HHS Public Access

Author manuscript

Addiction. Author manuscript; available in PMC 2017 July 01.

Published in final edited form as:

Addiction. 2016 July ; 111(7): 1203–1213. doi:10.1111/add.13373.

Estimating under- and over-reporting of drinking in national surveys of alcohol consumption: Identification of consistent biases across four English-speaking countries

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Abstract

Background and aims—Questions about drinking "yesterday" have been used to correct under-reporting of typical alcohol consumption in surveys. We use this method to explore patterns of over- and under-reporting of drinking quantity and frequency by population sub-groups in four countries.

Design—Multivariate linear regression analyses comparing estimates of typical quantity and frequency of alcohol consumption with and without adjustments using the Yesterday method.

Setting and participants—Survey respondents in Australia (n=26,648), Canada (n=43,370), USA (n=7,969) and England (n=8,610).

Measurements—Estimates of typical drinking quantities and frequencies over the past year plus quantity of alcohol consumed the previous day.

Findings—Typical frequency was underestimated by less frequent drinkers in each country. For example, after adjustment for design effects and age, Australian males self reporting drinking "less than once a month" were estimated to have in fact drunk an average of 14.70 (±0.59) days in the past year compared with the standard assumption of 6 days ($t=50.5$, $p<0.001$). Drinking quantity "yesterday" was not significantly different overall from self-reported typical quantities over the

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Conflicts of interest: TG presented a paper at a conference on Lifesyles and Drinking Patterns in Young Adults at the European Parliament, Brussels 5 March 2014 funded in part by the Osservatorio Permanente sui Giovani e l'Alcool. No other potential COIs to declare.

past year in Canada, USA and England but slightly lower in Australia (e.g. 2.66 vs 3.04 drinks, t=20.4, p<0.01 for women).

Conclusions—People who describe themselves as less frequent drinkers appear substantially to under-report their drinking frequency, but country and sub-group specific corrections can be estimated. Detailed questions using the Yesterday method can correct under-reporting of quantity of drinking.

Keywords

Survey; Quantity-Frequency method; Yesterday method; Alcohol; Under-reporting

Introduction

It is well documented that self-report surveys result in substantial underestimates of alcohol consumption (1, 2). In particular, the widely used quantity-frequency (QF) approach yields estimates of per capita alcohol consumption derived from self-reported surveys that may be less than half those derived from official alcohol sales data (1–3). In recent years, researchers have taken an increasing interest in studying the reasons for underreporting and attempting to correct for it. Notable examples of this include including standard “uplift” correction factors for underreporting in estimates of alcohol attributable morbidity and mortality in the Global Burden of Disease study (4), in applications of the Sheffield Alcohol Policy Model (5) to estimate impacts of alternative policy scenarios on public health, and in re-estimates of compliance with low risk drinking guidelines (6, 7). Recently, a method has been described for estimating the degree of underreporting for different sub population groups (1). This method employs supplementary data collected by the “Yesterday method” in a Canadian national survey and from official alcohol sales to re-estimate mean drinking frequencies and quantities for population subgroups and apply these to responses of survey respondents to a last 12 months QF measure. When applied in Canada, this approach indicates that while men and women under report their alcohol consumption to a similar degree, under reporting is significantly greater for younger and also lower level consumers. Livingston and Callinan (2015) (8) found similar results comparing a detailed context-specific set of questions with standard graduated frequency approaches, with low-risk drinkers under-reporting proportionately more than heavier drinkers in the standard survey data.

The present paper focuses on a phenomenon that was been identified serendipitously during these investigations of underreporting of alcohol consumption. This concerns a strong tendency among survey respondents who describe themselves as infrequent drinkers to be drinking far more frequently than indicated in their responses to past 12 months quantity and frequency questions. For example, respondents identifying themselves as drinking “less than once a month” were approximately 3 times more likely to indicate they drank the day before the interview than would be expected by chance (1). Conversely, significantly fewer people in this study reported having drunk the day before the interview than would be expected among those who said they drank “every day of the week”.

Population alcohol surveys worldwide tend to use standard assumptions to interpret responses to drinking frequency questions, typically using the midpoint of the lower and upper bounds to quantify individual frequencies (e.g. assuming 2.5 days per week if the response option is 2 or 3 days per week) (9). These assumptions are then factored in to estimates of alcohol attributable fractions (10), estimates of the global burden of disease (4), policy modelling studies (5) and the development of low-risk drinking guidelines (11). We sought to investigate, therefore, whether consistent patterns of bias can be observed cross nationally in how people respond to drinking frequency questions with a view to seeing if the bias can be both estimated and corrected at the individual country level. The Yesterday method also provides a way to investigate underreporting of quantity and so this was also investigated in the present study for the same purposes.

The Yesterday method is proposed as a complement not an alternative to questions focusing on longer time periods. Its use is predicated on two plausible assumptions. Firstly, that it is much easier to remember whether or not alcohol was consumed the day before the interview than to accurately estimate average drinking frequency over the previous year. This information can be used to estimate typical drinking frequencies among sub-groups of drinkers (e.g. all those reporting drinking one day per week in a QF survey) by examining the proportions reporting any alcohol the day before the interview compared with what would be expected based on their self-reported frequency (i.e. one in seven drinkers in this example) (1). It is necessary for interviews to be conducted on each day of the week and data to be weighted so each weekday is equally represented to make this calculation. The second assumption is that it is easier to remember how much was consumed the day before the interview than to estimate typical quantities on drinking days in the past year. Previous research using national Australian survey data, found that detailed Yesterday questions about beverage types and container sizes yielded estimates of daily drinking quantity that were 28% higher than a simple Yesterday question on just the overall number of “standard drinks” (2). Both of these estimates were, in turn, higher than estimates based on typical QF methods.

Given the size of the correction factors previously estimated for both typical quantity and frequency of drinking, we investigated this phenomenon cross-nationally employing data from four countries where data on consumption the day before the interview were collected in a national alcohol survey. In each case, both the specific measures of typical drinking quantity and frequency over the past year and also for the number of drinks consumed the previous day were slightly different in each survey. This precluded a pooled analysis but, nonetheless, it was possible to investigate whether similar patterns of under-reporting of drinking frequency and quantity were evident cross nationally.

Methods

National survey sampling

Data from four national surveys (Australia, Canada, England and US) were available for analysis in this study. All the surveys incorporated data collected between 2008 and 2011 using nationally representative sample frames. The methods employed in each survey are briefly described below and summarised in Table 1.

i. *The 2010 National Drug Strategy Household Survey (NDSHS)* is a random household survey of Australians aged 12 and over using a drop and collect approach and a clustered stratified random sample with regions sampled randomly within 15 geographic strata (13).

ii. *The Canadian Alcohol and Drug Use Monitoring Survey (CADUMS)* is an age 15+ general population telephone survey initiated in April 2008 by the Controlled Substances and Tobacco Directorate, Health Canada (14, 15). It used random digit dialing (RDD) and Computer Assisted Telephone Interviewing (CATI). Within each of ten provincial strata, a random sample of telephone numbers was selected with equal probability of selection. The 2008, 2009 and 2010 CADUMS were included in the analysis because of the availability of the same alcohol data.

iii. *The 2011 Health Survey for England (HSE)* is an annual survey commissioned by the Health and Social Care Information Centre since 1991 (16). A multistage stratified sampling design was used for 8,610 adults aged 16+ living in private households interviewed between January 2011 and February of 2012. Those who reported drinking in the last 12 months were asked to complete a prospective seven day drinking diary (starting day was usually the following day from the interview).

iv. *The 2010 U.S. National Alcohol Survey (NAS12)* is a Computer Assisted Telephone Interview (CATI) survey of the US adult population aged 18 or older, with 7,969 who completed at least the drinking questions (complete, mid-terminate and partial interviews) in a dual-frame sample (6,854 landline; 1,115 cell phone) (17). Fieldwork from June 2009 to March 2010 was conducted by Random Digit Dialing (RDD) in all 50 states and DC. By landline, one adult per private residence was randomly selected (18). All adults answering the cell phone were selected. The cooperation rate was 49.9% for landlines and 71.3% for cellphones (19). Additional survey details can be seen elsewhere (20).

Measures of alcohol consumption

In each survey, data were available for a QF measure of alcohol consumption over the past year i.e. capturing both typical drinking frequencies and quantities (2, 21). Each survey also included a question or questions about drinking the day before the interview. Combining drinking information from these two approaches made it possible to compare self-reported drinking frequencies over the past year for sub-groups of drinkers with how often (as a group) they reported drinking “yesterday”. In a group who all say they drink once a week, for example, there should on average be one in 7 who report drinking “yesterday”. There were some differences in the methods used. For example in Canada and England, the yesterday questions were repeated for multiple beverage categories whereas in the US and Australia respondents simply estimated the total number of drinks consumed the day before the interview. Interviews were conducted on each day of the week in all four surveys enabling responses to be weighted by day of week.

In all surveys, the frequency of drinking any beverage alcohol in the past 12 months and the number of drinks on any single day were assessed. In England, number of drinks was derived from summing beverage-specific quantities reported for any single day and on the

last day of the seven-day drinking diaries for 'yesterday drinking'. In Australia and the US, yesterday drinks were the number of drinks on any kind of alcohol the day before the interview. In Canada, beverage-specific yesterday drinks were assessed for beers, wines, coolers and spirits. The question formats and response options in each country are also presented in an Appendix. For simplicity of presentation, all estimates of numbers of "drinks" or "units" of alcohol in each survey are expressed in terms of 10 g "standard drinks".

Analysis

All analyses were performed at the country level because of the differences in design strategies, survey sampling methods and measures of alcohol consumption.

Comparison of QF versus Yesterday-adjusted drinking frequencies—The number of drinkers in each QF frequency category who reported drinking the day before the interview was used to estimate more accurate mean drinking frequencies for both men and women. The proportion of drinkers in each frequency category who drank "yesterday" was multiplied by 365 e.g. if one in every 10 "once per month" QF respondents reported drinking yesterday, this was taken to indicate a frequency of 0.1 × 365 or 36.5 days per year instead of the usual assumption of 12 drinking days per year (1, 7). The usual QF procedure for quantifying drinking frequency in terms of drinking days per year is to use midpoints for each frequency response, e.g. for drinking "less than once a month" the midpoint of the lowest possible (i.e. 1 day) and highest (11 days) per year is taken i.e. 6 days. Estimated drinking frequencies from these two methods were then compared statistically using multivariate linear regression analyses (22) after they were applied to each individual who reported drinking in the past year via the QF questions. Adjustment was made for age and sample design effects and 95% CIs estimated. The t-test was used to assess the significance of differences found for each drinking frequency subgroup by gender.

Comparison of QF versus Yesterday-adjusted drinking quantities—The Yesterday method was used to estimate an average quantity consumed on a drinking day for subgroups of drinkers defined by their QF drinking frequencies. For example, mean quantity consumed "yesterday" was estimated for all drinkers who reported both drinking yesterday and also once a month on the QF. Multivariate linear regression analyses were used to compare statistically the estimates of daily drinking obtained from the Yesterday questions and the QF. Adjustment was made for design effects and confounding effect of age, and 95% CIs calculated for each drinking frequency sub-group by gender. The t-test was also used to test the significance of differences between these pairs of estimates of quantity consumed on a typical drinking day.

Stata 12.0 (England) or SAS 9.3 were used to analyze the sample survey data because the procedures designed in these statistical software can handle complex survey sample design, including designs with stratification, clustering and/or unequal weighting and adjust for confounding effects of covariates such as age (25, 26). The estimates were based on the weighted sample for each country and the expansion weights were recalculated and were rescaled to the sample size (24).

Results

As shown in Tables 2, 3, 4 and 5 both under-reporting by infrequent drinkers and over-reporting by frequent drinkers were confirmed in each country examined though there were between country differences. Underreporting of drinking frequency was significant and most pronounced among respondents reporting lower frequencies of drinking over the past 12 months. In the Australian survey (Table 2), males who said they drank less than once a month over the past 12 months were estimated to be actually drinking 2.45 times more frequently than they reported, while for female drinkers this ratio was 2.78. Among Canadian survey respondents self-reporting drinking “less than once a month” (Table 3), these ratios were 3.34 for males and 2.81 for females. Similarly, in the England survey (Table 5) there were 1.62 times more males and 4.24 more females reporting consuming the day before than expected based on their self-reported drinking frequencies in the previous 12 months. In the US sample, underreporting of drinking frequency was most pronounced for those self-reporting frequency of “once a month” with correction factors estimated of 2.44 for women and 2.67 males based on numbers reporting drinking “yesterday”.

“Breakeven” points occurred at which drinking frequencies were not significantly over- or under-estimated in each country. In the US, this occurred for males self-reporting drinking five or six times a week in the past year and females self-reporting drinking between three and six times a week in the past year (Table 4), and for England drinkers self-reporting drinking once or twice a week for females (Table 5). The tendency for over-estimating drinking frequency by more frequent drinkers was least pronounced among Australians with as many as 95% male and 94% female of “daily drinkers” reporting drinking the day before the interview (Table 2). This tendency was greatest among US drinkers for whom only 84% of male and 82% of female ‘daily” drinkers reported drinking “yesterday” (Table 4).

By contrast, there was no evidence that the Yesterday method provided a means of correcting for under-reporting of quantity compared with usual quantity from the QF method or as calculated from the beverage specific QF used in England. In fact, for several drinking categories (all relatively infrequent drinkers) in Australia, Canada and England there were significantly *lower* estimates of daily quantity consumed estimated from the Yesterday questions compared with last 12 month QF methods. Only Canadian male drinkers reporting consumption every day evidenced *higher* estimates of drinking quantity from the Yesterday questions than the QF. In overall models for all drinkers, significantly lower estimates were obtained for typical quantities consumed on a drinking day from the Yesterday method than the QF methods in Australia. Otherwise, there were no overall significant differences between the two types of estimate across the three other countries. Within individual drinking categories, Yesterday-based estimates of daily quantity were significantly lower than those from the last 12 months QF among less frequent drinkers. Adequate or significantly higher estimates of drinking quantity were obtained for more frequent drinkers, though this varied by country.

Table 6 reports per capita alcohol consumption estimates in litres of pure alcohol consumed per person aged 15 + per year for each country. These are compared with firstly per capita consumption estimates based on unadjusted QF self-report survey data showing that

coverage of official consumption estimates ranged from a low of 31% for Canada to 57.5% for England. Adjustments to these estimates using estimates of quantity consumed per day from the Yesterday questions were lower for Australia (4.11 versus 4.73 litres per person) but similar for the other countries. More substantial increases in coverage and per capita alcohol consumption estimates were obtained after adjusting drinking frequency estimates for Australia and Canada, with a slight increase for USA and no change for England.

Discussion

We suggest that some consistencies observed in these patterns of results from four different English-speaking countries indicate the presence of systematic biases operating in patterns of self-reported alcohol consumption which can be both estimated and corrected in national surveys. If these biases are corrected, estimates of the distribution of drinking across the population would be affected and, in some instances, also the overall level of drinking.

The observed biases involve both substantial under estimates of drinking frequencies by those who claim to be the infrequent drinkers and also significant over estimates among self-professed daily or almost daily drinkers. While the size of the correction factors required are substantial among the least frequent drinkers, being mostly in the range between 2 and 4, arguably the amount of alcohol consumed by this group is small and these underestimates will make relatively small impacts overall. However, significant underreporting of drinking frequency was also observed among those claiming to drink as often as 2 to 3 times per week in Canada and 3 to 4 times a week in both the USA and Australia which would have more impact on estimates of total consumption. It was estimated here that applying adjustments for underreporting drinking frequency resulted in 46.2% (or 45.51% vs 31.12%) greater coverage of official estimates of per capita alcohol consumption in Canada, 14.5% in Australia and 3.8%% in the USA (derived from figures in Table 6). There was negligible impact on coverage of official alcohol consumption for the England survey which is distinguished by using the beverage specific quantity frequency method, known to result in higher coverage than a simple quantity frequency approach (12).

Contrary to expectations, estimates of drinking quantities based on the Yesterday method were lower than those based on QF methods in Australia and otherwise not significantly different in the other countries. In Australia, Canada and England there was a tendency for infrequent drinkers to report lower quantities the day before the interview than their estimate of typical consumption, while the estimates from both methods were similar for more frequent drinkers. We note that only simple versions of the Yesterday method were available for the present analyses for USA and Australia which are less effective in correcting for underreporting of quantity (2). It would be necessary to include questions on multiple beverage categories as well as different container sizes to be able to develop correction factors for underreporting of quantity. Methods have also been developed to estimate age and gender specific adjustments for typical drinking quantities based on the Yesterday method by taking account of typical beverage preferences among these groups and the differential underreporting of beer, wine and spirits compared with official sales data (1). Given the relatively low coverage of total consumption based on survey estimates, even after

for correction of drinking frequency, there is still substantial under-estimation of per capita consumption and some of this is likely due to under-reporting typical quantity.

Overall, the present findings and previous related studies point to the conclusion that under reporting of alcohol consumption is *not* evenly distributed across age and gender subgroups, both as a consequence of underreporting drinking frequency and quantity. Correcting for differential under-reporting of alcohol consumption will therefore impact on estimates of the global burden of disease from alcohol and its distribution across population sub-groups, compliance with low risk drinking guidelines and impacts of alcohol policies. We note that in net terms, these systematic biases serve to underestimate drinking frequency overall by between 2% (males) to 16% (females) in the US, 16% to 24% in Australia and 43% to 53% in Canada (see Tables 2,3 and 4). Thus corresponding estimates of the burden of disease from alcohol, the extent of compliance with low risk drinking guidelines and the scale of public health impacts from alcohol policies may be underestimated to some degree in these countries. Global burden of disease estimates are based on the attributable fraction methodology which uses estimates of the prevalence of drinking for different age and gender subgroups estimated from national surveys (10) i.e. the differential patterns of under- or over-reporting consumption as a function of age and drinking level reported here and elsewhere (1) would impact these.

These findings also have some relevance to the quest in alcohol epidemiology to account for the cause of underreporting of alcohol consumption in general population surveys. The analyses reported here suggest that faulty recall of drinking frequency is partly responsible, particularly among younger and lower volume drinkers. We suggest that this also fits with results from studies comparing other survey approaches. For example, Livingston and Callinan (8) highlight the significant improvement in coverage particularly for low risk drinkers using a survey instrument developed by Casswell et al (27) that prompts respondents to consider their drinking frequencies over a wide range of contexts and beverages.

In conclusion, we recommend inclusion of detailed questions about drinking the day before in national alcohol surveys to more fully estimate and correct for under reporting of both frequency and quantity of drinking – for the population as a whole and also for sub-groups defined by age and drinking level.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

This work was partly funded by the Centre for Addictions Research of BC Endowment Fund (TS, JZ) and also in part by Center grant P50 AA005595 from NIAAA (TKG). Opinions expressed are those of the authors and do not necessarily reflect those of the US National Institutes of Health or other sponsoring institutions.

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Table 1

Characteristics of the four surveys

Name of survey	Countries	Interview mode	Years	Total samples	Participation rates
National Drug Strategy Household Survey (NDSHS)	Australia	Drop and collect	2010	26,648 aged 12+	50.6%
Canadian Alcohol and Drug Monitoring Survey (CADUMS)	Canada	Telephone	2008–2010	43,371 aged 15+	44.1%
National Alcohol Survey (NAS)	USA	Telephone	2010	7,969 aged 18+	52.1%
Health Survey for England (HSE)	England	Face-to-face and self- completion†	2011	8,610 aged 16+	66.0%

Note:

†For the last 12 month QF it was a face-to-face interview and for the analysed drinking diaries, it was self-completion.

Table 2

Estimated drinking days, drinks and correction factor for male and female drinkers in Australia (2010) by comparing reported numbers of yesterday drinkers with frequencies expected from past year QF drinking frequency responses

Drinking categories by gender	Sample	N	Drinking days in past year (F)				Mean 10g Drinks per Drinking Day in Past Year (Q)			
			Assumed from QF	Estimated (±95% CI)	t-statistic	F Ratio	Typical Day/QF	Typical Yesterday	t-statistic	Q Ratio
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)
Males										
Never	1,885									
Less than once a month	965	39	6	14.70 (±0.59)	**50.50** ***	**2.45**	2.61 (±0.23)	1.93 (±0.60)	**−2.38** *	**0.72**
Once a month	631	61	12	32.91 (±1.63)	**36.83** ***	**2.74**	3.59 (±0.30)	3.04 (±0.80)	−1.39 ns	0.85
2 to 3 times a month	1,258	225	30	67.67 (±0.91)	**63.99** ***	**2.26**	4.43 (±0.29)	2.82 (±0.74)	**−4.41** ***	**0.64**
1 to 2 times a week	2,200	858	78	140.27 (±1.07)	**189.93** ***	**1.95**	5.45 (±0.26)	3.55 (±0.32)	**−10.83** ***	**0.65**
3 to 4 times a week	1,756	1,209	182	249.21 (±1.16)	**163.97** ***	**1.37**	4.69 (±0.23)	3.72 (±0.25)	**−7.05** ***	**0.79**
5 to 6 times a week	1,400	1,182	286	303.92 (±1.73)	**41.47** ***	**1.06**	4.39 (±0.22)	4.18 (±0.32)	−1.29 ns	0.95
Every day	1,313	1,249	365	345.46 (±0.92)	**−65.56** ***	**0.95**	4.99 (±0.27)	4.95 (±0.32)	−0.31 ns	0.99
Total drinkers	9,523	4,823	148	172.14 (±2.90)	**20.93** ***	**1.16**	4.54 (±0.11)	4.00 (±0.15)	**−7.21** ***	**0.88**
Total	11,408									
Females										
Never	3,189									
Less than once a month	2,119	91	6	16.67 (±0.43)	**62.40** ***	**2.78**	2.23 (±0.13)	1.90 (±0.51)	−1.34 ns	0.85
Once a month	1,076	82	12	28.42 (±0.57)	**76.90** ***	**2.37**	2.80 (±0.19)	2.23 (±0.71)	−1.60 ns	0.80
2 to 3 times a month	1,935	301	30	55.57 (±0.55)	**115.59** ***	**1.85**	3.28 (±0.17)	2.24 (±0.30)	**−6.21** ***	**0.68**
1 to 2 times a week	2,374	869	78	130.60 (±1.01)	**146.17** ***	**1.81**	3.71 (±0.16)	2.76 (±0.30)	**−5.97** ***	**0.74**
3 to 4 times a week	1,622	1,067	182	237.74 (±1.15)	**133.07** ***	**1.31**	3.09 (±0.16)	2.51 (±0.17)	**−6.02** ***	**0.81**
5 to 6 times a week	1,034	884	286	311.52 (±1.49)	**36.09** ***	**1.09**	2.80 (±0.14)	2.69 (±0.18)	−1.58 ns	0.96
Every day	762	719	365	343.48 (±1.47)	**−32.48** ***	**0.94**	3.17 (±0.22)	3.05 (±0.23)	−1.67 ns	0.96
Total drinkers	10,922	4,013	103	127.51 (±2.69)	**20.40** ***	**1.24**	3.04 (±0.07)	2.66 (±0.10)	**−6.97** ***	**0.88**
Total	14,211									

Note: (A): Unweighted sample. (B): Unweighted yesterday drinkers. (C): Assumed drinking days using mid-points for each frequency category. (D): Estimated drinking days adjusted for design effects and age. (E): t-statistic for difference between (D) and (C). (F): Ratio of (D) and (C). (G): Mean drinks in a typical day per QF drinker adjusted for design effects and age. (H): Mean drinks yesterday for yesterday drinkers adjusted for design effects and age. (I): t-statistic for difference between (H) and (G). (J): Ratio of (H) and (G). t-test: ns=not significant

*P<0.05

**P<0.01

***P<0.001 (significant results in boldface).

Addiction. Author manuscript; available in PMC 2017 July 01.

Table 3

Estimated drinking days, drinks and correction factor for male and female drinkers in Canada (2008–2010) by comparing reported numbers of yesterday drinkers with frequencies expected from past year QF drinking frequency responses

Drinking categories by gender	Sample	N	Drinking Days in Past Year (F)				Mean 10g Drinks per Drinking Day in Past Year (Q)			
			Assumed From QF	Estimated (±95% CI)	t-statistic	F ratio	Typical day/QF	Typical Yesterday	t-statistic	Q Ratio
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)
Male										
Never	3,922									
Less than once a month	2,342	131	6	20.07 (±0.26)	106.05 ***	**3.34**	3.18 (±0.38)	2.97 (±0.98)	−0.39 ns	0.93
Once a month	1,748	200	12	42.32 (±0.79)	75.41 ***	**3.53**	2.95 (±0.27)	2.96 (±1.24)	−0.57 ns	0.88
2 to 3 times a month	2,418	549	30	82.66 (±0.80)	128.83 ***	**2.76**	3.73 (±0.31)	3.67 (±1.13)	−0.07 ns	0.99
Once a week	2,468	779	52	114.68 (±0.59)	208.92 ***	**2.21**	3.85 (±0.30)	3.43 (±0.48)	−1.28 ns	0.89
2 to 3 times a week	2,873	1,427	130	181.34 (±0.17)	592.83 ***	**1.39**	3.98 (±0.20)	4.10 (±0.43)	0.43 ns	1.03
4 to 6 times a week	920	685	260	271.12 (±1.88)	11.58 ***	**1.04**	4.22 (±0.36)	4.45 (±0.52)	0.69 ns	1.05
Every day	1,086	951	365	319.17 (±0.85)	−105.27 ***	**0.87**	4.16 (±0.42)	5.00 (±0.79)	**2.01** *	**1.20**
Total drinkers	13,855	4,722	90	128.44 (±0.28)	**73.21** ***	**1.43**	3.75 (±0.12)	3.79 (±0.13)	0.55 ns	1.02
Total	17,777									
Female										
Never	7,513									
Less than once a month	5,571	255	6	16.88 (±0.13)	160.69 ***	**2.81**	2.33 (±0.12)	2.73 (±1.41)	0.55 ns	1.17
Once a month	2,743	246	12	32.47 (±0.35)	113.85 ***	**2.71**	2.85 (±0.26)	2.21 (±0.39)	**−2.99** **	**0.77**
2 to 3 times a month	3,250	647	30	71.57 (±0.62)	132.29 ***	**2.39**	2.90 (±0.12)	2.31 (±0.36)	**−3.01** **	**0.80**
Once a week	2,686	792	52	109.04 (±0.63)	178.98 ***	**2.10**	2.81 (±0.15)	2.31 (±0.35)	**−2.35** *	**0.82**
2 to 3 times a week	2,384	1,109	130	168.58 (±0.81)	93.36 ***	**1.30**	3.42 (±0.55)	2.99 (±0.34)	−1.20 ns	0.87
4 to 6 times a week	636	451	260	258.07 (±1.42)	−2.68 **	**0.99**	2.68 (±0.26)	2.85 (±0.50)	0.78 ns	1.07
Every day	682	572	365	304.37 (±3.06)	−38.91 ***	**0.83**	5.22 (±1.95)	5.59 (±2.97)	0.49 ns	1.07
Total drinkers	17,952	4,072	57	121.58 (±0.16)	**70.30** ***	**1.53**	2.92 (±0.15)	2.61 (±0.30)	−1.90 ns	0.89
Total	25,465									

Note: (A): Unweighted sample. (B): Unweighted yesterday drinkers. (C): Assumed drinking days using mid-points for each frequency category. (D): Estimated drinking days adjusted for design effects and age. (E): t-statistic for difference between (D) and (C). (F): Ratio of (D) and (C). (G): Mean drinks in a typical day per QF drinker adjusted for design effects and age. (H): Mean drinks yesterday for yesterday drinkers adjusted for design effects and age. (I): t-statistic for difference between (H) and (G). (J): Ratio of (H) and (G). t-test: ns=not significant

*P<0.05

**P<0.01

***P<0.001 (significant results in boldface).

Table 4

Estimated drinking days, drinks and correction factor for male and female drinkers in US (2010) by comparing reported numbers of yesterday drinkers with frequencies expected from past year QF drinking frequency responses

Drinking categories by gender	Sample	N	Drinking Days in Past Year (F)				Mean 10g drinks per Drinking Day in Past Year (Q)			
			Assumed From QF	Estimate (±95% CI)	t-statistic	F ratio	Typical day/QF	Yesterday	t-statistic	Q ratio
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)
Male										
Never	905									
Less than once a month	381	12	6	12.43 (±0.81)	15.63 ***	**2.07**	2.51 (±0.32)	3.89 (±1.76)	1.53 ns	1.55
Once a month	284	21	12	32.07 (±0.60)	57.15 ***	**2.67**	3.04 (±0.52)	3.12 (±2.38)	0.06 ns	1.03
2 to 3 times a month	356	42	30	49.14 (±2.67)	14.04 ***	**1.64**	3.26 (±0.50)	1.72 (±0.67)	−3.79 ***	**0.53**
1 to 2 times a week	502	131	78	89.89 (±1.47)	17.93 ***	**1.22**	3.50 (±0.29)	3.30 (±0.71)	−0.45 ns	0.95
3 to 4 times a week	307	168	182	205.24 (±3.18)	14.37 ***	**1.13**	3.93 (±0.49)	3.75 (±0.73)	−0.39 ns	0.95
5 to 6 times a week	95	75	286	285.92 (±8.11)	−0.02 ns	1.00	3.70 (±1.09)	5.75 (±0.23)	1.35 ns	1.56
Every day	234	202	365	308.32 (±4.63)	−24.01 ***	**0.84**	8.26 (±4.90)	7.78 (±2.42)	−0.19 ns	0.94
Total drinkers	2,159	651	105	107.72 (±5.39)	**11.05** ***	**1.02**	3.99 (±0.57)	3.85 (±0.83)	−0.24 ns	0.96
Total	3,064									
Female										
Never	2,157									
Less than once a month	961	24	6	10.83 (±0.85)	11.10 ***	**1.81**	2.13 (±0.22)	2.37 (±1.23)	0.30 ns	1.11
Once a month	392	28	12	29.27 (±1.71)	19.81 ***	**2.44**	2.41 (±0.31)	2.95 (±1.05)	0.97 ns	1.22
2 to 3 times a month	493	71	30	52.56 (±0.90)	49.03 ***	**1.75**	2.20 (±0.17)	2.11 (±0.62)	−0.26 ns	0.96
1 to 2 times a week	452	120	78	85.19 (±1.43)	12.60 ***	**1.19**	2.48 (±0.24)	3.60 (±1.08)	1.86 ns	1.45
3 to 4 times a week	242	131	182	188.03 (±6.89)	1.72 ns	1.03	2.77 (±0.38)	2.60 (±0.53)	−0.46 ns	0.94
5 to 6 times a week	56	47	286	293.23 (±26.5)	0.53 ns	1.03	4.07 (±1.75)	4.42 (±1.29)	0.33 ns	1.09
Every day	139	113	365	298.98 (±4.34)	−29.85 ***	**0.82**	3.82 (±1.34)	3.91 (±1.06)	0.13 ns	1.02
Total drinkers	2,735	534	64	74.60 (±4.12)	**11.40** ***	**1.16**	2.73 (±0.27)	3.09 (±0.41)	1.46 ns	1.14
Total	4,892									

Note: (A): Unweighted sample. (B): Unweighted yesterday drinkers. (C): Assumed drinking days using mid-points for each frequency category. (D): Estimated drinking days adjusted for design effects and age. (E): t-statistic for difference between (D) and (C). (F): Ratio of (D) and (C). (G): Mean drinks in a typical day per QF drinker adjusted for design effects and age. (H): Mean drinks yesterday for yesterday drinkers adjusted for design effects and age. (I): t-statistic for difference between (H) and (G). (J): Ratio of (H) and (G). t-test: ns=not significant

*P<0.05

**P<0.01

***P<0.001 (significant results in boldface).

Table 5

Estimated drinking days, drinks and correction factor for male and female drinkers in England (2011) by comparing reported numbers of yesterday drinkers with frequencies expected from past year Beverage-Specific QF drinking frequency responses

Drinking categories by gender	Sample	N	Drinking Days in Past Year (F)				Mean 10g Drinks per Drinking Day in Past Year (Q)			
			Assumed From QF	Estimate (±95% CI)	t-statistic	F ratio	Typical day/QF	Yesterday*	t-statistic	Q Ratio
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)
Male										
Never	461									
Once or twice a year	127	3	2	2.43 (±0.52)	3.66***	**1.62**	6.62 (±1.91)	3.69 (±2.72)	**−2.20***	**0.56**
Once every 2 months	149	6	6	14.35 (±0.44)	35.91***	**2.39**	6.66 (±1.39)	4.82 (±3.68)	−0.95 ns	0.72
Once or twice a month	319	36	18	41.56 (±0.58)	82.05***	**2.31**	7.56 (±0.86)	3.02 (±1.68)	**−4.54****	**0.40**
Once or twice a week	730	196	78	97.83 (±0.07)	508.10***	**1.25**	6.14 (±0.43)	4.58 (±0.81)	**−3.30****	**0.75**
Three or four days a week	420	194	182	166.62 (±2.94)	−10.16***	**0.92**	5.50 (±0.45)	5.30 (±0.87)	−0.42 ns	0.96
Five or six days a week	141	89	286	229.65 (±3.60)	−32.53***	**0.80**	4.36 (±1.00)	4.36 (±0.99)	0.02 ns	1.00
Almost every day	357	289	338	290.89 (±4.87)	−18.90***	**0.86**	5.66 (±0.99)	5.95 (±0.83)	0.85 ns	1.05
Total drinkers (adjust)	2,243	813	134	125.50 (±3.80)	−4.24***	**0.94**	6.23 (±0.30)	5.23 (±0.41)	**−4.30*****	**0.84**
Total	2,704									
Female										
Never	882									
Once or twice a year	305	5	2	6.36 (±0.82)	11.40***	**4.24**	4.00 (±0.66)	1.88 (±1.26)	**−2.85****	**0.47**
Once every 2 months	364	24	6	24.85 (±0.71)	49.56***	**4.14**	5.28 (±0.66)	2.29 (±0.87)	**−5.15*****	**0.43**
Once or twice a month	471	56	18	42.65 (±0.92)	49.89***	**2.37**	4.96 (±0.48)	2.96 (±0.61)	**−5.17*****	**0.60**
Once or twice a week	834	178	78	77.79 (±0.23)	−1.78 ns	1.00	4.47 (±0.27)	3.32 (±0.55)	**−3.73*****	**0.74**
Three or four days a week	377	174	182	166.75 (±3.22)	−9.20	**0.92**	4.12 (±0.46)	4.13 (±0.75)	0.04 ns	1.00
BFive or six days a week	94	60	286	214.43 (±13.82)	−10.05***	**0.75**	3.08 (±0.82)	3.35 (±1.17)	0.75 ns	1.09
Almost every day	230	172	338	272.26 (±3.58)	−36.86***	**0.81**	3.70 (±0.42)	4.55 (±0.90)	1.66 ns	1.23
Total drinkers (adjust)	2,675	669	93	88.17 (±3.01)	−3.07***	**0.95**	4.54 (±0.19)	3.86 (±0.36)	**−3.51*****	**0.85**
Total	3,557									

Note: (A): Unweighted sample. (B): Unweighted yesterday drinkers. (C): Assumed drinking days using mid-points for each frequency category. (D): Estimated drinking days adjusted for design effects and age. (E): t-statistic for difference between (D) and (C). (F): Ratio of (D) and (C). (G): Mean drinks in a typical day per QF drinker adjusted for design effects and age. (H): Mean drinks yesterday for yesterday drinkers adjusted for design effects and age. (I): t-statistic for difference between (H) and (G). (J): Ratio of (H) and (G). t-test: ns=not significant

*P<0.05

**P<0.01

***P<0.001 (significant results in boldface).

Table 6

Coverage of age 15+ per capita consumption with successive adjustments for under- or over-reporting of Drinking Quantity (Q), Frequency (F) and Volume (QxF) for each country

Country	Years	15+ Per Capita Alcohol Consumption	Unadjusted QF Survey Estimate		Survey estimate uplifted by Q only		Survey estimate uplifted by F only	
			L/person	% covered	L/person	% covered	L/person	% covered
Australia	2010	10.53	4.73	44.90	4.11	39.00	5.41	51.40
Canada	2008–10	8.13	2.53	31.12	2.71	33.33	3.70	45.51
USA	2010	8.60	3.14	36.51	3.10	36.05	3.26	37.91
England	2011	9.30	5.35	57.51	5.10	54.87	5.32	57.25

Note: The estimates were based on the number of self-reported drinks where one US standard drink is assumed to be 17.7 ml of ethanol, one Australian standard drink = 12.7 ml, one Canadian standard drink = 17.05 ml and one UK standard unit = 10 ml.