The Association between Alcohol Exposure and Self-Reported Health Status: The Effect of Separating Former and Current Drinkers

Wenbin Liang*, Tanya Chikritzhs
National Drug Research Institute, Curtin University, Perth, Western Australia, Australia

Abstract

**Aims:** To investigate the direction and degree of potential bias introduced to analyses of drinking and health status which exclude former drinkers from exposure groups. **Design:** Pooled analysis of 14 waves (1997–2010) of the U.S. National Health Interview Survey (NHIS).

**Setting:** General population-based study.

**Participants:** 404,462 participants, from 14 waves of the NHIS, who had known self-reported health status and alcohol consumption status.

**Measurements:** Self-reported health status was used as the indicator of health. Two approaches were used to classify alcohol consumption: (i) separation of former drinkers and current drinkers, and (ii) combined former and current drinkers. The prevalence of fair/poor health by alcohol use, gender and age with 95% confidence intervals was estimated. The difference in prevalence of fair/poor health status for lifetime abstainers, former drinkers, current drinkers and drinkers (former drinkers and current drinkers combined) were compared using Poisson regression with robust estimations of variance.

**Findings:** Excluding former drinkers from drinker groups exaggerates the difference in health status between abstainers and drinkers, especially for males.

**Conclusions:** In cohort study analyses, former drinkers should be assigned to a drinking category based on their previous alcohol consumption patterns and not treated as a discrete exposure group.

Introduction

Many cohort studies from the medical epidemiology literature have observed a ‘J-shape’ or U-shape association between alcohol consumption and risk for various types of chronic diseases including coronary heart disease [1,2,3], stroke [3,4] and diabetes [5,6]. The vast majority of studies appear to indicate that abstainers have a higher risk of these chronic conditions compared to those who regularly consume alcohol at low or moderate levels, while former drinkers and heavy drinkers have the highest risk of all [7,8,9]. In most studies, former drinkers are participants who used to drink alcohol but stopped sometime before the beginning of a study. These former drinkers are sometimes separated from other participants who were still consuming alcohol at baseline and treated as a distinct ex-drinker group (e.g. [10,11]). More often, however, analysts have mixed former drinkers with lifetime abstainers who have never consumed alcohol and/or long-term abstainers [8,12]. Study participants who have been exposed to alcohol at some time during their lifetime but who are considered to be ex-drinkers according to a study’s parameters, are almost universally observed in epidemiological studies to have higher risks for the various chronic diseases examined, and thus, the term ‘sick quitters’ has (rightly or wrongly) appeared in the literature as a catch-all phrase for describing them [13,14,15,16,17].

From a methodological stand point, no wide-spread procedure has been given in the epidemiological literature in relation to the real possibility that the very act of quitting drinking may be due to one or more of the many harmful health effects that are directly or indirectly attributable to alcohol. For instance, in relation to tobacco use, it has been very clearly established that given the same level of cumulative smoking exposure, ex-smokers have similar or higher risks of tobacco-caused disease compared to current smokers. Indeed, Doll and colleagues emphasized that ex-smokers and current smokers should be combined in
analyses rather than being treated as two distinct groups [18]. In relation to alcohol, it is reasonable to hypothesize therefore, that if a proportion of people stop drinking due to ill-health, whether alcohol-related or not, then the methodological act of separating former drinkers from current drinkers will ultimately bias toward selecting a healthier current drinkers sample [19]. It is important, therefore, to examine whether bias may be introduced into epidemiological studies by separating drinkers who have stopped drinking, from those who continue to drink. The aim of this study was to investigate the direction and degree of potential bias introduced to analyses of drinking and health status which exclude former drinkers from exposure groups, using 14 waves (1997–2010) of the U.S. National Health Interview Survey (NHIS).

Methods

This study used combined data from 14 waves (1997–2010) of the National Health Interview Survey (NHIS) obtained from the official website of Integrated Health Interview Series of U.S. National Health Interview Survey: Minnesota Population Center and State Health Access Data Assistance Center, Integrated Health Interview Series: Version 5.0. Minneapolis: University of Minnesota, 2012 [http://www.ihis.us]. Details of the survey sampling strategy and data collection methods have been described in detail elsewhere [20,21,22,23,24]. Briefly, the NHIS were nationally focused and conducted by the National Center for Health Statistics (NCHS), Centers for Disease Control and Prevention (CDC). They were conducted to provide comprehensive estimations of health indicators at national level, and state stratified samples were drawn from all 50 states and the District of Columbia to ensure the samples are representative at state level [20,21,22,23,24]. Households were the basic unit of the NHIS. For each selected household, if there was more than one family residing in a household, all families in the household were selected. One randomly selected adult (≥18yrs) was selected per family to provide information in detail regarding their health and health-related behavior, including alcohol use in the last 12 months. In this study, self-reported health status was used as the indicator of health. Adult health status was divided into two groups for comparison: (1) excellent, very good, and (2) good, fair, and poor. For classification of alcohol consumption, two approaches were used. The first approach separated former drinkers and current drinkers. Participants were grouped as follows: (i) lifetime abstainer, <12 drinks in lifetime; (ii) former drinker, 12+ drinks in lifetime, but none in past 12 months; and (iii) current drinker, 12+ drinks in lifetime and 1+ drink(s) in the past 12 months. The second approach combined former drinkers and current drinkers into one ‘drinking’ group, producing two groups for comparison: lifetime abstainers, <12 drinks in lifetime; and (ii) drinkers, 12+ drinks in lifetime. The surveys did not provide information regarding previous alcohol consumption among former drinkers, therefore we were restricted to using one level of consumption (i.e. current drinkers). This approach remains valid for the aim of the current study, which is to demonstrate the potential magnitude of this bias and thereby to inform future cohort studies.

Analysis

Stratified analysis. For each classification, we estimated the weighted prevalence of fair/poor health for the matrix defined by, alcohol use, gender, and age with 95% confidence intervals. We then plotted the prevalence of fair/poor health estimated by the two different approaches to classifying former alcohol users. In addition, to illustrate the effect that mixing former drinkers with lifetime abstainers has on estimates of fair/poor health status, we plotted the weighted prevalence of fair/poor health status across lifetime abstainers and former drinkers. We then plotted the weighted prevalence of fair/poor health for the matrix defined by alcohol use, gender, and age with 95% confidence intervals. Given that 14 waves of surveys have been used, the sampling weights provided in the original data were adjusted so that each wave would have an equivalent weight in the analyses.

Multivariate analysis. The difference in prevalence of fair/poor health status across lifetime abstainers and former drinkers, current drinkers and drinkers (former drinkers and current drinkers

Figure 1. Prevalence of fair/poor health by age for males and females (spike with caps: 95% confidence interval).
doi:10.1371/journal.pone.0055881.g001
combined) were compared using Poisson regression with robust estimations of variance. In order to include two different classifications of alcohol use in the same model, a random sample consisting of 50% of the former drinkers and 50% of the current drinkers was selected and regrouped into the ‘drinker’ group. There were therefore four groups in the model: lifetime abstainers, former drinkers (50% of all former drinkers), current drinkers (50% of all current drinkers) and drinkers (the other 50% of former drinkers and the other 50% of all current drinkers). The multivariate analyses controlled for age, gender, year of survey, marital status, highest educational attainment, employment status.

Figure 2. Prevalence of fair/poor health by age, gender and drinking status: Abstainers vs. former drinkers vs. current drinkers (spike with caps: 95% confidence interval).

Figure 3. Prevalence of fair/poor health by age, gender and drinking status: Abstainers vs. former and current drinkers combined (spike with caps: 95% confidence interval).
in the past 1–2 weeks, family income compared to the poverty threshold and ownership status of the family home.

Results

This study included 404,462 participants, from 14 waves of the NHIS, who had known self-reported health status and alcohol consumption status including: 97,212 lifetime abstainers (24%); 62,643 former drinkers (15.5%); and 244,607 current drinkers (60.5%). Estimates of the prevalence of poor/fair health are shown in Figures 1–3. Figure 1 shows that the prevalence of poor/fair health increased with age for both males and females. Figure 2 shows that from about age 30yrs, former drinkers had the highest prevalence of poor/fair health, whereas the prevalence was lowest among current drinkers, especially females. In Figure 3, former drinkers and current drinkers were pooled together and compared to abstainers. Among females, the difference in the prevalence of poor/fair health between abstainers and the combined drinking group was reduced (i.e. compared to Figure 2) although it remained considerably large. For males, the convergence between abstainers and drinkers (former and current) was substantial but the difference remained marginally significant at several ages.

Estimations from multivariate analysis (Table 1) were consistent with observations from the stratified analysis. After combining former drinkers and current drinkers into a single drinking group, all those exposed to alcohol, the prevalence ratio of fair/poor health among drinkers compared to lifetime abstainers more closely approached unity, especially for males.

Discussion

Excluding former drinkers from the drinking group appears to exaggerate the difference in health status between abstainers and drinkers, especially for males. Fillmore et al have showed that many cohort studies had introduced a bias by mixed former drinkers with lifetime abstainers. In addition to classification bias identified by Fillmore et al [12], the current study demonstrated a systematic bias will still exist even after separating former drinkers from lifetime abstainers. These observations are consistent with studies on the health impacts of tobacco smoking and the well-recognized residual health effects which impact upon the health of former smokers [18,25,26,27,28].

Given these findings, it follows that published cohort studies of one or more chronic diseases which, compared to abstinence, find ‘protection’ due to alcohol consumption among current drinkers as well as elevated risks among those who had been exposed to alcohol at some time in the past (ex-drinkers), yet conclude protective effects, are at risk of logical incoherence. The observation that an individual may have stopped drinking prior to the commencement of a study does not alter the antecedent fact that they had first been exposed to alcohol.

There are lessons to be learnt here from clinical trials. In clinical trials, it is not unusual for some participants to withdraw from treatment or to change their treatment plan. When this happens, results from former participants are preferably not separated out from the treatment group but are retained. This is because it has been clearly established that excluding ‘dropouts’ may introduce bias which makes it appear as if the treatment group is subject to less ill-effects or has more positive outcomes than the control group. In addition, people who complete a particular treatment may, at the outset, be predisposed to have better outcomes [29,30]. Therefore, in order to reduce bias in clinical trials, ‘intention-to-treat’ analysis is recommended [30]. This essentially involves ‘returning’ any participants who had withdrawn from the trial along with their health outcomes, back into the group which they had originally been assigned prior to analysis. In the same way, for analyses undertaken on cohort studies, former drinkers should be added back to a drinking category based on their previous alcohol consumption pattern.

Conclusion

This study demonstrated that a methodological approach which separates past and present drinkers will likely lead to overestimation of the difference in health status between abstainers and drinkers, especially for males. In cohort study analyses, former drinkers should be assigned to a drinking category based on their previous alcohol consumption patterns and not treated as a discrete exposure group.

Author Contributions

Conceived and designed the experiments: WL. Performed the experiments: WL. Analyzed the data: WL. Contributed reagents/materials/analysis tools: WL. Wrote the paper: WL. TC.

References

1. Corrao G, Rabbati L, Bagnardi V, Zambon A, Poikolainen K (2000) Alcohol and coronary heart disease: a meta-analysis. Addiction 95: 1505–1523.
2. Rimm EB, Williams P, Fosher K, Criqui M, Stampfer MJ (1999) Moderate alcohol intake and lower risk of coronary heart disease: meta-analysis of effects on lipids and haemostatic factors. BMJ 319: 1523–1528.
3. Ronksley PE, Brien SE, Turner BJ, Mukamal KJ, Ghiil WA (2011) Association of alcohol consumption with selected cardiovascular disease outcomes: systematic review and meta-analysis. BMJ 342.
4. Reynolds K, Lewis LB, Nolen JDL, Kinney GL, Sathiya B, et al. (2003) Alcohol Consumption and Risk of Stroke: A Meta-analysis. JAMA 289: 579–580.
5. Koppes LLJ, Dekker JM, Hendriks HJ, Bouter LM, Heine RJ (2005) Moderate Alcohol Consumption Lowers the Risk of Type 2 Diabetes. Diabetes Care 28: 719–725.
6. Howard AA, Aronson JH, Gourevitch MN (2004) Effect of Alcohol Consumption on Diabetes Mellitus. Annals of Internal Medicine 140: 211–219.
7. Roercke M, Rehm J (2011) Ischemic Heart Disease Mortality and Morbidity Rates in Former Drinkers: A Meta-Analysis. American Journal of Epidemiology 173: 245–259.
8. Fillmore KM, Kerr WC, Stockwell T, Chikritzhs T, Bostrom A (2006) Moderate alcohol use and reduced mortality risk: Systematic error in prospective studies. Addiction Research and Theory 14: 101–132.
9. Katsay AL, Udahbe N (2007) Alcohol Drinking and Total Mortality Risk. Annals of Epidemiology 17: 863–867.
10. Liao Y, McGee DL, Cao G, Cooper RS (2000) Alcohol Intake and Mortality: Findings from the National Health Interview Surveys (1988 and 1990). American Journal of Epidemiology 151: 651–659.
11. Harris LR, English DR, Hopper JL, Powles J, Simpson JA, et al. (2007) Alcohol consumption and cardiovascular mortality accounting for possible misclassification of intake: 11-year follow-up of the Melbourne Collaborative Cohort Study. Addiction 102: 1574–1585.
12. Fillmore KM, Stockwell T, Chikritzhs T, Bostrom A, Kerr W (2007) Moderate alcohol use and reduced mortality risk: systematic error in prospective studies and new hypotheses. Ann Epidemiol 17: S16–23.
13. Jackson R, Broad J, Connor J, Wells S (2005) Alcohol and ischaemic heart disease: probably no free lunch. Lancet 366: 1911–1912.
14. Liang W, Chikritzhs T (2011) Reduction in alcohol consumption and health status. Addiction 106: 75–81.
15. Naimi TS, Brown DW, Brewer RD, Giles WH, Mensah G, et al. (2005) Cardiovascular risk factors and confounders among nondrinking and moderate-drinking U.S. adults. Am J Prev Med 28: 369–373.
16. Roercke M, Greenfield TK, Kerr WC, Bondy S, Cohen J, et al. (2011) Heavy drinking occasions in relation to ischaemic heart disease mortality—an 11–22 year follow-up of the 1984 and 1995 US National Alcohol Surveys. Int J Epidemiol 40: 141–151.
17. Godtfredsen NS, Holst C, Prescott E, Vestbo J, Olsner M (2002) Smoking Reduction, Smoking Cessation, and Mortality: A 16-year Follow-up of 19,732 Men and Women from the Copenhagen Centre for Prospective Population Studies. American Journal of Epidemiology 156: 994–1001.
18. Shinton R, Bever G (1989) Meta-analysis of relation between cigarette smoking and stroke. BMJ 298: 789–794.
19. Liang W, Binns CW, Jian L, Lee AH (2007) Does the consumption of green tea reduce the risk of lung cancer among smokers? Evidence-based complementary and alternative medicine : eCAM 4: 17–22.
20. Shilton S, Campbell F (1999) What is meant by intention to treat analysis? Journal of Clinical Epidemiology 52: 1001–1007.