



Short Communication

The utility of collateral student drinking reports: Evidence from a biomarker study

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HIGHLIGHTS

- Collateral informants are often used to validate college student drinking reports
- We used EtG, a direct biomarker, to assess the utility of collateral reports
- Collaterals rarely provided new information about heavy drinking
- Collateral informants have limited utility in studies of college students

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ABSTRACT

Introduction: Researchers have increasingly used collateral informants to validate the reports provided by primary research subjects. We assessed the utility of collateral informants for college students in a study that incorporates biomarkers to validate student reports of recent drinking behavior.

Methods: Students from a Midwestern university were randomly selected for a study in which they provided 90-day Timeline Followback data, hair and fingernail specimens for ethylglucuronide (EtG) testing, and information about collateral (friends or peers) informants who were familiar with their drinking behavior. We compared summary measures of recent drinking to collateral informant reports for the subset of 72 students who were selected to participate in the collateral validation process who had complete measures. Kappa, weighted kappa, and McNemar tests were performed to evaluate levels of agreement. We compared levels of use indicated by each informant within the context of EtG findings. We also compared respondent and collateral reports with respect to heavy drinking directly to EtG test results.

Results: There was considerable overlap between the reports provided by the student participants and their collateral informants. Within the context of EtG-informed analyses, collaterals rarely provided new information about heavy use beyond that provided by the study subjects.

Conclusions: Collateral informants have limited utility in non-clinical studies of heavy drinking in randomly selected college students.

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1. Introduction

In alcohol research, a collateral informant – typically a person who is familiar with the behavior of the subject in a social situation – is often used to verify the accuracy of student reporting. Although a number of studies have investigated how reports by collateral informants correspond to those provided by the original subjects (e.g., Borsari & Muellerleile, 2009), in the absence of objective indicators of drinking reports, it is difficult to evaluate the utility of collaterals. By incorporating a direct biomarker of individual alcohol use, ethylglucuronide (EtG;

Jones et al., 2012; SAMHSA, 2006), this paper provides the first objective evidence directly addressing collateral informant utility.

2. Materials and method

2.1. Design

Details about the design are available in a previous report (Berger et al., 2014). Randomly selected student participants from a large, Midwestern university completed a web-assisted interview, a web-based survey, and at the end of the survey provided permission plus contact details for up to three, peer-collateral candidates. Participants also provided a hair and/or fingernail sample for EtG analysis. In total, 527 student participants (87%) provided permission and collateral contact details. To contact collaterals, student participants were

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first categorized into three groups based on their past 12 month Alcohol Use Disorders Identification Test (AUDIT; [Saunders, Aasland, Babor, de la Fuente, & Grant, 1993](#)) total score (range 0 to 40): abstainers (AUDIT score = 0); nonhazardous drinkers (AUDIT score ≤ 7); and hazardous drinkers (AUDIT score ≥ 8). In order to achieve at least 30 collateral reports for each drinking group, 40 student participants from each group were randomly selected and their collaterals contacted by phone. If study interviewers were unable to reach the first collateral listed by student participants, then the second and/or third collateral was contacted if provided by the student participant. In the end, 31 collaterals of abstainers, 32 collaterals of nonhazardous drinkers, and 34 collaterals of hazardous drinkers were reached and gave permission to be interviewed for a total of 97 collateral interviews. Collateral participants were compensated \$20.00 for their participation.

Our final student sample consisted of 72 observations with sufficient testable hair and fingernail sample weight (≥ 5 mg), complete TLFB data, and collateral reports. Regarding the relationship between the student participants and collateral informants, 54% were friends of the informants, 17% were boyfriends or girlfriends, 4% were roommates, 7% were brothers or sisters of the study participants, and 18% were related family members. The three groups of collateral informants were combined in our analyses.

2.2. Measures

Student participants were asked to complete the Timeline Followback method ([Sobell, Maisto, Sobell, & Cooper, 1979; Sobell & Sobell, 1992](#)), which was used to document daily intake of alcoholic beverages during the previous 90 days as measured in standard drink units ([National Institute on Alcohol Abuse and Alcoholism, 2005](#)). Using 90-day Timeline Followback data (TLFB; [Sobell et al., 1979; Sobell & Sobell, 1992](#)), average drinks per drinking day (DDD; [Longabaugh & Wirtz, 2001](#)) was determined and two categorical measures derived from DDD. The first measure had six categories that classified average DDD of student participants as either “0 drinks,” “1 or 2 drinks,” “3 or 4 drinks,” “5 or 6 drinks,” “7 to 9 drinks,” and “10 or more drinks.” The second measure was dichotomous and classified average DDD of student participants as either “heavy drinkers,” those drinking at least 5 or 6 drinks per occasion on average, and “non-heavy drinkers,” those classified as drinking between 0 and 4 drinks on average per drinking occasion.

After being asked a general question about whether their student participants drank, collaterals were asked the following question based on the AUDIT in relation to their student participant's alcohol use during the past 12 months: “How many drinks containing alcohol does (name of student participant) have on a typical day when drinking?” Collateral participants could select from the following responses: “1 or 2,” “3 or 4,” “5 or 6,” “7 to 9,” or “10 or more,” similar to the student participant measure based on average DDD. When collaterals reported “never” to the first question, the quantity consumed was set to 0. These response categories were then used to categorize collateral participant response about their student participant into either student

“heavy drinkers,” collateral report of “5 or 6” or more drinks on a typical day when drinking, and student “non-heavy drinkers,” collateral report of no more than “3 or 4” drinks on a typical day when drinking.

Student participants' hair and/or fingernail samples were tested for EtG at United States Drug Testing Laboratories, Des Plaines, IL using liquid chromatography–tandem mass spectrometry. For the purposes of the current study, we classified student participants according to whether or not there was the presence of *any* EtG detected in their hair and/or fingernail specimen.

3. Results

3.1. Overall agreement

Evaluating overall agreement on average drinks per occasion between the 72 student participants and their collateral informants, we obtained a significant ($p < .001$) weighted Kappa of .63 (95% C.I.: .52,.73) suggesting “moderate” to “substantial” overall agreement on drinking levels (See [Table 1](#); [Fleiss, 1981](#); [Fleiss & Cohen, 1973](#); [Landis & Koch, 1977](#)).

With respect to overall classification of “heavy” drinking status, a simple Kappa of .53 (95% C.I.: .30,.75) reflected moderate levels of agreement between the two groups but with a wide confidence interval. McNemar's test was non-significant and the proportions of overall agreement, positive agreement and negative agreement were 81.9%, 64.9% and 87.9%, respectively. Four-fold table results (not shown here) suggested that 90% of those who did not classify themselves as heavy drinkers were classified the same way by collaterals. In contrast, only 60% of those self-identifying as heavy drinkers were similarly identified as such by collaterals.

3.2. Agreement: hair EtG +

The overall agreement among the 24 study subjects with a positive hair EtG produced a weighted Kappa of .49 (95% C.I.: .23,.75). The point estimate might suggest “moderate” agreement between ordinal ratings of drinking status while the confidence limit includes agreement levels considered “fair” to “substantial.” The simple Kappa statistic for binary ratings was .42 (95% C.I.: .05,.78), indicating a “moderate” level of agreement. This statistic was measured with low precision as indicated by the wide confidence band. McNemar's test was non-significant and the proportions of overall, positive, and negative agreement were 70.8%, 69.6% and 72.0%, respectively. There were potentially 12 underreports of heavy drinking among the student participants. For all but three of these participants (75%; 9/12), heavy drinking was also underreported by collaterals.

3.3. Agreement: hair EtG –

For participants where no hair EtG was detected ($n = 48$), we found “substantial” agreement. The weighted Kappa coefficient between ordinal drinking ratings was .64 (95% C.I.: .52, .77). Binary agreement in the absence of hair EtG was “moderate” with a simple Kappa of .50 (95% C.I.:

Table 1
Respondent-collateral agreement on drinking by biomarker test status.

Comparison	N	DDD ^a (ordinal)	Heavy drinking (binary measure)				
		Weighted kappa (95% C.I.)	Simple kappa (95% C.I.)	Overall agreement (%)	Positive agreement (%)	Negative agreement (%)	McNemar's p-value
Overall	72	.63 (.52, .73)	.53 (.30, .75)	81.9	64.9	87.9	.58
Hair positive respondents	24	.49 (.23, .75)	.42 (.05, .78)	70.8	69.6	72.0	1.0
Hair negative respondents	48	.64 (.52, .77)	.50 (.16, .84)	87.5	57.1	92.7	.69
Nail positive respondents	21	.22 (–.01, .45)	.32 (–.07, .71)	66.7	72.0	58.8	.45
Nail negative respondents	51	.65 (.51, .79)	.43 (.06, .81)	88.2	50.0	93.3	1.0

^a Drinks per drinking day.

Table 2

Agreement between biomarker test status and heavy drinking reports.

Comparison	N	HD ^a status positive (%)	Biomarker result positive (%)	Sensitivity of respondent report (%)	Specificity of respondent report (%)	Simple kappa (95% C.I.)	Overall agreement (%)	Positive agreement (%)	Negative agreement (%)	McNemar's p-value
Self-report vs. hair	72	27.8 (20/72)	33.3 (24/72)	50.0 (12/24)	83.3 (40/48)	.35 (.12, .58)	72.2	54.5	80.0	.50
Collateral vs. hair	72	23.6 (17/72)	33.3 (24/72)	45.8 (11/24)	87.5 (42/48)	.36 (.13, .59)	73.6	53.7	81.6	.17
Self-report vs. nails	72	27.8 (20/72)	29.2 (21/72)	66.7 (14/21)	88.2 (45/51)	.56 (.34, .77)	81.9	68.3	87.4	1.0
Collateral vs. nails	72	23.6 (17/72)	29.2 (21/72)	52.4 (11/21)	88.2 (45/51)	.43 (.20, .66)	77.8	57.9	84.9	.45

^a Heavy drinking.

.16, .84). McNemar's test was non-significant and the proportions of overall, positive, and negative agreement were 87.5%, 57.1%, and 92.7%. Most of the cases in the four-fold table were clustered in the non-heavy drinking cell. Out of the 40 student participants who did not self-report heavy drinking in this subgroup, collaterals classified only two of them as heavy drinkers. Of the eight student participants reporting heavy drinking in the EtG hair negative subgroup, only four (50%) were also identified as heavy drinkers by collaterals.

3.4. Agreement: fingernail EtG +

Only 21 subjects had positive EtG tests based on sampling of fingernails (see Table 1). When looking at this subgroup, the weighted Kappa coefficient between ordinal ratings was 0.22 (95% C.I.: -.01, .45), indicating "fair" agreement with the confidence limits spanning from "poor" to "moderate" agreement. The simple Kappa coefficient within this subgroup was .32 (95% C.I.: -.07, .71) when looking at comparisons of heavy drinking status. McNemar's test was non-significant and the proportions of overall, positive, and negative agreement were 66.7%, 72.0%, and 58.8%, respectively. Looking at the four-fold table generated from the dichotomous variables, self-reported heavy drinking was underreported by collaterals. Of the 14 student participants who reported heavy drinking, 9 or 64% were identified as heavy drinkers by collaterals. For the 11 collaterals who indicated heavy drinking among those they were reporting on, all but 2 student participants also self-identified as heavy drinkers (82%). Nearly all of those with a positive nail EtG (20/21) met the 20 ng/pg biomarker threshold, a value that is potentially indicative of heavy drinking (e.g., Berger et al., 2014). Taking this into account, the four-fold table generated from heavy drinking comparisons suggested that there were potentially 7 underreports among the student participants. For all but 2 of these student participants (5/7), heavy drinking was also underreported by collaterals. Among those student participants testing positive for EtG in nails who failed to report heavy drinking, collaterals nearly always failed to provide new information about heavy drinking.

3.5. Agreement: fingernail EtG –

Comparisons between collaterals and the subgroup of 51 participants with no EtG detected in nails yielded a weighted Kappa of .65 (95% CI: .51, .79), suggesting significant "substantial" agreement ($p < .001$). The kappa for the binary measure of heavy drinking was .43 (95% CI: .06, .81). McNemar's test was non-significant and the proportions of overall, positive, and negative agreement were 88.2%, 50%, and 93.3%, respectively. There were 6 student participants whose self-reports led them to be classified as heavy drinkers; only three of these subjects (50%) were also classified as heavy drinkers by collaterals. There were six collaterals who identified heavy drinking in the student participants; only 3 of these six participants (50%) also self-identified as heavy drinkers.

3.6. Agreement between survey report drinking and biomarkers

The agreement between survey reports of drinking and the hair test (see Table 2) was statistically significant and "fair" for student

participants (Kappa = .35; 95% C.I.: .12, .58; $p = .004$) and the collaterals (Kappa = .36; 95% C.I.: .13, .59; $p = .003$). The overall sensitivity of the self-report (using hair test results as the criterion) was marginally higher for the study subjects than for the collaterals (50% vs. 46%).

For participant "heavy" drinking, McNemar's test was non-significant and the proportions of overall, positive, and negative agreement were 72.2%, 54.5% and 80%, respectively. The results for collateral ratings were similar to student participant reports. McNemar's test was non-significant and the proportions of overall agreement, positive, and negative agreement were 73.6%, 53.7%, and 81.6%.

The agreement between survey reports and the fingernail test was "moderate" for both the participants (Kappa = .56; 95% C.I.: .34, .77; $p < .001$) and the collaterals (Kappa = .43; 95% C.I.: .20, .66; $p < .001$). The overall sensitivity of reporting (using fingernail test results as the criterion) was higher for the student participants than for the collaterals (67% vs. 52%). The proportions of overall, positive, and negative agreement were 81.9%, 68.3%, and 87.4% for student participants. Overall, positive, and negative agreement proportions were 77.8%, 57.9%, and 84.9% for collaterals. Both sets of comparisons yielded non-significant McNemar test statistics.

4. Discussion

Despite considerable overlap between reports provided by study subjects and collateral informants, collateral information led to an under-detection of heavy drinking. Overall, negative agreement between ratings was much higher than positive agreement in all but one of our comparisons. These findings provide support for the so-called protective effect among collaterals described by Borsari and Muellerleile (2009).

This study is limited by a small sample size. As a result of this small sample size, we were unable to look at factors influencing collateral-study subject discrepancy. Nor could we look at comparisons using the true biomarker cutoff values. Additionally, it might be useful in a larger sample to explore whether altering the cutoff for "heavy drinking" classification changes the results.

Nevertheless, since collaterals rarely provided new information about heavy use beyond that provided by the study subjects, these findings suggest that collateral informants have limited utility in non-clinically focused studies of randomly selected college students. In light of the growing availability of direct biomarkers as possible strategies for corroborating drinking reports, questions about the future need for collaterals in college drinking studies are raised.

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Contributors

Michael Fendrich conceptualized the manuscript and drafted most of the text. Daniel Fuhrmann ran the statistical analyses, wrote-up the statistical results, and created the tables. Lisa Berger, reviewed and edited the manuscript and incorporated the relevant literature. Charles Plate was the PI of the grant which funded the collection of the data that were analyzed for this manuscript. The three authors from USDTL (Charles Plate, Douglas Lewis & Joseph Jones) were responsible for analyzing and interpreting the EtG biomarker

data from the hair and fingernails which were used in this manuscript. All authors have approved the final manuscript.

Conflict of interest

Charles Plate, Douglas Lewis, & Joseph Jones are paid employees of USDTL which is a private drug and alcohol test firm which specializes in forensic testing. Douglas Lewis is President, Joseph Jones is Vice President, and Charles Plate is Research Director. All other authors declare that they have no conflicts of interest.

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