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The association of long-term alcohol biomarkers with risk for alcohol-related injury: Implications for screening

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INTRODUCTION

According to the Centers for Disease Control (CDC), alcohol misuse is the leading risk factor for serious injury in the US (CDC, 2013). It is also the third leading cause of preventable death, accounting for more than 75,000 deaths annually (CDC, 2013). Research suggests that screening and brief intervention for alcohol misuse in medical settings has considerable potential to save lives (CDC, 2011). Noting this, the American College of Surgeons Committee on Trauma, required that all level I trauma centers screen injured patients for alcohol problems. Those who screen positive are targeted for intervention. Nevertheless, when screening occurs, it may employ questions or tests of unknown validity to detect recent alcohol involvement.

Detection of alcohol involvement may be particularly problematic among hazardous drinkers who are not currently intoxicated at the time of admission to the health care setting. Given the potential problem of underreporting of recent alcohol use among hazardous drinkers, direct, long-term biomarkers for risky or hazardous drinking may have considerable utility in health care settings.

One such biomarker, ethyl glucuronide (EtG), is a direct, alcohol biomarker. It is only present when there is alcohol unlike indirect, alcohol biomarkers such as liver enzymes, which may be present because of alcohol or non-alcohol conditions. In a recent advisory issued by the Substance Abuse and Mental Health Services Administration (SAMHSA) (2012), alcohol biomarkers are not to be used alone, but may be used in addition to usual self-report methods or information obtained through interviews and physicals by appropriately trained personnel. One area in which alcohol biomarkers such as ETG can assist as an objective measure is in screening for possible alcohol issues/problems when individuals are unwilling or unable to self-report their own use (SAMHSA, 2012). In a recent study, EtG in both hair and fingernail samples was found to be most sensitive as a long-term (up to 12 weeks) alcohol biomarker for high-risk drinkers who self-reported their use (Berger, Fendrich, Jones, Fuhrmann, Plate, & Lewis, 2014).

While there has been considerable research on the use of biomarkers to detect alcohol involvement among patients presenting with trauma in emergency settings who are not currently intoxicated, most of that research has focused on the use of indirect biomarkers (e.g., Fleming et al., 2009; Neumann et al., 2009). These studies suggest that information about ongoing problematic (or hazardous) alcohol use is not enhanced by assessment of these indirect biomarkers. It is noted, however, that several previous studies examined direct biomarkers, including EtG, to detect recent problematic drinking among non-intoxicated patients in emergency and trauma settings (e.g., Kip et al., 2008; Neumann et al., 2008; Halley et al., 2011). These three studies suggest that direct biomarkers may enhance detection of recent alcohol involvement beyond the self-report. Of the three studies cited above, two used blood or urine EtG (Kip et al., 2008; Neumann et al., 2008) and focused on adult samples. Halley et al., focused on children and adolescents and employed fingernail testing for EtG (2011). We are not aware of any studies specifically focused on examining associations between trauma and drinking among college age students, a very high risk drinking group.

There is considerable practical utility for employing fingernail and hair testing as opposed to blood or urine as matrices for EtG testing in applied settings. Compared to urine and blood, fingernail and hair collection may be perceived as less invasive. Furthermore as noted above, fingernails and hair have much longer windows of detection- the 12 week period cited by Berger et al. (2014), compared to an 80 hour window for urine noted by Fleming et al (2009).

To explore EtG, therefore, as a screen for risk of alcohol-related injury among college age youth, we conducted a secondary analysis of a study of alcohol biomarkers in college students. We examined the associations between biomarker status and reports of alcohol-related injury among student respondents. We compared those associations with those obtained when a self-report measure of alcohol was used instead.

METHODS

The study design and data collection procedures are described in detail elsewhere (Berger, Fendrich, Jones, Fuhrmann, Plate, & Lewis, 2014). Briefly, the study employed a cross-sectional survey design. The study was a probability sample of undergraduate college students aged 18–25 years at a large, public urban university located in the Midwestern part of the US. The study response rate was 54%, yielding 606 students who were interviewed on campus during the summer and fall of 2010. Students were interviewed about their recent alcohol use and then completed self-report measures via a web-based format that included questions about alcohol-related problems in the past 12 months (a modified version of the Rutgers Alcohol Problems Index; White & Labouvie, 2000) and drinking behavior during the past 12 months (10-item AUDIT; Bohn, Babor, & Kranzler, 1995). Interviewers collected hair and fingernail samples from students for detection of EtG.

We examined associations in the subsample of 425 respondents with complete, valid data on biological and key self-report measures. The survey asked students “In the past 12 months how often have you experienced the following due to drinking alcohol?” One of the 21 items

in the list of responses evaluated whether or not a student experienced being “hurt or injured.” To construct the alcohol-related injury variable, responses, which were originally scored on a three-point scale (ranging from 0 to 2 or more times) were recoded into a binary format so that all students indicating at least one alcohol-related injury occasion in the last twelve months were scored “1” and all others were scored “0.” The AUDIT was recoded to classify students as “self-reported hazardous drinkers” during the past twelve months using the three AUDIT-C according to standard algorithms (Dawson, Grant, Stinson, & Zhou, 2005). The “EtG positive” measure counted a respondent as being “EtG Positive” if he or she tested positive on the EtG biomarker in either the hair or fingernail sample. For the purposes of this study, a positive test result of the biomarker was considered to be at a level of at least 20 pg/mg in fingernails (sensitivity/specificity 0.37/1.00 for any alcohol use; 0.85/0.75 for increasing-risk drinking; and 1.00/0.68 for high-risk drinking) and/or 30 pg/mg in hair (sensitivity/specificity 0.10/1.00 for any alcohol use; 0.34/0.96 for increasing-risk drinking; and 0.43/0.92 for high-risk drinking) (Berger et al., 2014).

Prior research suggested that EtG biomarkers, especially in fingernails, were a useful qualitative indicator of any alcohol use in the past 12 weeks (Berger et al., 2014). That same study also discussed biomarkers’ potential utility as a long-term (12 week) quantitative indicator of increasing risk drinking (Berger et al., 2014). Accordingly, we examined and compared the odds of self-reported injury for those meeting hazardous drinking criteria with the odds of self-reported injury for those testing positive on the biomarkers. Adjusted odds ratios were calculated via logistic regression controlling for age, race/ethnicity, and gender.

RESULTS

Table 1 describes the sample characteristics in terms of gender, age, and race/ethnicity. Most of the participants were female (63.3%), 21 years or older (72.5%) and non-minority (i.e., white, 84.7%). There were 68 respondents (16%) who reported at least one alcohol-related injury in the past twelve months (see Table 2). There were 278 (65.4%) past-year hazardous drinkers in the sample, and 159 respondents (37.4%) who tested positive by meeting at least one of the biomarker thresholds.

Table 3 summarizes the bivariate association between each of the measures of drinking and self-reported risk of alcohol injury. Those with an EtG positive biomarker test result had 3.31 times the odds of reporting an alcohol-related injury in the past twelve months (95% CI: 1.94, 5.67). By comparison, those meeting the criteria for past-year hazardous drinking had 8.32 times the odds of reporting an alcohol-related injury (95% CI: 3.27, 21.20). Tests suggested that the odds ratios derived from each source were homogeneous, suggesting that self-reported hazardous drinkers did not have significantly higher odds of self-reported injury than biomarker positive subjects (Fleiss, Levin, & Paik, 2003). Adjusted odds ratios based on logistic regression analysis adjusting for age, race/ethnicity, and gender (see Table 4) yielded similar results: those with an EtG positive biomarker had 3.28 times the odds of reporting an alcohol-related injury (95% CI: 1.83, 5.86); and those meeting the criteria for hazardous drinking had 7.32 times the odds of reporting an alcohol-related injury (95% CI: 2.84, 18.82).

DISCUSSION

Whether looking at adjusted or unadjusted odds ratios, the conclusions are the same: measures based on positive long-term biomarkers and self-reports of recent hazardous drinking behavior are associated with increased risk for alcohol-related injury. The self-report associations are considerably higher. It is also noted, however, that the confidence intervals surrounding the prediction for self-report are wide, suggesting that biomarkers may be a more precise indicator of risk compared to self-report. Nevertheless, *both* indicators of drinking are clearly in the same direction.

There are several limitations to the findings. We underscore that our assessment of drinking behavior occurred in a non-threatening setting (a research unit on a college campus) in a group that readily admits drinking behavior (college students). In many settings where injuries are being treated, disclosure of alcohol involvement may be far more threatening. Indeed, it was with this in mind, that these analyses were motivated in order to provide a more accurate picture of the relationships between drinking measures and alcohol-related injury.

In a recent study, less than two-thirds of adolescents showing positive EtG results in fingernail testing across two emergency department settings in Spain actually reported drinking alcohol in “previous months” on a questionnaire (Hally et al., 2015). Thus, the large associations found here between drinking reports and alcohol-related injury (where reports were obtained in a non-threatening, research friendly context) would likely not be replicated in other settings, underscoring the utility of biomarker-based screening.

This is a cross-sectional, secondary analysis that provides suggestive results about the utility of biomarker screening in assessing injury risk. It would be important to design research that could more definitively determine whether or not alcohol biomarker results can identify those at risk for future injury. Such information could inform implementation of strategies among medical personnel such as “Brief Motivational Interventions” (e.g., Fleming et al., 2002). A longitudinal study following those with positive and negative biomarker results would need to be conducted to definitively address this issue.

Additional limitations are noted about the injury question. It is based on a single, non-specific question. It may be important to distinguish between more and less severe injuries and their relationship to drinking. In addition some respondents may understate the linkage between injuries and alcohol involvement, even though this question requires them to make the linkage directly.

At the same time, however, the findings demonstrate the potential utility of long-term biomarkers for identifying injury risk, especially in situations where accurate information about recent drinking history may be challenging or difficult to obtain (e.g., in emergency departments and trauma units). Understanding that alcohol screening based on self-report may be particularly difficult in acute care settings and under conditions in which disclosure of drinking behavior may be perceived as threatening, we suggest that the routine collection of direct biomarkers may lead to important intervention and prevention activity on the part of health care providers in settings where adolescents and young adults are being treated for

injury. Indeed, the time-frame assessed by *long-term*, direct biomarkers – up to 12 weeks – may be of added utility in screening. Compared to 12-month self-reports, such biomarkers may point to more *recent* risky drinking behavior which may need more immediate attention and follow-up.

Once biomarker results are known, providers could follow up with information about the potential for future injury risk and direct referral to physicians and programs who could further assess and address potential alcohol treatment needs. Indeed, the collection and rapid analysis of EtG biomarker data via hair or fingernails – in addition to verbal reports of behavior – could prove valuable for informing targeted brief interventions by health care providers that could ultimately prevent future serious injury and accidental death.

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Table 1

Sample Description

Age (years)	%	N
<21	27.6	117
21	25.4	108
22–26	47.1	200
Gender		
Female	63.3	269
Male	36.7	156
Race/Ethnicity		
Non-White *	15.3	65
White	84.7	360

* African American, American Indian, Asian, Hispanic/Latino, Other

Table 2

Response to Alcohol-Related Injury Question: Were you hurt or injured due to your drinking during the past 12 months?

Response	N	%
Yes	68	16.0
No	357	84.0
Total	425	100

Table 3
Self-Reported Alcohol-Related Injury By Biomarker and 12 Month AUDIT-C Hazardous Drinking

	Self-Reported Alcohol Injury				
	Yes		Odds Ratio		95% Confidence Interval
	%	N			
Drinking Measure					
Biomarker Test (EtG)					
Positive (N=159)	26.4	42			
Negative (N=266)	9.8	26			
			3.31		1.94–5.67
Audit C Self-Report					
Hazardous (N=278)	22.7	63			
Non-Hazardous (N=147)	3.4	5			
			8.32		3.27–21.2

Table 4

Adjusted Odds of Reporting Alcohol-Related Injury by Drinking Measure *

Drinking Measure		
Biomarker Test (EtG)	Odds Ratio	95% Confidence Interval
Positive vs. Negative	3.28	1.83 – 5.86
Audit C- Self Report		
Hazardous vs. Non Hazardous	7.32	2.85 – 18.82

* Adjusted for age (21 years or older vs. others), race/ethnicity (white vs. non-white), and gender (male vs. female)