



ORIGINAL ARTICLE

Influence of the recall period on a beverage-specific weekly drinking measure for alcohol intake

O Ekholm¹, K Strandberg-Larsen² and M Grønbaek¹

¹National Institute of Public Health, University of Southern Denmark, Copenhagen, Denmark and ²Social Medicine Section, Department of Public Health, University of Copenhagen, Copenhagen, Denmark

Background/Objectives: Our knowledge of the association between alcohol intake and alcohol-related health outcomes depends, to a large extent, on the validity and reliability of self-reported alcohol intake. Weekly drinking measures are frequently used in epidemiological surveys, but it has been shown that respondents have problems in correctly reporting intake for a full week. The aim of this study is to investigate whether a beverage-specific question implies better recall and, thereby, eliminates or diminishes the previously reported association between the recall period and the self-reported weekly alcohol intake.

Subjects/Methods: The data is derived from the Danish Health Interview Survey 2005, which is based on a region-stratified random sample of 21 832 Danish citizens aged ≥ 16 years (response rate: 67%). The data were collected via face-to-face interviews.

Results: A beverage-specific question on alcohol intake on each day during the last week did not alter the strong association between the recall period and self-reported alcohol intake. However, the overall self-reported alcohol intake increased substantially when using the beverage-specific question instead of asking for the overall alcohol intake on each day. Moreover, the analyses indicated that interviews on Sundays should be avoided if the purpose is to assess alcohol intake for the previous day (Saturdays).

Conclusions: It seems problematic to recall alcohol intake even when the recall period is as short as 1 week. Weekly drinking measures should primarily be used when the main aim of the study is to assess the average volume of alcohol intake in a specific population.

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Introduction

Assessing alcohol intake in population surveys has been shown to be associated with various methodological issues. Owing to the importance of estimating the association between alcohol intake and alcohol-related health outcomes, validity and reliability are essential issues. The so-called weekly drinking measure (often called the 7-day recall measure) is frequently used in epidemiological surveys (Rehm, 1998). In a previous version of the Danish Health Interview Survey 1994 (Kjøller *et al.*, 1995) it was shown that, although the recall period is only 1 week, respondents experience difficulties in correctly reporting alcohol intake for a full week (Ekholm, 2004). The 1994 survey respondents

were asked how many alcoholic drinks they had each day during the last week. There is a widespread agreement that beverage-specific questions result in higher reported alcohol intake than more general questions (Russell *et al.*, 1991; Rehm, 1998; Feunekes *et al.*, 1999; Serdula *et al.*, 1999; Ekholm *et al.*, 2008). In the most recent Danish Health Interview Survey (2005), a beverage-specific question was used to assess how many alcoholic drinks the respondent had each day during the last week. This enables an evaluation whether a beverage-specific question implies better recall and, thereby, diminishes the previously observed association between the recall period and the self-reported alcohol intake.

Subjects and methods

Data derives from the national representative Danish Health Interview Survey in 2005 (Ekholm *et al.*, 2006, 2009). The main purpose of the Danish Health Interview Surveys

Correspondence: Dr O Ekholm, National Institute of Public Health, University of Southern Denmark, Øster Farimagsgade 5A, second floor, 1353 Copenhagen K, Denmark.

E-mail: oek@niph.dk

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is to describe the status and trends in health and morbidity in the adult population (≥ 16 years) and the factors that influence health status, including health behaviour and health habits, lifestyles, environmental and occupational health risks and health resources. The sample in 2005 was drawn from the Danish Civil Registration System (each Dane has a unique personal registration number). All selected persons received a letter of introduction that briefly described the purpose and content of the survey, emphasising that participation was voluntary. The survey was based on a region-stratified random sample of 21 832 Danish citizens, out of which 14 566 individuals (67%) completed the interview. Data were collected via face-to-face interviews at the respondents' home during the period May 2005 to March 2006 to account for a possible seasonal effect. Respondents who reported no alcohol use within the last year were excluded from the main analyses (768 individuals). In addition, 142 individuals with missing values on the question about alcohol intake in the last week were excluded. Hence, the final study population consisted of 13 656 individuals. However, it should be mentioned that the 12-month abstainers were included in the initial descriptive analyses regarding the mean weekly alcohol intake, and the distribution of alcohol intake by sex and age in Denmark.

In a previous version of the Danish Health Interview Survey (1994), the question on alcohol intake concerned how many alcoholic drinks the respondent had each day during the last week (Ekholm, 2004). In the most recent Danish Health Interview Survey, this question was replaced by a beverage-specific question (Table 1). The total alcohol intake was computed as the sum of the five types of beverages. Intake was measured in number of standard drinks (one drink contains ~ 12 g of alcohol), which corresponds to one bottle of beer (33 cl), one table glass of wine or one shot of spirits (4 cl). The equivalent number of standard drinks is shown on most cans and bottles of alcoholic

Table 1 Question about alcohol intake in the Danish Health Interview Survey 2005 (English translation)

How many standard alcoholic drinks did you consume each day last week? You may answer in the categories beer, white wine, red wine, fortified wine and spirits. Let us start with yesterday:

	Beer	White wine	Red wine	Fortified wine	Spirits
Monday	—	—	—	—	—
Tuesday	—	—	—	—	—
Wednesday	—	—	—	—	—
Thursday	—	—	—	—	—
Friday	—	—	—	—	—
Saturday	—	—	—	—	—
Sunday	—	—	—	—	—

1 Bottle of beer = 1 standard drink, 1 bottle of strong beer = 1.5 standard drinks, 1 glass red or white wine = 1 standard drink, 1 bottle of red or white wine = 6 standard drinks, 1 glass of fortified wine = 1 standard drink, 1 bottle of fortified wine (70 cl) = 10 standard drinks, 1 glass of aquavit = 1 standard drink, 1 bottle of spirits (75 cl) = 25 standard drinks.

beverages in Denmark. In addition, public educational campaigns often use the term 'standard drinks' to encourage sensible drinking. Hence, the general Danish population is assumed to be familiar with the term and size of a 'standard drink'. The footnotes that are shown in Table 1 (for example, one bottle of beer = one drink) were used to help the interviewer to convert different self-reported drinks into the correct number of standard drinks but not shown to the respondents. The interviews were carried out on all 7 days of the week and the weekday of the interview was noted.

To make a comparison with the former study, we decided *a priori* to categorize the daily alcohol intake into high, moderate and no-intake categories. The definition of high intake was defined with the Danish National Board of Health's sensible drinking limits in mind (Grønbaek *et al.*, 1997; Mørch *et al.*, 2005). According to this definition, an intake of more than 21 drinks per week for men and more than 14 drinks per week for women are discouraged because of the possible negative health effects. Therefore, an average intake of more than three drinks per day for men and two drinks per day for women exceeds the recommended weekly alcohol limit and was therefore defined as high intake. A daily intake of one to three drinks for men (one to two drinks for women) was defined as moderate intake. Hence, the variables defining alcohol intake for each of the 7 days of the week have the natural ordering response categories, namely, high, moderate and no alcohol intake.

Statistical analysis

For each day of the week, cumulative logits were modelled by performing ordinal logistic regression using the unconstrained partial proportional odds model with self-reported alcohol intake as the dependent variable and the recall period as the predictor variable (Stokes *et al.*, 2000). The cumulative logits are the log odds of high intake versus moderate intake or no intake and the log odds of high or moderate intake versus no intake, respectively. Both log odds focus on higher to less higher intake and odds ratios describe the association between the self-reported alcohol intake and different recall periods. The proportional odds model takes both of these odds into account and, therefore, the odds ratio for a predictor variable can be interpreted as a summary of the odds ratios obtained from separate dichotomous logistic regressions using both cut points of the ordinal outcome (Scott *et al.*, 1997). Adjustments were made for potential confounders such as gender, age, cohabitation status and combined school and vocational education. The analyses were performed using SAS version 9.1 (SAS Institute Inc., Cary, NC, USA).

Results

The mean number of standard drinks in the last week was 9.5 (including 12-month abstainers) and it was higher for

Table 2 Percentage of respondents reporting a given number of standard drinks in the last week by sex and age

	16–24 years	25–44 years	45–64 years	≥ 65 years	All
Men					
0 Drinks	21.7 (2.2)	17.1 (2.6)	12.1 (3.5)	14.2 (4.0)	15.2 (3.2)
1–7 Drinks	24.3	35.9	28.2	31.8	31.2
8–14 Drinks	17.3	20.9	23.2	21.6	21.5
15–21 Drinks	14.1	12.5	15.3	14.2	14.0
22–29 Drinks	7.9	6.9	8.9	8.9	8.1
≥ 30 Drinks	14.7	6.6	12.4	9.4	10.0
Total	100	100	100	100	100
No. of respondents	705	2349	2575	1362	6991
Women					
0 Drinks	36.7 (5.5)	34.5 (5.9)	19.5 (4.3)	35.7 (14.7)	29.5 (7.2)
1–7 Drinks	33.2	43.2	43.7	39.3	41.3
8–14 Drinks	19.8	14.6	22.2	15.0	17.8
15–21 Drinks	6.1	4.3	7.9	5.2	5.9
22–29 Drinks	2.2	1.9	3.6	2.2	2.6
≥ 30 Drinks	2.1	1.5	3.2	2.6	2.4
Total	100	100	100	100	100
No. of respondents	716	2456	2664	1597	7433

The proportion of 12-month abstainers is presented in brackets.

men (13.0) than for women (6.3). The self-reported intake was considerably higher than the means in 1994 (all adults: 8.1 drinks; men: 11.1; women: 5.3) and 2000 (all adults: 8.3 drinks; men: 11.3; women: 5.4). Table 2 shows the overall alcohol intake in the study population (including 12-month abstainers) in the last week by sex and age. In all, 18.1% of men and 10.9% of women exceeded the sensible drinking limits in the last week. In all age groups, a higher proportion of men than women exceeded the sensible drinking limits. A total of 15.2% of men and 29.5% of women did not have any alcohol intake in the last week. Furthermore, 3.2% of men and 7.2% of women did not use alcohol during the last year.

The distribution of alcohol intake by the type of beverage for men and women is shown in Table 3. Beer was the predominant alcoholic beverage among men (beer accounts for 53% of the total alcohol consumption), whereas the most predominant alcoholic beverage was red wine (48% of the total alcohol consumption) among women. In general, the distribution of the intake on weekdays was similar to that of weekends. However, the proportion of spirits in the total alcohol intake was higher on Fridays and Saturdays compared with other days of the week among both men and women.

Table 4 shows the sum of the total reported alcohol intake for different recall periods. For example, the estimated weekly intake would have been ~10.6 drinks if the recall period was 1 day. However, the estimated weekly intake would have been only about 9.1 drinks if we had used a recall period of 7 days. The table also shows that the reported

Table 3 The distribution of alcohol intake by type of beverage (percentage of the total alcohol intake) for men and women

	Beer	White wine	Red wine	Fortified wine	Spirits	Total	Respondents with alcohol intake
Men							
Monday	59	7	25	1	9	100	2544
Tuesday	57	6	27	1	9	100	2590
Wednesday	56	6	29	1	9	100	2619
Thursday	54	6	28	1	11	100	2527
Friday	53	5	27	1	14	100	3819
Saturday	48	6	28	2	16	100	4735
Sunday	51	6	31	2	11	100	3399
Overall week	53	6	28	1	12	100	5927
Women							
Monday	26	12	50	2	10	100	1594
Tuesday	26	13	50	4	7	100	1586
Wednesday	25	13	52	2	9	100	1607
Thursday	27	12	50	2	10	100	1683
Friday	25	12	46	2	14	100	2826
Saturday	22	13	45	3	17	100	3837
Sunday	23	14	49	2	11	100	2471
Overall week	24	13	48	2	13	100	5194

Table 4 The weekly sum of the reported (crude) mean daily alcohol intake for different recall periods

Time lapses between day of interview and self-reported alcohol intake	Men	Women	All
1 Day	13.9	6.9	10.6
2 Days	13.7	7.5	10.7
3 Days	13.4	6.4	9.9
4 Days	13.2	6.5	9.9
5 Days	13.5	6.4	10.0
6 Days	12.4	6.6	9.6
7 Days	11.9	6.0	9.1

alcohol intake declines for both men and women when the recall period increases. Note that these are crude estimates, and therefore not adjusted for potential confounding factors.

Table 5 shows, for each day in the last week, the associations between self-reported alcohol intake and different recall periods (all $P < 0.01$). In all analyses, individuals with the shortest recall period (1 day) were used as the reference group. The analyses showed proportional odds for the predictor variable recall period. Hence, the log cumulative odds are proportional to the distance between the recall period values and the influence of the recall period is independent of the cutoff point for the cumulative logit. The table shows that the respondents' reporting of alcohol intake declines when the recall period increases. The decline is remarkable already after 2–3 days. For example, the analysis of the reported intake on the last Tuesday shows that respondents with a recall period of 2 days had 0.76 times lower odds of reporting higher intake to lower alcohol intake compared with those with a recall period of 1 day. The clear association between the recall period and alcohol intake was

Table 5 Odds ratio of reporting higher intake to less higher intake for each day during the last week by recall period

Time lapses between day of interview and self-reported alcohol intake	Reported alcohol intake for each day during the last week						
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
1 Day	1	1	1	1	1	1	1
2 Days	0.87 ^a	0.76 ^a	0.74 ^a	0.72 ^a	0.81	1.24 ^a	0.94
3 Days	0.74 ^a	0.64 ^a	0.68 ^a	0.61 ^a	0.85	1.18	0.84 ^a
4 Days	0.71 ^a	0.58 ^a	0.50 ^a	0.65 ^a	0.81 ^a	1.21	0.84 ^a
5 Days	0.60 ^a	0.48 ^a	0.63 ^a	0.64 ^a	0.83	1.12	0.74 ^a
6 Days	0.50 ^a	0.58 ^a	0.64 ^a	0.66 ^a	0.77 ^a	0.93	0.70 ^a
7 Days	0.58 ^a	0.56 ^a	0.60 ^a	0.59 ^a	0.63 ^a	0.85	0.55 ^a
Mean intake (s.d), including 12-month abstainers	0.8 (2.5)	0.8 (2.6)	0.9 (2.7)	0.9 (2.7)	1.9 (4.3)	2.9 (5.1)	1.2 (3.0)

The odds ratios are adjusted for gender, age, cohabitation status and combined school and vocational education.

^aThe 95% confidence limits does not contain the value 1, indicating that the reported alcohol intake is significantly different from the reference group (1 day).

found for each day of the week and stratification by gender did not change the results (data not shown). However, respondents that were interviewed on Sundays were less likely to report higher alcohol intake for Saturdays than respondents interviewed on Mondays. The analyses were also conducted separately for each type of beverage. Fortified wine was combined with spirits because of the low number of individuals that reported that they had fortified wine in the last week. A clear relationship between the recall period and reported alcohol intake was found for each type of beverage (data not shown). Table 5 also shows the mean self-reported alcohol intake for each day during the last week (including 12-month abstainers). The highest means were reported for Saturdays (2.9 drinks) and Fridays (1.9 drinks). The means were also calculated separately for each gender (data not shown). For both men and women the highest means were reported for Saturdays (men: 3.9 drinks; women: 2.0 drinks) and Fridays (men: 2.6 drinks; women: 1.3 drinks).

Discussion

In comparison with the previous Danish Health Interview Surveys, the self-reported alcohol intake increased substantially when the beverage-specific question was used in 2005. However, the more specific question did not eliminate (or even diminish) the strong association between the recall period and the self-reported alcohol intake that was found in a previous study (Ekholm, 2004). The results did not differ when stratifying for gender or type of beverage.

The finding that respondents interviewed on Sundays report relatively low alcohol intake for Saturdays is interesting. In the central and the northern parts of Europe, alcohol intake is higher on weekends, which may be linked to the common 5-day working schedule (Simpura and Karlsson, 2001). Hence, a possible explanation could be that individuals with a high intake on a given Saturday are being unwilling (or unable) to be interviewed on the following day. Religious factors are most likely of minor importance.

In general, Danes are not very religious and church attendance is low. Results from the Danish Health Interview Survey 2005 show that only 8.4% of Danes actively practise religion (such as attending church services, meditation, prayer and reading religious texts) at least a few times a week.

A major disadvantage with short-term recall methods is that there is often a large time variation in drinking (that is, intake may vary according to season). For example, the reference period may not accurately reflect the individual's typical alcohol consumption and infrequent drinkers may be misclassified as abstainers (Dawson, 2003). It has also been suggested that short-term recall methods provide underestimates of the proportion of high risk drinkers (Rehm *et al.*, 1999). These issues may have a significant effect on the possibility of identifying associations between alcohol intake and health outcomes in epidemiological studies. Therefore, short-term recall methods are more useful when the main objective of the survey is to assess the average volume of alcohol consumption in a certain population (Dawson, 2003). An alternative approach could be to ask about the intake for each day in a typical week as this method will take into account the large variation in drinking habits over time. A recent Danish study showed that it is feasible to use this kind of measure in epidemiological studies (Ekholm *et al.*, 2008). This question about the intake for each day in a typical week could be supplemented by a measure of binge drinking frequency in order to identify infrequent binge drinkers.

Several studies have shown that the mean alcohol content of drinks (both drinks consumed at home as well as drinks purchased in restaurants or other licensed establishments) is larger than the definition of a standard drink (Lemmens, 1994; Kerr *et al.*, 2005, 2008). These studies also show that the discrepancy is larger in spirits and wine drinks than for beer. The main reason is probably that spirit and wine drinkers often pour their own servings (Kerr *et al.*, 2005). Beer is mostly consumed from single-serving containers (generally bottled in 33 cl format in Denmark). It has been suggested that studies should incorporate protocols that allow for the subject to measure their drinks using actual

vessels from their home (Kaskutas and Kerr, 2008). If this is not possible, photographs of glasses may be an acceptable option to assess drink size. In Denmark, most alcoholic beverage labels include the equivalent number of standard drinks and the term 'standard drink' is well known by the general Danish population. In Australia, all alcoholic beverages are required to state on the label the number of standard drinks they contain. Nevertheless, a study showed that the alcohol content of drinks is larger than the defined standard drink (Stockwell *et al.*, 2008). The study showed that the amount of ethanol in a typical Australian standard drink is 12.8 g compared with 10 g in an official Australian standard drink. An official standard drink in Denmark is equivalent to 12 g of alcohol but the amount in a typical Danish standard drink is unknown, and likely to vary with type of alcohol. However, the underestimation, because of the size or strength of the drink, is most likely smaller in Denmark than in other countries because the general Danish population is familiar with the term 'standard drink'. We find no reason to believe that this issue has affected the conclusion of this study.

Official sales data showed that Danes drank ~11.31 of pure alcohol per person (aged ≥ 14 years) in 2005 (Statistics Denmark, 2010). Self-reported alcohol intake in this study thus accounted for 73% of the sales statistics. However, it should be mentioned that official sales data may not reflect the actual consumption in Denmark. For example, the increasing cross-border trade in the region has made the validity of official sales data more unclear (Hellman and Ramstedt, 2009).

The validity of self-reported alcohol intake has been debated and questioned in many studies. However, for most research purposes, self-reported drinking measures are generally considered to be valid (Del Boca and Noll, 2000; Del Boca and Darkes, 2003). Self-reported measures are also considered to be the best method to obtain information about moderate alcohol intake (Alvik *et al.*, 2005). Self-reported measures are also relatively cheap to obtain as well as acceptable for the respondents to give (Del Boca and Darkes, 2003). An alternative assessment method is to use so-called biomarkers, to indicate current or past alcohol intake. A biomarker is 'a characteristic that is objectively measured and evaluated as an indicator of normal biological processes, pathogenic processes or pharmacological responses to a therapeutic intervention' (Biomarkers Definition Working Group, 2001). Examples of biomarkers that are used to measure past ethanol intake include phosphatidylethanol, alanine aminotransferase and fatty acid ethyl esters. Biomarkers have the advantage that they objectively assess alcohol intake (Babor *et al.*, 2000). However, some major limitations are the costs, that raised levels may result from other causes than heavy drinking (for example, age, use of prescribed drugs, digestive diseases and liver disorders of non-alcoholic origin), and the problems to identify other patterns of drinking than chronic, heavy drinking (Peterson, 2004–2005). Several research programmes are trying to develop a biomarker that allows for accurate assessment of

alcohol intake and drinking patterns and the future looks quite bright (Freeman and Vrana, 2010). But self-reported measures are still (and probably will be for many years to come) preferable when assessing alcohol intake in studies of the general population. In addition, declining response rates in epidemiological surveys have been observed over the past decades and this is perceived as an increasing problem for the validity of survey results (Hartge, 2006; Galea and Tracy, 2007; Ekholm *et al.*, 2009). Changing the declining response rate trend is a great challenge for survey researchers. Including the biomarkers in the epidemiological surveys will increase the respondent burden and is, therefore, likely to have a negative effect on the response rate. Another method suggested for assessing alcohol intake is daily reports (Leigh, 2000). Prospective drinking measures are often assumed to be more accurate than retrospective drinking measures. However, prospective drinking diaries are also burdensome for the respondents and this may also affect the response rate negatively (Leigh, 2000). Leigh also states that daily data collection is expensive and may lead to reactivity (that is, changes in alcohol intake as individuals become more aware of it).

In conclusion, the self-reported alcohol intake increased substantially when using a beverage-specific question instead of an overall alcohol measure; nevertheless, the beverage-specific question did not alter the strong association between the recall period and self-reported alcohol intake. This indicates that it may be problematic to recall alcohol intake for a full week.

Conflict of interest

The authors declare no conflict of interest.

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