Alcohol consumption and self-reported sunburn: A cross-sectional, population-based survey

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Background: Heavy drinking has been associated with several cancers, including melanoma and basal cell carcinoma.

Objective: The purpose of this study was to determine whether excessive drinking is associated with sunburn, a risk factor for skin cancer.

Methods: As part of the 2004 Behavioral Risk Factor Surveillance System, a population-based telephone survey, 299,658 adults reported their use of alcohol in the preceding month and a history of sunburn in the preceding year.

Results: Approximately 33.5% of respondents reported a sunburn within the past year. Heavier average alcohol use and binge drinking were both positively associated with prevalence and number of sunburns within the past year. The adjusted odds ratios for prevalence and number of sunburns among binge drinkers were 1.39 (95% confidence interval 1.31-1.48) and 1.29 (95% confidence interval, 1.20-1.38), respectively. Associations tended to be of similar magnitude for average alcohol use and in all subgroups evaluated.

Limitations: This study was cross-sectional and relied upon participant self-report.

Conclusion: Excessive drinking is associated with higher rates of sunburn among American adults. The observed relationship typifies the high-risk behavior associated with excessive drinking and suggests one pathway linking alcohol use with skin cancer. (J Am Acad Dermatol 2006;55:584-9.)

Heavy and binge drinking have been linked with numerous adverse health outcomes. Among these are increased risk of several aerophagic and biliary tract malignancies, including laryngeal, pharyngeal, esophageal, gastric, colorectal, and hepatocellular cancer.[1] Given the location of these cancers, alcohol is commonly thought to exert its carcinogenic effects by direct exposure. However, alcohol intake has also been linked to several other cancers, such as lung[2] and bladder cancer,[3] for which direct exposure is an unlikely explanation. In many of these cases, alcohol may act indirectly through its effects on cigarette smoking, as alcohol intake itself appears to increase the prevalence and intensity of cigarette use.[4]

Cigarette smoking is but one of many alcohol-related behaviors that pose substantial health risks. Although the dangers of drinking and driving automobiles are well known, alcohol use is also associated with boating[5] and snowmobile[6] fatalities, bicycle injuries,[7] marijuana use,[8] and high-risk sexual behavior.[9] The pathways by which alcohol increases these risky behaviors are likely to be manifold and complex, but appear to include enhanced impulsivity and aggression.[10]

Recently, a few studies have linked alcohol consumption to higher risk of skin cancer, including melanoma[11-14] and basal cell carcinoma,[15,16] although this finding has not been universal.[17-23] Unfortunately, no clear mechanism has emerged to

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explain these associations.[24] Given the relationship of alcohol intake with other risky behaviors, we hypothesized that alcohol intake may also be related to excessive sun exposure, which could in turn increase risk of skin cancer. Unfortunately, we know of no data to confirm or refute this hypothesis.

To examine the relationship of alcohol intake, including usual intake and heavy episodic (or binge) drinking with excessive sun exposure, we analyzed data from the 2004 Behavioral Risk Factor Surveillance System (BRFSS), a large, population-based, annual telephone survey of adults in the United States.

METHODS

Survey design

The BRFSS, administered by the Centers for Disease Control and Prevention, is an ongoing data collection program designed to measure behavioral risk factors in the adult population (≥ 18 years of age) living in households in the 50 states, the District of Columbia, Puerto Rico, Guam, and the Virgin Islands.[25] Factors assessed by the BRFSS include tobacco use, health care coverage, HIV/AIDS knowledge and prevention, physical activity, and fruit and vegetable consumption. Data are collected from a random sample of adults (one per household) through a telephone survey conducted by state health personnel or contractors. The questionnaire has 3 parts: (1) the core component; (2) optional modules; and (3) state-added questions. The 2004 core and module questionnaires are publicly accessible at http://apps.nccd.cdc.gov/BRFSSModules/ModByState.asp?Yr=2004. In 2004, a total of 303,822 individuals participated; the median completion rate, defined as the proportion of all respondents interviewed among all eligible units that were actually contacted, was 76.7%. To ensure representativeness to the target population, probability sampling and poststratification weights are used. For these analyses, we excluded 924 participants with missing or ambiguous information regarding sunburn and an additional 3240 with missing information on heavy alcohol use, leaving 299,658 eligible respondents. All analyses were exempted from Institutional Review Board review by an institutional Committee on Clinical Investigations.

Assessment of alcohol intake

Participants reported the number of days that they consumed at least one drink in the previous 30 days and the average number of drinks that they consumed on those days. A drink was defined as "1 can or bottle of beer, 1 glass of wine, 1 can or bottle of wine cooler, 1 cocktail, or 1 shot of liquor." Drinking frequency and quantity consumed per drinking day were multiplied to yield total alcohol consumption. Individuals also reported the number of times in the preceding 30 days that they had consumed 5 or more drinks on an occasion, the BRFSS definition of binge drinking.[26] Based on responses to these questions, we categorized average alcohol intake into 5 categories: 0, less than 1 drink per day, 1 to less than 2 drinks per day, 2 to less than 3 drinks per day, and 3 or more drinks per day, and dichotomized binge drinking into any or none.

Table I. Selected characteristics of 2004 Behavioral Risk Factor Surveillance System respondents according to reported sunburn in the previous year, weighted to the US adult population

	Sunburn in previous year		
Characteristic	**Yes**	**No**	***P* value**
Age, mean (y)	38.5	49.0	<.001
Female	29.5%	70.5%	<.001
Male	38.0%	62.0%	
Married	34.8%	65.2%	<.001
Other marital status	31.8%	68.2%	
Race			<.001
White, non-Hispanic	41.1%	58.9%	
Black, non-Hispanic	5.8%	94.2%	
Hispanic	20.7%	79.3%	
Other race	22.8%	77.2%	
Multiracial	30.0%	70.0%	
Body-mass index (kg/m^2)			<.001
<25	35.2%	64.8%	
25-29.9	34.2%	65.8%	
≥ 30.0	32.1%	67.9%	
Smoking			<.001
Current daily	36.3%	63.7%	
Current occasional	36.8%	63.2%	
Former	32.2%	67.8%	
Never	33.2%	66.8%	
Season of interview			<.001
Winter	30.5%	69.5%	
Spring	33.4%	66.6%	
Summer	37.5%	62.5%	
Autumn	32.8%	67.2%	

Assessment of sunburn

In 2004, the BRFSS included two core questions on excess sun exposure. Participants were prompted to report whether they had had a sunburn in the preceding 12 months and, if so, how many sunburns they had experienced. A sunburn was defined as "anytime that even a small part of your skin was red for more than 12 hours."

Other behavioral characteristics

We estimated state-specific UVB exposure as previously described[27]; estimates were based on

Table II. Weighted odds ratios for prevalence and number of sunburns in preceding year among 2004 BRFSS respondents, according to alcohol intake

	Usual alcohol intake (drinks/d)					
	None	<1	1-<2	2-<3	3+	Binge drinking
Prevalence of sunburn						
Age- and sex-adjusted	Ref	1.79	2.31	2.33	1.73	1.70
95% CI		(1.73-1.86)	(2.16-2.47)	(2.11-2.57)	(1.53-1.95)	(1.62-1.79)
Multivariable-adjusted	Ref	1.28	1.37	1.37	1.15	1.39
95% CI		(1.23-1.34)	(1.26-1.48)	(1.22-1.53)	(1.01-1.32)	(1.31-1.48)
No. of sunburns						
Age- and sex-adjusted	Ref	1.07	1.40	1.46	2.00	1.46
95% CI		(1.01-1.13)	(1.28-1.54)	(1.28-1.67)	(1.69-2.37)	(1.37-1.55)
Multivariable-adjusted	Ref	1.02	1.18	1.20	1.56	1.29
95% CI		(0.97-1.08)	(1.06-1.30)	(1.04-1.37)	(1.31-1.87)	(1.20-1.38)

Multivariable models were adjusted for age, sex, season of interview, state-specific UVB exposure, race, marital status, education, income, employment, body-mass index, physical activity, number of children in the household, smoking, and alcohol intake (binge and usual intake). *CI,* Confidence interval.

surface-level readings from National Weather Service station meters[28] that weight measured UVB wavelengths by their relative erythema response. Race was categorized into 5 groups (non-Hispanic white, non-Hispanic black, Hispanic, multiracial, and other race). We categorized physical activity as any leisure-time physical activity or exercise in the preceding 30 days. Based on the reported month of interview, we assigned seasons using consecutive 3-month blocks beginning with January. The BRFSS defined an HIV/AIDS risk factor among adults younger than 65 years of age as any of the following activities within the past year: use of intravenous drugs, treatment for a sexually transmitted disease, payment or receipt of money or drugs in exchange for sex, or anal sex without a condom. The 2004 BRFSS also queried respondents about whether they lived in a home with a loaded firearm.

Statistical analyses

We performed two sets of models based on the sun exposure questions included in the 2004 BRFSS. First, we performed conventional logistic regression analyses to determine the prevalence ratios for any sunburn among the full BRFSS sample. Second, we created ordinal logistic regression models to determine the association of alcohol intake with number of sunburns among those respondents who reported at least one sunburn in the last year; the outcome variable included ascending categories of 1, 2, 3, and 4 or more sunburns. In all models, we adjusted for age, sex, season of interview (4 categories), state-specific UVB exposure, race (5 categories), marital status (6 categories), education (4 categories), income (5 categories), employment status (7 categories), body-mass index (3 categories), physical activity, number of children in the household (6 categories), and smoking (4 categories). We assigned indicator variables to covariates with missing data. Adjustment for states as individual indicator variables, rather than with estimated UVB exposure, did not alter our results. To assess other high-risk behaviors, we also included the HIV risk factor and loaded gun ownership in sensitivity analyses. In all cases, we used Intercooled STATA 8.2 for Windows (StataCorp; College Station, Tex; 2005) to account for the sampling weights and presented weighted odds ratios with their 95% confidence intervals. We estimated the fraction of respondents with sunburn attributable to alcohol use using standard methods.[29]

RESULTS

Of the 299,658 eligible respondents, a total of 93,187 (weighted prevalence 33.5%) reported a sunburn within the past year. Of these, 33,999 (34.2%) reported one burn, 27,563 (28.9%) reported 2 burns, 13,612 (15.2%) reported 3 burns, and 17,974 (21.6%) reported 4 or more burns. Table I shows selected unadjusted characteristics of respondents according to prevalence of sunburn. As expected, respondents who reported a sunburn were younger, more likely to be current smokers, and less likely to be black or Hispanic. Although respondents were prompted to report sunburns sustained over the previous year, respondents interviewed during summer months were more likely to report sunburn.

A total of 34,498 (14.8%) respondents reported binge drinking. The weighted prevalence estimates of sunburn among binge drinkers and other respondents were 52.3% and 30.3%, respectively. Table II shows prevalence ratios for sunburn according to usual alcohol intake and binge drinking. Both usual

alcohol intake and binge drinking were associated with higher prevalence, although the risks associated with usual intake were attenuated more strongly with multivariable adjustment. The odds ratios for number of sunburns among respondents who reported at least one sunburn tended to be similar to the overall odds ratios for prevalence of sunburn, and a clear dose-response relationship between usual alcohol intake and number of sunburns was evident. Although ownership of a loaded firearm was positively associated with both prevalence (odds ratio 1.12; 95% confidence interval 1.05-1.19) and number (odds ratio 1.15; 95% confidence interval, 1.06-1.26) of sunburns, additional adjustment for firearm ownership did not materially influence the estimates associated with either binge or usual alcohol intake. Among respondents younger than 65 years of age, the odds ratios for prevalence and number of sunburns associated with binge drinking after additional adjustment for HIV risk behaviors were 1.39 (95% confidence interval, 1.31-1.48) and 1.29 (95% confidence interval, 1.21-1.39), respectively.

Table III shows the associations of binge drinking with prevalence and number of sunburns stratified by selected characteristics. The associations tended to be consistent across all subgroups evaluated, and only the odds ratio for number of sunburns among the small subgroup of older participants with at least one sunburn was not statistically significant. Of particular note, the excess risk associated with binge drinking was equally evident among individuals whose average consumption was less than daily or greater than that.

To estimate the overall impact of alcohol use on sunburn, we determined the attributable proportion of cases based on the prevalence of any alcohol use. The weighted prevalence of any alcohol use was 53.7%, and the adjusted prevalence ratio for sunburn among all drinkers relative to abstainers was 1.41 (95% confidence interval, 1.35-1.46). Based on these estimates, approximately 18.0% of cases of sunburn were potentially attributable to alcohol use.

Table III. Adjusted odds ratios for prevalence and number of sunburns in preceding year associated with binge drinking among 2004 Behavioral Risk Factor Surveillance System respondents, stratified by selected characteristics

Characteristic	Prevalence of sunburn	No. of sunburns
Men	1.40	1.26
95% CI	1.29-1.51	1.15-1.38
Women	1.51	1.39
95% CI	1.38-1.66	1.25-1.53
White	1.43	1.27
95% CI	1.34-1.52	1.19-1.36
Nonwhite	1.34	1.36
95% CI	1.14-1.59	1.05-1.76
Age<50 y	1.40	1.32
95% CI	1.30-1.50	1.22-1.43
Age 50+ y	1.49	1.13
95% CI	1.33-1.68	0.95-1.34
Married	1.48	1.25
95% CI	1.37-1.60	1.15-1.37
Other marital status	1.31	1.33
95% CI	1.18-1.44	1.19-1.48
<1 drink/d	1.50	1.29
95% CI	1.40-1.61	1.20-1.39
1+ drinks/d	1.62	1.31
95% CI	1.44-1.81	1.15-1.50
Winter	1.46	1.20
95% CI	1.28-1.65	1.04-1.39
Spring	1.35	1.34
95% CI	1.19-1.53	1.17-1.55
Summer	1.44	1.34
95% CI	1.27-1.63	1.18-1.53
Autumn	1.35	1.27
95% CI	1.20-1.51	1.12-1.45

Odds ratios adjusted for age, sex, season of interview, state-specific UVB exposure, race, marital status, education, income, employment, body-mass index, physical activity, number of children in the household, smoking, and usual alcohol intake (except for the stratifying characteristic).
CI, Confidence interval.

DISCUSSION

In this population-based survey of roughly 300,000 adults, alcohol consumption was positively associated with prevalence and number of sunburns, with particular risk associated with binge drinking. The higher risks associated with heavy and binge drinking persisted after adjustment for sociodemographic features and were evident among essentially all subgroups evaluated.

Although this cross-sectional survey cannot establish cause-and-effect relationships, our results are consistent with a large body of evidence that implicates alcohol intake, and especially episodes of heavy intake, in the manifestation of risk-related behaviors. Hingson et al[30] have estimated that in 2001 alone, more than 1700 college students aged 18 to 24 years died from alcohol-related injuries, more than 500,000 suffered unintentional injury, and more than 600,000 were assaulted by other students who were drinking. Alcohol intake also increases time spent gambling and the riskiness of bets made[31] and is a strong risk factor for suicide[32] and nonfatal injury.[33] Disinhibition[34] and impulsivity[35] are two of the most widely accepted mechanisms by which excessive alcohol consumption promotes risky behaviors, and both are particularly linked to binge and

heavy drinking. Viewed in this light, exposure to excessive sunlight represents yet another important dimension of the proclivity for risk-taking produced by excessive drinking.

At the same time, it is not possible to distinguish in this study whether alcohol intake directly causes individuals to allow themselves excessive sun exposure and develop sunburn. Although plausible mechanisms exist, it may be that heavy and binge drinking are markers for underlying willingness to disregard health risks and that it is this underlying willingness that also leads to greater prevalence of sunburn. In this context, excessive drinking and excessive sun exposure are both manifestations of risk-taking, although it is striking that adjustment for other plausible manifestations (such as high-risk sexual activity) did not attenuate the observed relationships. Even if this latter explanation is true, clinicians should view excessive alcohol consumption as a marker of susceptibility to a wide variety of health risks, including solar damage and potentially skin cancer.

Although total cumulative dose of sun exposure is undoubtedly a key risk factor for skin cancer, severe sunburn related to periodic exposure to large amounts of solar radiation may be an important modifying element.[36] The particularly strong relationship of number of severe sunburns with risk of melanoma seen in large prospective cohort studies supports this hypothesis.[37] Although it seems plausible that alcohol intake could increase the severity of sunburn in addition to its prevalence, we do not have direct information with which to assess this possibility; however, this may be another pathway by which alcohol intake predisposes to skin cancer.

We are not aware of any previous studies relating alcohol consumption to sunburn. Some recent observational studies have found higher risk of melanoma associated with alcohol use,[11,14] although these have not had the finely detailed information on drinking pattern available in the BRFSS. Of interest, Le Marchand et al[14] recently found that lifetime alcohol use was associated with higher melanoma risk, particularly among men, but that this association was present only among individuals with low levels of polyunsaturated fat intake (P interaction .04). Given the very limited dietary information available in the BRFSS, we could not test whether polyunsaturated fat intake interacts with alcohol use on prevalence of sunburn.

Other important limitations of our study warrant discussion. All of the information in the BRFSS is self reported, and no independent validation of reported alcohol intake or sunburn can be made, although there is no reason to believe that these variables are measured with less accuracy in BRFSS than in other studies. The associations of both alcohol use and sunburn with sociodemographic characteristics expected from previous studies are reassuring in this regard. The BRFSS is also a cross-sectional survey, and the associations evaluated herein might differ in prospective analyses. We also did not have information on the timing between alcohol use and sunburn and hence cannot evaluate whether the observed association represents an immediate or long-term effect of alcohol.

To conclude, this study indicated that binge and heavy average drinking were associated with higher rates of self-reported sunburn in this population-based cross-sectional telephone survey of American adults, even after accounting for sociodemographic characteristics. If confirmed in prospective studies, the observed relationship typifies the high-risk behavior associated with excessive drinking and suggests one pathway by which alcohol use may lead to skin cancer.

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