

ORIGINAL ARTICLE

Comparison of assessment methods for self-reported alcohol consumption in health interview surveys

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Objective: To select a simple method for assessing alcohol consumption and to compare how different reference periods and response categories influence the self-reported frequency of binge drinking.

Design: Four random samples of 1000 adult Danes. Data were collected via personal interview at the respondents' home.

Setting: Denmark, nationwide.

Participants: The total number of interviewed was 2593 individuals.

Measurements: The assessment methods in the four samples were (1) the 7-day recall method, (2) intake each day in a typical week, (3) intake last weekend, and (4) intake in a typical week. Furthermore, binge drinking was assessed in the samples using different reference periods and response formats.

Findings: The sex- and age-adjusted mean number of drinks in the last week (the 7-day recall method) was 10.6 drinks compared to 10.4 drinks among respondents reporting their intake for each day in a typical week and 8.7 drinks among subjects reporting the average intake in a typical week. Furthermore, subjects that reported their typical intake for each day were as likely as subjects that had the 7-day recall method to report a high weekly alcohol intake. Respondents who had close-ended questions were more likely to report binge drinking compared to respondents that had open-ended questions.

Conclusions: Questions concerning typical alcohol intake for each day of the week are feasible to use in epidemiological studies. Furthermore, it is more appropriate to use close-ended questions compared to open-ended questions in measuring binge-drinking when the reference period is long.

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Introduction

The difficulties with assessing self-reports of alcohol consumption in a population have been widely discussed (Midanik, 1989; Embree and Whitehead, 1993; Grønbæk and Heitmann, 1996; Del Boca and Darkes, 2003). One of the advantages with using self-reports of alcohol intake in comparison with, for example, sales figures is that it is possible to estimate the alcohol intake according to different

sociodemographic characteristics. It is, of course, also possible to evaluate the progress of health promotion programmes addressing alcohol intake in different sociodemographic groups. Another advantage with using self-reported information is that it is possible to link individual drinking behaviour with mortality and morbidity. The sensible drinking limits in Denmark (Grønbæk *et al.*, 1997; Mørch *et al.*, 2005) as well as in many other countries (Department of Health, 1995; National Health and Medical Research Council, 2001; Andréasson and Allebeck, 2005) are, to a great extent, based on the many epidemiologic studies that have used self-reported information. This underlines the importance that the self-reported intake is as adequate as possible.

It has been anticipated that more specific questions result in higher reported alcohol intake (Dawson, 1998; Rehm, 1998; McCann *et al.*, 1999). For example, there is a widespread agreement that beverage-specific questions yields higher reported alcohol intake compared to global

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questions (Russell *et al.*, 1991; Lemmens *et al.*, 1992; Dawson, 1998; Rehm, 1998; Feunekes *et al.*, 1999; Serdula *et al.*, 1999). Furthermore, some studies have suggested that questions concerning typical intake underestimate alcohol intake in comparison with so-called short-term recall methods (Lemmens *et al.*, 1992; Stockwell *et al.*, 2004). The so-called weekly drinking measure (often also called the 7-day recall measure) is widely used in epidemiological surveys. This assessment method asks respondents about their alcohol intake each day during the last week. There exists a large time variation in drinking, and thereby a measure for the intake in the past week may not accurately represent the typical alcohol consumption. In addition, respondents seem to have difficulties in correctly reporting alcohol intake even when the recall period is as short as one week (Ekholm, 2004). The consequence could be that some respondents will be misclassified and, hence, possibly lead to either an over- or underestimation of the true association between drinking habits and the health or social outcomes. Hence, a question that adequately assesses the typical weekly consumption would be valuable for researchers throughout the world.

The purpose of this study was to select a simple method for assessing the average alcohol consumption and to compare how different reference periods and response categories influence the self-reported frequency of binge drinking.

Material and methods

Data derives from a national representative Health Interview Survey carried out in the summer of 2003. In the present

survey, four random samples of 1000 adult Danish citizens (age 18 or more) in each were drawn from the Danish Civil Person Register. All selected subjects received a letter of introduction that briefly described the purpose and content of the survey and it was emphasized that participation was voluntary. The data were collected via personal interview at the respondents' home. Trained interviewers carried out the data collection and all interviewers conducted interviews in all four samples. The overall response rate was 65.2% (sample 1: 64.7%; sample 2: 63.0%; sample 3: 65.5%; sample 4: 67.5%).

All respondents were asked how many beers they consumed during the last weekday (i.e. Monday to Thursday). The question was repeated for each of the following beverages: strong beer; red and white wine; liqueurs; spirits; ready to drink products (premixed spirits). This question was included as an attempt to check whether the four samples had similar alcohol habits. Furthermore, all respondents were asked identical questions on sociodemographic characteristics (marital status and educational status). Educational status was classified according to The International Standard Classification of Education (ISCED), which combines school and vocational education.

Table 1 shows the different beverage-specific questions that were used to assess alcohol intake. The consumption in sample 1 was estimated using the 7-day recall method. The question in sample 2 is almost identical to the question in sample 1, but asks about the intake on each day in a typical week. The questions in samples 3 and 4 ask about the intake, the last weekend and the weekly average intake, respectively. Hence, it is possible to estimate the weekly intake from the questions in samples 1, 2 and 4 and from the questions in

Table 1 Questions concerning alcohol drinking habits in the four samples

<i>Sample</i>			
1	2	3	4
<i>Questions concerning alcohol intake^a</i>			
How many alcoholic drinks did you have each day last week? We'll start with yesterday and take one day at a time ^a	How many alcoholic drinks do you have each day in a typical week? We'll start with Monday and take one day at a time ^a	How many drinks did you have during the last weekend? (that includes Friday, Saturday and Sunday) ^a	How many alcoholic drinks do you have on average per week? ^a
<i>Questions concerning binge drinking</i>			
How many times did you have five or more drinks on a single occasion within the past 3 months?	How many times did you have five or more drinks on a single occasion within the past 3 months?	How many times did you have five or more drinks on a single occasion within the past year?	How many times did you have five or more drinks on a single occasion within the past year?
<i>Response categories</i>			
Close-ended response categories ^b	Open-ended response format	Close-ended response categories ^b	Open-ended response format

1 bottle of beer = one drink; one bottle of spirits = 25 drinks.

1 bottle of strong beer = 1.5 drinks; one glass red/white wine = one drink.

1 bottle of red/white wine = six drinks; one glass of liqueur = one drink.

1 bottle of liqueur 70 cl. = 10 drinks; one glass of aquavit = one drink.

1 drink = 12 g of alcohol.

^aBeverage-specific (beer; strong beer; red and white wine; liqueurs; spirits; ready to drink products).

^bResponse categories: never; less than once a month; approximately 1–3 times a month; approximately once a week; more than once a week.

samples 1–3 it is possible to estimate the weekend intake. The intake was measured in number of drinks, with one drink equalling approximately 12 g (or 15 ml) of pure alcohol.

Furthermore, the respondents were asked different questions concerning binge drinking (five or more alcoholic drinks on one occasion). The questions concerning binge drinking (Table 1) were used to investigate the difference between different reference periods (3 months and 1 year), and the difference between an open-ended response format and a close-ended response format.

Statistical analysis

The sex- and age-adjusted mean number of alcoholic drinks was estimated using a direct standardization method. The weights for the standardization variable were proportional to the sex and the age distribution in the Danish population in 2003. The Danish National Board of Health's sensible drinking limits (21 drinks per week for men and 14 drinks per week for women) were used to define high alcohol intake. An intake of more than nine drinks per weekend (an average of three or more drinks per day) for men and six drinks per weekend (an average of two or more drinks per day) exceeds the recommended weekly alcohol limit and was therefore defined as a high weekend alcohol intake. Logistic regression analyses (age- and sex adjusted) were used to investigate the association between high self-reported alcohol intake and different questions concerning alcohol intake. Logistic regression analyses were also used to assess the association between binge drinking and different assessment methods. The analyses were adjusted for sex and age and the results are presented as odds ratios (OR) with 95% confidence intervals (CI). Goodness of fit of the models was assessed by the Hosmer–Lemeshow test and the tests indicated that the models fit the data adequately.

Results

Table 2 shows the characteristics of the respondents in the four samples by sex, age, marital status and combined school and vocational education. The four samples were similar in sociodemographic characteristics. The mean number of alcoholic drinks consumed on the last weekday was almost the same in all four samples (sample 1 and 3: 1.1 drinks; sample 2 and 4: 1.2 drinks) as shown in Table 3. The percentage that reported that they had at least one drink on the most recent weekday varied between 40% (sample 1) and 44% (sample 3). The χ^2 test indicated that the four samples could not be considered different according to the self-reported alcohol intake on the last weekday ($P=0.6065$). Hence, it seems reasonable to compare the different measures of alcohol consumption applied in the four samples.

The sex- and age-adjusted mean number of drinks in the last week was 10.6 drinks in sample 1 compared with 10.4 drinks among those respondents who were asked about the

Table 2 The characteristics of the respondents by sex, age, marital status, combined school and vocational education (ISCED)

	Sample			
	1	2	3	4
<i>Sex (%)</i>				
Men	49	47	47	46
<i>Age (%)</i>				
18–29 year	18	14	18	15
30–44 year	29	30	28	31
45–64 year	34	38	36	36
65+ year	19	18	18	19
<i>Marital status (%)</i>				
Married	56	55	55	54
Cohabiting	14	17	18	13
Single (separated, divorced, widowed)	14	13	12	16
Single (unmarried)	17	15	16	17
<i>Combined school and vocational education (%)</i>				
–10 year	22	22	22	22
11–12 year	19	23	22	22
13–14 year	34	33	34	32
15+ year	24	20	19	17
No information	2	2	2	7
No of respondents	644	626	650	673

Table 3 The self-reported alcohol intake on the most recent weekday

	Sample			
	1	2	3	4
No of drinks on the most recent weekday.	1.1	1.2	1.1	1.2
Mean (s.d.)	(2.1)	(2.2)	(2.0)	(2.2)
At least one drink on the most recent weekday. Percent	40	43	44	41
No of respondents	644	626	650	673

intake in a typical week (sample 2) (Table 4). Among the respondents who reported the average weekly intake (sample 4) the mean number of drinks was somewhat lower (8.7 drinks). The mean intake in the weekend did not differ greatly between the three types of measures. We also found that subjects that reported their typical intake for each day were as likely as subjects that reported their intake for each day last week to report a high weekly alcohol intake. Responders that reported the average weekly intake were less likely to report a high weekly alcohol intake (OR: 0.58; 95% CI: 0.42–0.81) compared to subjects that were asked about their intake for each day last week. The analyses were also carried out for men and women separately and showed that sex did not modify the associations between the assessments methods and the reported alcohol intake. We found that subjects that reported their typical intake or their intake last weekend were as likely as responders that reported their alcohol intake for each day last weekend to report a

Table 4 The sex- and age-adjusted mean number of reported alcoholic drinks and the association between a high reported alcohol intake^a and different beverage-specific questions

	Weekly intake			Weekend intake			n
	Mean (s.d.)	OR	95% CI	Mean (s.d.)	OR	95% CI	
Intake each day last week (sample 1)	10.6 (30.8)	1		6.4 (24.6)	1		644
Intake each day in a typical week (sample 2)	10.4 (30.7)	1.01	(0.75–1.36)	6.5 (24.9)	1.06	(0.82–1.36)	626
Intake last weekend (sample 3)	—	—		6.7 (25.0)	0.92	(0.72–1.18)	650
Average weekly intake (sample 4)	8.7 (29.0)	0.58	(0.42–0.81)	—	—		673

Abbreviations: CI, confidence interval; OR, odds ratio.

^aWeekly intake: men: > 21 drinks; women: > 14 drinks; weekend intake: men: > nine drinks; women: > six drinks.

Table 5 Results from multivariate logistic regression analyses showing the association between self-reported binge drinking (five drinks or more on one occasion) and different assessment measures

	Binged at least once a week			Binged at least once a month			n
	%	OR ^a	95% CI	%	OR ^a	95% CI	
3-month reference period (close-ended response category ^a)	10.1	1		41.5	1		644
3-month reference period (open-ended response format)	4.1	0.38	(0.24–0.62)	34.6	0.75	(0.59–0.96)	626
1-year reference period (close-ended response category ^a)	11.3	1.15	(0.80–1.66)	39.3	0.90	(0.71–1.15)	650
1-year reference period (open-ended response format)	4.2	0.41	(0.26–0.66)	25.4	0.47	(0.36–0.60)	673

Abbreviations: CI, confidence interval; OR, odds ratio.

^aSex- and age adjusted odds ratios.

high alcohol intake (OR: 1.06; 95% CI: 0.82–1.36 and OR: 0.92; 95% CI: 0.72–1.18, respectively).

Table 5 shows the association between binge drinking and different reference periods and response categories. Respondents who had a close-ended question were more likely to report binge drinking compared to respondents that had an open-ended question. For the responders with close-ended questions we found that 11.3% of the subjects with a reference period of 1 year reported that they binge-drank at least once a week compared with 10.1% among responders with a reference period of 3 months (OR: 1.15; 95% CI: 0.80–1.66).

Discussion

Questions concerning intake each day in a typical week does not seem to underestimate the alcohol intake compared to a 7-day recall measure. Furthermore, we found that individuals who had questions with an open-ended response format under-reported binge drinking compared to subjects who had questions with a close-ended response format.

The fact that the question concerning typical intake is beverage-specific for each day of the week could explain why the total intake is equivalent to the 7-day recall method. It is feasible to use this kind of measure in many epidemiological studies where the purpose is to investigate the association between alcohol intake and health outcomes. Estimating the intake each day in a typical week will take into account the large variation in drinking habits over time. For many

individuals the alcohol intake varies greatly between different weeks and months and hence, there is a high risk that a subject will be misclassified when measuring the intake with a method like the 7-day recall method. On the other hand, the measurement of the intake each day in a typical week can be criticized, because it is unable to assess drinking patterns on, for example, public holiday (Stockwell *et al.*, 2004). However, these drinking patterns are also difficult to capture with other assessment methods. A study has shown that the recall concerning alcohol intake only is reliable for two to three days (Ekholm, 2004). Official sales data indicate that Danes drank approximately 50 million litres of pure alcohol in 2003 (11.5 litres per person aged 14 years or older) (Statistics Denmark, 2006). Self-reported consumption of the typical alcohol intake in the present study thus accounted for 71% of sales statistics, which is a high coverage rate. A possible drawback with using a beverage-specific assessment method and asking for the intake for each day of the week could be somewhat tedious for both the respondent and the interviewer. This type of questions is also time-consuming and, hence, expensive. It is hard to compare the results from the assessment methods used in this study with, for example, the graduated frequency (GF) and quantity-frequency (QF) measures. However, as it is well known that more specific questions result in higher reported alcohol intake, there could be some disadvantages with using GF or QF measures compared to the beverage-specific intake on each day in a typical week. The GF approach has, for example been criticized as burdensome and difficult for respondents (Gmel *et al.*, 2006) and, hence, this method is probably not suitable

to measure the beverage-specific intake for different time-periods (e.g. each day of the week). The QF approach has, for example, been criticized because respondents tend to report modal consumption instead of mean consumption (Gmel *et al.*, 2006). Studies have also shown that the QF method generally generates lower estimates of volume, compared with the GF method (Rehm, 1998).

It is not surprising that the average weekly intake measure yields a lower intake than the two other measures. This measure was less specific than the other two measures and the result was therefore in accordance with findings in other studies (Dawson, 1998; Rehm, 1998; McCann *et al.*, 1999). However, when the alcohol intake only should be reported for a short period (e.g. last weekend), the results indicate that it is not necessary to ask for each day in the period.

Higher reported alcohol intake compared to global questions is not the only advantage of using beverage-specific questions in epidemiological studies. Several studies have shown that the type of alcohol (e.g. beer, wine or spirits) effects the association between alcohol intake and, mortality and morbidity (Grønbaek *et al.*, 1995, 2000, 2004; Prescott *et al.*, 1999; Klatsky *et al.*, 2003). Beverage-specific effects on health outlines the importance of collecting information on type of alcohol in epidemiological studies.

Binge drinking is associated with adverse health effects (e.g. alcohol poisoning, suicide, hypertension, unintentional injuries and gastritis) and mortality (Naimi *et al.*, 2003) and the terminology have been used in many studies (Kuntsche *et al.*, 2004; Serdula *et al.*, 2004; Mukamal *et al.*, 2005). The fact that an open-ended response format is not advisable when the reference period is long, has been suggested before (Ivis *et al.*, 1997; Greenfield, 2000, Strandberg-Larsen *et al.*, 2006). The highest category in the open-ended questions was more than once a week, which may be too low to capture the heaviest drinkers. Hence, the difference between the two methods would probably be even larger with more specific answer categories in the open-ended questions. An obvious problem with the open-ended response format is the rather complicated estimations that have to be made to estimate the correct number of heavy drinking occasions. For example, an individual that drank heavily every Friday, Saturday and Sunday within the past year should report that he binged approximately 156 times. Close-ended questions on the other side, have been somewhat criticized for limiting the number of possible responses among frequent drinkers (Dawson, 2003). However, it is most likely impossible for a frequent drinker to remember the correct number of drinking days within the past year and probably much easier to remember if it was 3 or 4 times a week or nearly every day. Questions with an open-ended response format are, however, most likely useful when the reference period is short (e.g. 30 days or less).

For most research purposes, self-reported drinking shows reasonable levels of reliability and validity (Del Boca and Noll, 2000; Del Boca and Darkes, 2003). It is also a rather inexpensive method to collect information. Hence, self-

reports probably will continue to be the most used method to assess alcohol consumption, although there are other methods to assess alcohol consumption. Biochemical markers (e.g., γ glutamyltransferase, aspartate aminotransferase, alanine aminotransferase and mean corpuscular volume) and information collected from collateral informants are examples of such measures. These two measures are mostly used to assess excessive alcohol consumption. Biochemical markers have the advantage that they are precise and reliable and cannot be biased by recall or a respondent's motivation to report socially improper behaviour (Babor *et al.*, 2000). However, some disadvantages with biochemical markers are the costs and that the raised levels may result from other causes than heavy drinking (e.g., use of prescribed drugs, smoking, obesity, pregnancy and liver disorders of non-alcoholic origin) (Sharpe, 2001). Examples of limitations in using collateral informants are that they often are hard to recruit and that they often lack detailed information concerning the quantity and frequency of drinking (Babor *et al.*, 2000).

It is well known that the sex and the age of the interviewer affect the respondents' reported alcohol intake in face-to-face surveys (Heeb and Gmel, 2001). A strength with this study is that we used the same interviewers to collect the data in all four samples. Thus, the interview effects are considered to be negligible for our results and conclusions. As the characteristics of the responders are similar in all four samples, we assume that non-response bias is unlikely to be consequential for the results and conclusions in this study.

Conclusion

We conclude that a question concerning the intake each day in a typical week is feasible to use in epidemiological studies. The advantage with estimating the intake in a typical week compared with the intake in a given period is that it takes into account the large time-variation in drinking. Hence, assessment methods that measure the day-specific intake in a typical week are probably better to estimate the 'true' association between alcohol intake and health outcomes. Furthermore, our results suggest that it is more appropriate to use close-ended questions compared to open-ended questions in measuring binge-drinking when the reference period is long. The length of the reference period seems to be ignorable for the self-reported frequency of binge occasions when using close-ended questions.

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