



## Practice of Epidemiology

# Are Lifetime Abstainers the Best Control Group in Alcohol Epidemiology? On the Stability and Validity of Reported Lifetime Abstinence

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Received for publication January 2, 2008; accepted for publication March 18, 2008.

Lifetime abstainers have often been recommended as the comparison group in alcohol epidemiology. The objective of this study was to provide insight into the validity and stability of lifetime abstinence by using data derived from the National Alcohol Survey, a national probability survey of US households conducted in 1984, and its 2 follow-up surveys conducted in 1990 and 1992. Results indicated that more than half (52.9%; all proportions were weighted to represent the US population) of those who reported never having a drink of any alcoholic beverage in the 1992 survey reported drinking in previous surveys. Depending on assumptions, this difference may result in an underestimation of alcohol-attributable mortality of 2%–15% in men and 2%–22% in women. Sociodemographic factors differentiated those who consistently reported lifetime abstinence across surveys from the rest of the study population. Results suggest that using reported lifetime abstainers as a sole comparison group is problematic, especially if reporting is based on 1 measurement only. Establishing multiple measurement points and including irregular lifetime light drinkers with lifetime abstainers as the comparison group are recommended for future epidemiologic studies.

alcohol drinking; control groups; data collection; longitudinal studies; reproducibility of results

**Editor's note:** An invited commentary on this article appears on page 872, and the authors' response is published on page 876.

Alcohol consumption has been causally related to more than 60 disease categories in the *International Statistical Classification of Diseases and Related Health Problems*, Tenth Revision (1, 2), and most of these associations depend on the volume of alcohol consumed, often measured as average volume per day. Although the dose-response associations for the different outcome categories are different (3), they all share the problem of finding the appropriate control group for the effect of volume of drinking. Many early publications based the dose-response curves on using current abstainers as a comparison group (4).

This procedure has been heavily criticized, most influentially in the area of cardiovascular epidemiology and with respect to the cardioprotective benefits (5), but of course the argument brought forward applies equally to other dose-response associations. The core of the criticism is based

on the heterogeneity of abstainers as a control group: there are at least 2 very distinct groups of abstainers—former drinkers, many of whom had given up drinking for health reasons; and long-term or even lifetime abstainers (6). For both groups, associations with health outcomes are different. For example, in a recent series of meta-analyses on alcohol consumption and all-cause mortality, Gmel et al. (7) found that the mortality risk for former drinkers compared with lifetime abstainers was 44% higher for women (95% confidence interval: 28, 61) and 21% higher for men (95% confidence interval: 10, 32). Thus, former drinkers had a higher mortality risk than lifetime abstainers, and both had a higher risk than light drinkers, who benefitted from the cardioprotective effect of alcohol on ischemic disease.

As a reason for the higher risk for former drinkers, the “sick-quitter” hypothesis has been proposed: many people stop consuming alcohol because of health reasons (5; refer to the Discussion section below). Regarding morbidity, Lown et al. (8) found that 52% of lifetime drinkers now abstaining who reported prior loss of control of drinking (i.e., alcohol dependence) indicated health harms categorized as involving

“internal organs” versus only 2.5% of current abstainers who never had loss-of-control symptoms ( $P < 0.0001$ ), an indication of the inclusion, among quitters, of many with serious health conditions.

On the basis of these considerations, lifetime abstainers have often been recommended as the control group in alcohol epidemiology (9). However, what do we know about the stability and validity of this group? Previous research indicates that there may be substantial inconsistency in self-reports of lifetime abstinence. An analysis considering 2 measurements 10 years apart in the First National Health and Nutrition Examination Survey found that 45% of men and 33% of women who reported never having at least 12 drinks in 1 year at time 2 had reported drinking at time 1, although 68% of these subjects reported very light drinking consistent with the question asked (10). In a British longitudinal study with 5 measurements over the ages of 16–45 years, more than half of those reporting never drinking at age 45 years had reported at least some drinking in the past (11). This study also found that many of those who reported being occasional-only drinkers had reported drinking more regularly in previous assessments.

The present article provides further insight into lifetime abstinence using baseline and 2 follow-ups of a nationally representative alcohol survey in the United States. Specifically, the following 5 questions will be answered: 1) What is the measurement error for self-reported lifetime abstinence? 2) What had been the previous drinking status of people who erroneously reported lifetime abstinence in the second follow-up? 3) What was the chance of starting to drink for people reporting lifetime abstinence at baseline? 4) How different were people who consistently reported lifetime abstinence compared with the rest of the population? and 5) What is the potential impact of misclassification on alcohol-attributable mortality?

## MATERIALS AND METHODS

### Study design and sample

The baseline data were derived from the 1984 National Alcohol Survey, an in-person survey in which respondents were selected through a multistage area probability procedure with a sampling frame including households in the 48 contiguous US states. One adult aged 18 years or older in each household was selected randomly. Completed interviews were obtained for 5,221 respondents, with Hispanics and blacks oversampled (1,777 whites, 1,947 blacks, and 1,453 Hispanics), representing a 74% overall response rate. Since resource constraints allowed only a partial follow-up, only drinkers with heavier drinking patterns were selected with certainty for those who, in 1984, reported 4 or more alcohol-related problems during their lifetime and/or currently reported consuming 5 or more drinks on a single occasion, while drinkers with less heavy drinking patterns were subject to a probability selection. This follow-up sampling scheme resulted in a total eligibility sample of 3,452. Two separate follow-ups were conducted in 1990 and 1992, with completed interviews obtained for 2,198 and 2,247 respondents, respectively. As in the 1984 survey, data in

the 1992 survey were collected via face-to-face interviews only. In the 1990 survey, data were also collected via face-to-face interviews; however, data were also gathered by using mail and telephone interviews. Temple University's Institute of Survey Research (Philadelphia, Pennsylvania) conducted the fieldwork for all 3 surveys. This institute pretested all survey instruments and intensively trained and supervised all data collectors. A more detailed description of sampling methodology for the 1984 National Alcohol Survey and its 1990 and 1992 follow-ups can be found elsewhere (12, 13).

**Sample.** Because the present analysis focused on lifetime abstinence, the study sample was defined in terms of respondents for whom frequency of alcohol consumption data were available in the last (i.e., the 1992) follow-up survey. Of the 2,247 respondents in the 1992 survey, 5 (0.2%) provided no information on frequency of alcohol consumption; these cases were excluded. Respondents of ethnicities other than white, Hispanic, or black were also excluded because of sample size limitations ( $n = 13$ ; 0.6%), resulting in a final analytic sample of 2,229. Most respondents ( $n = 1,886$ ; 84.6%) were included in the 1984 baseline survey and both follow-ups (1990 and 1992), and 343 respondents (15.4%) were included in the 1984 baseline survey and the 1992 follow-up survey only.

Of the final sample of 2,229 respondents, only a small proportion (less than 3% of the sample) failed to provide valid responses for 2 of the variables in the present analyses. A mean substitution procedure was used to recover the 15 respondents for whom age data were missing. Additionally, a regression model using data on age, sex, and education was used to impute household income for the 60 respondents who did not provide information on this variable.

**Alcohol measures.** In the 1984 and 1992 surveys, frequency of alcohol consumption was measured with the following question: How often do you usually have any kind of beverage containing alcohol, whether it is wine, beer, whiskey, or any other drink? The 11 response options were as follows:

1. 3 or more times a day
2. 2 times a day
3. Once a day
4. Nearly every day
5. 3 or 4 times a week
6. Once or twice a week
7. 2 or 3 times a month
8. About once a month
9. Less than once a month
10. Less than once a year
11. I have never had any kind of beverage containing alcohol

In the 1990 survey, the question on frequency of alcohol consumption was divided into 2 parts. First, respondents were asked, When was the last time you had a drink of any alcoholic beverage, whether of beer, wine, wine cooler, spirits, or mixed drink, even if it was only a little bit? Response options included 1) in the last 12 months, 2) more than 12 months ago but within the last 5 years, 3) more than 5 years

ago, and 4) never had a drink of any alcoholic beverage. Respondents who reported drinking in the last 12 months were asked a question on frequency of alcohol consumption that was worded similarly to the one used in the 1984 and 1992 surveys: How often do you usually have any kind of drink containing alcohol—whether it is wine, beer, whiskey, or any other drink? The response options were similar to those used in the 1984 and 1992 surveys, except that the categories of 2 times a day and once a day were collapsed into 1 category, once or twice a day. In addition, the 11th option, I have never had any kind of beverage containing alcohol, was eliminated because this response was ascertained in the prior item. Although the data in the 1990 survey were gathered by using 3 different modes of collection, the majority of responses for the alcohol items (86.6%) were obtained by using self-administered booklets.

The original categories were recategorized into 6: 1) never had a drink, 2) former drinker—did not drink during the 12 months preceding the survey, 3) current drinker with drinking frequency of less than once a month, 4) 1 to 3 times a month, 5) 1 to 4 times a week, and 6) daily or almost daily.

To compare respondents who consistently reported lifetime abstinence with the rest of the study population, we created 4 categories: 1) consistent lifetime abstainers—those who reported consistently “never drinking” responses across surveys, 2) inconsistent lifetime abstainers—those who erroneously reported lifetime abstinence in the 1992 survey because they had reported drinking at some point in their life in previous surveys, 3) former drinkers—those who did not consume alcohol during the past 12 months prior to 1992, and 4) current drinkers.

**Sociodemographic factors.** Sex was coded 1 for females and 0 for males. Age in years was derived by subtracting the date of birth from the date of the interview. Respondent ethnicity was measured with 2 dichotomous variables that identified blacks and Hispanics (with whites as the reference group). Marital status was coded 1 for respondents who were married, 0 otherwise. Respondent self-reported household income served as a proxy for social class. Those respondents who resided in households with incomes of less than \$30,000 (coded 1) were compared with those who did not reside in such households (coded 0).

### Statistical analyses

All statistical analyses were conducted by using Stata version 10.0 software (Stata Corporation, College Station, Texas). We weighted all analyses to produce nationally representative results. To assess the consistency of lifetime abstinence responses in the 1992 follow-up survey, we compared the frequencies in the cells of the table representing respondent reported drinking response in the 1984 survey with respondent reported drinking response in the 1990 follow-up survey. For respondents who participated in only 2 surveys, we compared their responses in the 1984 baseline survey with their responses in the 1992 follow-up survey. These analyses included only those respondents who reported in the 1992 follow-up survey that they had never consumed a drink of any alcoholic beverage.

**Table 1.** Demographic Characteristics of the Sample ( $n = 2,229$ ),<sup>a,b</sup> National Alcohol Survey, United States, 1984–1992

	No.	%
Sex		
Female	1,187	52.7
Male	1,042	47.3
Ethnicity		
White	790	82.0
Black	733	10.8
Hispanic	706	7.2
Marital status		
Not married	865	33.2
Married	1,364	66.8
Household income <sup>c</sup>		
<\$30,000	1,459	51.0
≥\$30,000	770	49.1
	<b>Mean</b>	<b>95% CI</b>
Age, years	46.1	46.6, 49.0

Abbreviation: CI, confidence interval.

<sup>a</sup> Counts are unweighted values.

<sup>b</sup> Percentages and the mean are weighted values.

<sup>c</sup> Percentages do not total 100 because of rounding.

To examine whether respondents who consistently reported lifetime abstinence differed in terms of sociodemographic characteristics from the rest of the population (i.e., inconsistent lifetime abstainers, former drinkers, and current drinkers), we estimated 3 multinomial logistic regression models. In this analysis, the entire sample was used.

Sensitivity analyses were conducted to determine the potential impact of erroneously reporting lifetime abstinence on alcohol-attributable all-cause mortality. Sensitivity analyses were based on the prevalence of different alcohol consumption categories from our study coupled with information on relative risk for all-cause mortality from Gmel et al. (5).

## RESULTS

### Sociodemographic characteristics of the sample

Table 1 presents the sociodemographic characteristics of the study sample measured in the 1992 survey. The majority of the respondents were women whose mean age was mid-forties, who were married, and who resided in households with annual incomes of less than \$30,000. Oversampling led to an almost equal distribution by ethnicity. The demographic characteristics of the 4 categories of drinkers are shown in Table 2.

### What is the measurement error for self-reported lifetime abstinence?

In the 1992 follow-up survey, 309 respondents reported that they had never had a drink of any alcoholic beverage. Of these respondents, 267 had complete frequency of alcohol consumption data for all 3 surveys and 42 had complete

**Table 2.** Demographic Characteristics of the 4 Types of Drinkers ( $n = 2,229$ ),<sup>a,b</sup> National Alcohol Survey, United States, 1984–1992

	Consistent Lifetime Abstainer ( $n = 137$ )		Inconsistent Lifetime Abstainer ( $n = 172$ )		Former Drinker ( $n = 486$ )		Current Drinker ( $n = 1,434$ )	
	No.	%	No.	%	No.	%	No.	%
Sex								
Female	118	81.2	107	61.1	285	54.1	677	48.9
Male	19	18.8	65	38.9	201	45.9	757	51.1
Ethnicity								
White	30	79.1	38	75.5	147	79.5	575	83.8
Black	40	11.9	70	16.9	187	13.6	436	9.2
Hispanic	67	9.0	64	7.5	152	6.9	423	7.1
Marital status								
Not married	48	36.2	64	29.7	201	35.2	552	32.7
Married	89	63.8	108	70.3	285	64.8	882	67.3
Household income								
<\$30,000	114	68.8	136	69.0	361	58.4	848	45.2
≥\$30,000	23	31.2	36	31.0	125	41.6	586	54.9
	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
Age, years	58.7	53.5, 64.1	56.1	51.6, 60.5	50.7	48.1, 53.2	45.1	43.7, 46.4

Abbreviation: CI, confidence interval.

<sup>a</sup> Counts are unweighted values.

<sup>b</sup> Percentages and means are weighted values.

data for only 2 surveys (1984 and 1992). There was remarkably low consistency in the never-drinking responses reported across surveys. Of the 267 self-reported lifetime abstainers for whom data for all 3 surveys were available, only 46.6% ( $n = 114$ ) reported the same drinking response (never had a drink) in all 3 surveys. Similarly, of the 42 respondents who had data for only 2 surveys (1984 and 1992), 49.8% ( $n = 23$ ) reported the same never-drinking response in both surveys. Collectively, only 47.1% ( $n = 137$ ) of the 309 lifetime abstainers in the 1992 survey consistently reported the same never-drinking responses. In other words, more than half ( $n = 172$ ; 52.9%) of the reported lifetime abstainers in the 1992 follow-up survey reported their drinking status erroneously, assuming that the previously reported drinking was veridical.

#### What had been the previous drinking status of people who erroneously reported lifetime abstinence in the second follow-up?

Of the 172 respondents who erroneously reported lifetime abstinence in the 1992 follow-up survey, 38.0% ( $n = 50$ ) reported that they were never drinkers, 36.8% ( $n = 58$ ) said that they were former drinkers, and 25.2% ( $n = 64$ ) reported that they were current drinkers in the 1984 baseline survey. Of the lifetime abstainers and former drinkers ( $n = 108$ ), 6.2% ( $n = 12$ ) reported that they had consumed 5 or more drinks at least monthly prior to ( $n = 11$ ) or subsequent to ( $n = 1$ ) 1984. Of the 64 current drinkers, 23 (22.7%) reported that they had consumed 5 or more drinks at least

monthly—17 in 1984, 1 prior to 1984, and 5 subsequent to 1984. Thus, collectively, of the 172 inconsistent lifetime abstainers, 10.3% ( $n = 35$ ) reported drinking 5 or more drinks at least monthly at some point in their life. The 35 inconsistent abstainers reporting prior periods of heavy drinking were predominantly black ( $n = 19$ ) and Hispanic ( $n = 11$ ).

#### What was the chance of starting to drink for people reporting lifetime abstinence at baseline?

In the 1984 baseline survey, 346 respondents reported that they had never had a drink of any alcoholic beverage. Between the 1984 baseline survey and the 1992 follow-up survey, 26.6% ( $n = 102$ ) of lifetime abstainers in the 1984 baseline survey had started and quit drinking. An additional 11.4% ( $n = 57$ ) transitioned into drinking and continued to drink. Only 62.1% of lifetime abstainers in the 1984 baseline survey remained never drinkers in the 1992 follow-up survey.

#### How different were people who consistently reported lifetime abstinence compared with the rest of the population?

Table 3 displays the odds ratios and 95% confidence intervals from the 3 multinomial logistic regression models that compared whether sociodemographic factors differentiated consistent lifetime abstainers from inconsistent lifetime abstainers, former drinkers, and current drinkers. Compared

**Table 3.** Multinomial Logistic Regression Contrasting Respondents Who Consistently Reported Lifetime Abstinence With the Rest of the Study Population Regarding Sociodemographic Factors ( $n = 2,229$ ), National Alcohol Survey, United States, 1984–1992

	Ceteris Paribus, Odds Ratios for Consistent Lifetime Abstainers With the Given Characteristics Compared With Those for					
	Inconsistent Lifetime Abstainers		Former Drinkers		Current Drinkers	
	OR	95% CI	OR	95% CI	OR	95% CI
Female	2.76	1.03, 7.38	3.99	1.63, 9.75	4.70	1.96, 11.3
Black <sup>a</sup>	0.72	0.35, 1.48	1.10	0.59, 2.04	1.74	0.96, 3.15
Hispanic <sup>a</sup>	1.28	0.65, 2.51	1.61	0.86, 3.00	1.79	1.04, 3.09
Age, years	1.01	0.98, 1.04	1.03	1.01, 1.05	1.05	1.03, 1.07
Married	0.93	0.37, 2.32	1.71	0.80, 3.64	1.96	0.95, 4.05
Household income (<\$30,000 = 1)	0.84	0.31, 2.23	1.24	0.56, 2.72	1.85	0.87, 3.93

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

<sup>a</sup> Reference group is white.

with inconsistent lifetime abstainers, former drinkers, and current drinkers, consistent lifetime abstainers were significantly more likely to be female. Consistent lifetime abstainers were also significantly more likely to be older in comparison with former drinkers and current drinkers. Relative to current drinkers, consistent lifetime abstainers were more likely to be Hispanic.

#### What is the potential impact of misclassification on alcohol-attributable mortality?

Obviously, the impact of misclassification of lifetime abstainers depends on drinking pattern before abstinence. If they are mainly people who consumed alcohol very rarely and on these occasions in moderation, their risk should not be different from that for lifetime abstainers; if they experienced heavy-drinking occasions before quitting, their risk should be closer to that for other former drinkers in epidemiologic studies. We modeled the distribution in different steps, where 90%–0% of the misclassified lifetime abstainers were similar to correctly classified lifetime abstainers. As a result, alcohol-attributable all-cause mortality was underestimated by 1.5%–15.1% in men and 2.2%–21.6% in women. On the basis of the prior drinking reported by people who erroneously reported lifetime abstinence, the effect in our sample should be closer to the lower estimates, but, for subgroups such as black or Hispanic, the results may vary. For instance, in the analyses shown above, 19 of the 70 blacks with inconsistent lifetime abstinence reported consuming 5 or more drinks at least monthly at some period in their lives (weighted: 17.0%). Hispanic inconsistent lifetime abstainers and blacks had similarly high rates of prior heavy drinking.

#### DISCUSSION

To adjust for the sick-quitter phenomenon, that is, people quitting consumption of alcohol because of health problems, it has been suggested that alcohol epidemiology should use

lifetime abstainers as the comparison group. As indicated above, this suggestion has 2 main downsides:

1. Measurement error and lack of validity of reported lifetime abstinence
2. Exacerbation of effects of potential confounding by small numbers in this group in some populations

Overall, lifetime abstinence can be easily assessed, but the reported answers seem to be prone to substantial measurement error. The finding that more than half of those reporting lifetime abstinence had reported in 1 of the earlier assessments drinking at some time in their life should strongly caution against using this variable as a key comparison for alcohol epidemiology. On the other hand, most of the drinking reported previously seems to be of low frequency and low quantity, so the resulting measurement error for establishing risk relations is minor. This finding is consistent with an analysis of 3 longitudinal studies in which the majority of those moving between abstinence and drinking were very light drinkers (14). Note also that classification into other groups of drinkers, including occasional-only drinkers (11), is also subject to measurement error. The data underline again the importance of multiple measurement of exposure in alcohol epidemiologic studies regarding both average volume and patterns of drinking (15).

With respect to the best comparison group in alcohol epidemiology, it will be important to separate those who had very low or no alcohol exposure at all from others. Assessing lifetime exposure does identify a part of this group, but this assessment should be supplemented with a question on current and past heavy exposure to alcohol at each measurement point. If people consistently report no drinking or drinking very small quantities of alcohol and no heavy drinking, they constitute the ideal comparison group for the effects of volume of drinking on disease outcomes (1). Trying to identify such a group of consistently small-quantity or nondrinkers may be of greater importance than trying to correctly identify lifetime abstainers and separate

them from irregular, small-quantity drinkers, as has been called for by some authors (16). Of course, identifying such a group is biologically and epidemiologically plausible because there should be no chronic health effects from irregular, small-quantity drinking (17, 18).

Finally, use of such a comparison group also avoids some of the criticism regarding potential confounding. In many high-income countries, alcohol consumption is normative, and only a small minority of the population are lifetime abstainers. Members of this minority differ from drinkers in terms of other health determinants (19). Therefore, alcohol epidemiology results based on lifetime abstention may be more prone to the potential confounding that affects all group comparisons (9). Using a larger and less distinct group for comparison could help to alleviate this problem. Indeed, use of lifetime occasional drinkers as the main control group was first suggested and applied by Shaper et al. (5) to address the sick-quitter hypothesis in their United Kingdom sample with very few complete lifetime abstainers. Of course, in studies of developing countries, where abstaining is more common (20), the problem of normative drinking does not arise.

In sum, use of reported lifetime abstainers as a sole comparison group is problematic, especially if results are based on 1 measurement only. To explore the effects of drinking on chronic outcomes, one should try to establish multiple measurement points and include irregular lifetime light drinkers with lifetime abstainers in the comparison group. Most importantly, those reporting past heavy drinking should be excluded from this group because they usually have risks similar to those for current, heavy drinkers (7, 8).

## ACKNOWLEDGMENTS

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Support for this study was provided by a grant from the National Institute on Alcohol Abuse and Alcoholism ("Drinking Patterns & Ethnicity: Impact on Mortality Risks"; 1R01AA016644-01A1).

Conflict of interest: none declared.

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