 |
| 4 | 16,098 | 21.2 |
| Highest | 15,709 | 20.7 |
| **Survey Mode** |
| Drop-and-collect paper forms | 69,012 | 91.7 |
| Online forms | 5,166 | 8.3 |
| Telephone interviews  | 74 | 0.1 |

*Table 2. Descriptive statistics for month of survey completion and the mean total alcohol drinking volume in the past 12 months, the number of drinking occasions of at least 5 standard drinks and the proportion of respondents who reported long-term risky drinking in the last 12 months, National Drug Strategy Household Survey, 2010–16.*

|  |  |  |  |
| --- | --- | --- | --- |
|  | Total drinking volume | 5+ drinking occasions | Long-term risky drinking |
| Month completed | Mean (95% CI) | Proportion % (95% CI) |
| May | 451.3 (432.3 - 470.3) | 30.7 (28.9 - 32.5) | 19.1 (18.2 - 20.1) |
| June | 456.7 (437.6 - 475.7) | 31.6 (29.9 - 33.4) | 18.6 (17.7 - 19.5) |
| July | 424.2 (409.0 - 439.4) | 28.1 (26.7 - 29.5) | 17.9 (17.1 - 18.7) |
| August | 383.8 (366.9 - 400.7) | 25.0 (23.5 - 26.6) | 15.8 (14.9 - 16.7) |
| September | 396.4 (379.7 - 413.1) | 26.1 (24.6 - 27.6) | 16.5 (15.7 - 17.4) |
| October | 436.8 (419.9 - 453.6) | 28.8 (27.2 - 30.3) | 18.1 (17.3 - 18.9) |
| November | 451.9 (426.7 - 477.2) | 30.8 (28.4 - 33.2) | 18.3 (17.1 - 19.5) |

n = 68,933; CI = Confidence Interval

*Table 3. Regression analyses and logistic regression examining the relationship between the month of survey completion and total alcohol drinking volume in the past 12 months, the number of drinking occasions of at least 5 standard drinks, and long-term risky drinking, National Drug Strategy Household Survey, 2010–16.*

|  |  |  |  |
| --- | --- | --- | --- |
|  | Total drinking volume | 5+ drinking occasions | Long-term risky drinking |
| Month completed | Coef. (95% CI) | Odds Ratio (95% CI) |
| May | 0.04 (-0.05 – 0.13) | 0.05 (-0.02 – 0.12) | 0.98 (0.90 – 1.07) |
| June | 0.01 (-0.06 – 0.09) | 0.03 (-0.03 – 0.09) | 0.94 (0.87 – 1.01) |
| July | 0.03 (-0.03 – 0.09) | 0.03 (-0.02 – 0.07) | 0.99 (0.93 – 1.05) |
| August | -0.15 (-0.22 – -0.08)\* | -0.09 (-0.14 - -0.04)\* | 0.94 (0.87 – 1.00) |
| September | -0.08 (-0.16 - -0.01)\* | -0.07 (-0.12 - -0.02)\* | 0.98 (0.91 – 1.05) |
| October | 0.04 (-0.03 – 0.11) | -0.02 (-0.07 – 0.03) | 1.08 (1.01 – 1.16)\* |
| November | 0.11 (0.02 – 0.19)\* | 0.07 (0.01 – 0.13)\* | 1.11 (1.02 – 1.20)\* |

n = 69,277; CI = Confidence Interval. Note: survey year, mode of administration, state of residence, rurality, SEIFA, sex and age group were entered as control variables. \* p<0.05n