

Estimating the Quantity and Time Course of Alcohol Consumption from Transdermal Alcohol

Sensor Data: A Combined Laboratory-Ambulatory Study

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Abstract

Transdermal alcohol sensors offer enormous promise for the continuous, objective assessment of alcohol use. Although these sensors have been employed as abstinence monitors for some time now, it is only recently that models have been developed aimed at allowing researchers to derive estimates of the precise amount and time course of drinking directly from transdermal data.

Using data from a combined laboratory-ambulatory study, the current research aims to examine the validity of recently developed methods for estimating BrAC (breath alcohol concentration) directly from transdermal data. Forty-eight heavy social drinkers engaged in seven days of ambulatory assessment outside the laboratory, and also participated in a laboratory alcohol-administration session. Participants wore the SCRAM transdermal sensor throughout the study, and, during the seven days of ambulatory assessment, they provided daily self-reports of their drinking and also took randomly prompted photographs 6X/day which were then evaluated for evidence of alcohol consumption. Results indicated strong associations between daily self-reports of drinking quantity and estimates of BrAC derived from transdermal sensors at both the between and within-subject level. Data from randomly-prompted photos indicated that the time course of estimated BrAC also had validity. Results offer promise for novel methods of estimating BrAC from transdermal data, including those taking a nomothetic (population-based) approach to this estimation, thus potentially adding to our arsenal of techniques for understanding, diagnosing, and ultimately treating alcohol use disorder.

Keywords: Alcohol, transdermal, BrAC, measurement, laboratory, ambulatory methods

Historically, the most common means of measuring alcohol use has been via self-report. In other words, when researchers have wanted to know how much people drank, they have asked the drinkers themselves. Self-reports offer a low-cost means of assessing alcohol use and, depending on the purposes and circumstances of the investigation, such data may have high utility (Babor, Steinberg, Anton, & Del Boca, 2000; Sobell & Sobell, 1990). Nonetheless, self-reports are subject to biases, particularly when individuals are unmotivated to report accurately and/or when they are drinking at levels that impair memory and cognitive capacity (Del Boca & Darkes, 2003; Laforge, Borsari, & Baer, 2005; Shiffman, 2009). In addition, measures of drinking quantity typically rely on participants' own estimation of standard drink consumption, and many drinkers have some level of uncertainty surrounding the precise percent alcohol concentration and also the exact volume of alcohol contained in the drinks they consume (Kerr & Stockwell, 2012). Thus, researchers have long been seeking an objective, physiologically-based measure of alcohol consumption as a means by which to better understand causes and consequences of drinking.

A variety of means have been proposed for the objective assessment of alcohol consumption, ranging from blood- to urine- to breath-based analyses. Blood- and urine-based methods for assessing alcohol use can be intrusive and costly, and further offer limited utility for assessing the quantity of alcohol consumed. Breathalyzer readings assess alcohol use only at a single point in time, require motivated action by the drinker, and, when individuals are actively drinking, are subject to bias from mouth alcohol (Dougherty et al., 2012; Leffingwell et al., 2013). More recently, measures have been developed that examine alcohol levels through the continuous measurement of transdermal alcohol concentration (TAC; (Giles, Rertaud, Meggiorini, & Israel, 1986; Swift & Swette, 1992; see Leffingwell et al., 2013 for review). A

small percentage of the alcohol that is consumed is excreted transdermally, either passively through the skin or actively via the sweat glands (Swift, 2003). Research indicates that the content of alcohol in perspiration (both sensible and insensible) corresponds closely to blood alcohol concentration (BAC) (Davidson, Camara, & Swift, 1997; see Dougherty et al., 2012). Over the past several decades, several sensors have been developed capable of assessing transdermal alcohol use, for the first time offering the potential for a continuous, relatively low-cost and unobtrusive means of objectively assessing drinking (Leffingwell et al., 2013). Recent studies have explored the clinical utility of transdermal alcohol sensors, incorporating the continuous measurement of TAC into contingency management programs that allow clinicians and patients a detailed view of daily drinking behavior to inform their treatment goals (e.g., Barnett, Tidey, Murphy, Swift, & Colby, 2011; Dougherty et al., 2014).

Importantly, although transdermal alcohol sensors offer great promise, the data from these measures cannot currently be used to directly assess the quantity and time course of alcohol consumption (Swift, 2000). Individual difference factors, such as the thickness of the skin, can impact TAC, meaning that two individuals consuming the same amount of alcohol might have TAC readings that diverge substantially (Dumett et al., 2008; Luczak & Rosen, 2014). Furthermore, it is possible that situational factors, such as the degree of physical exertion, might alter the amount of alcohol detected by transdermal sensors (Swift, 2000). Finally, the time course of transdermally excreted alcohol diverges from that of BAC, with TAC often lagging behind BAC by up to 1-3 hours. The exact extent of this lag is believed to vary according to both individual and also situational (e.g., alcohol dose, physical exertion) factors (Leffingwell et al., 2013; Swift, 2000). In short, neither the precise amount of alcohol consumed nor the precise timing of this consumption can currently be inferred directly from transdermal measures. Since

the quantity and timing of alcohol consumption is often a central issue to both researchers and practitioners, further research that increases the interpretability of transdermal data is needed.

With the goal of addressing this gap, models have been developed aimed at translating continuous records of TAC into estimates of BrAC (Dumett et al., 2008; Luczak & Rosen, 2014; Rosen, Luczak, & Weiss, 2014). Informed by the physiological processes governing the transport of alcohol from the blood through the skin, these mathematical models are constructed to estimate the amount of alcohol consumed as well as the timing of consumption directly from transdermal data (Luczak & Rosen, 2014). Of note, several different modeling approaches have been developed for this translation. One approach integrates data from a laboratory-based calibration session in order to translate TAC into estimates of BAC and BrAC (breath alcohol content), relying on idiographic data from each participant (Dumett et al., 2008; Luczak & Rosen, 2014; Rosen, Luczak, Hu, & Hankin, 2013). Specifically, within this approach, participants are required to attend a laboratory-based session, during which alcohol is administered while both TAC and also breathalyzer readings are repeatedly taken over time. (See also Dai, Rosen, Wang, Barnett, & Luczak, 2016 and; Luczak et al., 2018 for an individual calibration approach relying on self-reports.) The individual “calibration” data for each participant is then used to convert that individual's complete TAC record into individual estimates of BrAC, thus allowing the researcher to estimate BrAC values and also BrAC time course from transdermal data collected outside the lab (referred to here as *Individual Calibration Estimates*). Another approach, developed more recently, bypasses individual calibration and instead relies on estimated population parameters in order to convert TAC to BrAC (Barnett et al., 2015). More specifically, based on the assumption that a single model might be used to describe the dynamics common to the entire population of individuals and transdermal devices,

these “nomothetic” models draw on data collected within prior transdermal research to estimate population parameters for transdermal alcohol data. These common parameters are then used to translate TAC into BrAC for all individuals in the new sample (referred to here as *Population Parameter Estimates*).

Using data from a combined laboratory-ambulatory study, the current research aims to examine the validity of the Individual Calibration and Population Parameter methods for estimating BrAC from transdermal data. We examined the drinking patterns of a sample of heavy social drinkers over the course of 7 days using transdermal monitoring. All participants responded to surveys during this period and also attended a laboratory-based alcohol-administration session. We examine both Individual Calibration and also Population Parameter estimates of BrAC, comparing these estimates with daily self-reports of drinking as well as photographic images supplying information on momentary alcohol consumption. Using these data, this study broadly aims to advance methods for assessing transdermal alcohol consumption and, in doing so, to further develop objective methods for measuring drinking.

Methods

Participants

Forty-eight heavy social drinkers were recruited via internet advertisements, posted notices in the local community, and via friend referrals from other participants. Exclusion criteria included medical conditions for which alcohol consumption is contraindicated, alcohol use disorder diagnosis (American Psychiatric Association, 2013), pregnancy in women, and reported discomfort with study drinking requirements. Individuals with a body mass index (BMI) less than 19 or greater than 27 were excluded, due to alcohol dosing requirements. Of participants, 56% were European American, 13% were African American, 6% were Hispanic, and 17% were

Asian. The sample was recruited such that there was an even distribution of men and women (50% female).. Eligible participants had to be between the ages of 21-30, with the average age of participants being 22.6 (range 21-28 years old). All participants in our study met the National Institute on Alcohol Abuse and Alcoholism's criteria for heavy or "at risk" drinking (NIAAA, 2017). Sample size was determined before any data analysis.

Procedures

Posted notices advertised for a "paid alcohol research study" involving multiple laboratory visits, an ambulatory assessment period, and \$200 of compensation (Fairbairn et al., 2018). Interested individuals were instructed to contact the lab via phone or email. Participants who met eligibility criteria were invited to a study initiation visit, where they were oriented to ambulatory assessment procedures and fitted with the transdermal sensor. Participants were instructed not to drink alcohol for at least 12 hours prior to all laboratory visits and were breathalyzed (Intoximeters Alco-Sensor IV) upon arrival at the laboratory to ensure 0.00 BrAC. During this study initiation visit, participants were fitted with transdermal sensors (see measures below) and were oriented to the ambulatory assessment procedures. In the current article, we report all measures and manipulations that are relevant to transdermal alcohol estimation. Reports of other measures and manipulations unrelated to the aims of the current work can be found elsewhere (e.g., Fairbairn et al., 2018).

Participants were informed that, for the next 7-days, in addition to wearing the transdermal sensor, they would be completing surveys in response to prompts. Participants responded to prompts using the Metricwire survey app (Trafford, 2016) directly on their smartphones or, for those who did not own smartphones, on one of the laboratory's iPod touch devices. Participants were informed that every morning, they would receive a survey prompting

them to provide self-reports of their alcohol consumption from the previous day (see below). In addition, they were informed that, between the hours of noon and midnight each day, they would receive 6 prompts at randomly spaced intervals. Within 15 minutes of the prompts sounding, they would need to provide a photograph of their surroundings (i.e., “Take a picture of what you see”). Participants were instructed to capture as much as possible of their current setting in photos, and were encouraged to zoom out and/or take a step back to get the entire scene. After taking photographs, participants also supplied brief captions describing the scene depicted.

Participants returned to the laboratory for two additional visits over the 7-day period of intensive ambulatory assessment, during the 1st of which visits participants were given feedback on their level of ambulatory compliance, and during the 2nd visit participants returned ambulatory equipment. For each participant, one of these visits also served as an alcohol-administration calibration session, held either 4 or 7 days after study initiation (order of sessions counterbalanced across participants). During the alcohol session, participants consumed an alcoholic beverage consisting of 1 part 100-proof vodka and 3.5 parts cranberry juice. To adjust for gender effects, men in the alcohol condition were administered a 0.82 g/kg dose of alcohol, and women were administered a 0.74 g/kg dose (Fairbairn & Sayette, 2013). Participants consumed their beverages in three equal parts over the course of 36 minutes. Participants provided breath samples upon entering the laboratory and at approximately 30-minute intervals after beverage administration was complete. Participants were required to remain in the laboratory until their BrAC dropped below .03%. Upon completion of the final session, participants were paid \$160, with a bonus of \$40 for those who responded to at least 70% of the ambulatory assessment prompts.

Measures

Transdermal Alcohol Concentration: The Secure Remote Alcohol Monitoring System (SCRAM©; Alcohol Monitoring Systems, Inc., Littleton, CO) bracelet—a device that fits around participants' ankles—was used to measure transdermal alcohol concentration (TAC). Readings derived from transdermal sensors were translated into estimates of BrAC using the *BrAC Estimator* software, a code based on a first principles forward model for the transport of alcohol from the blood through the skin and measurement by a transdermal sensor (Dumett et al., 2008; Luczak & Rosen, 2014; Luczak, Rosen, & Weiss, 2013; Rosen et al., 2013; Rosen, Luczak, & Weiss, 2014).

To calculate *Population Parameter BrAC Estimates*, we used the version of *BrAC Estimator* software embedded in the Transdermal Alcohol Sensor Data Macro (TASMAC Software; Barnett et al., 2015). The population filter used in the current release of the *BrAC Estimator* software was created using population BrAC/TAC data collected from two studies, one by Dr. Nancy Barnett at Brown University and one by Drs. Sean O'Connor and James Hays of the Indiana Alcohol Research Center. To calculate *Individual Calibration BrAC Estimates*, a MatLab-based code, designed by GR, was employed to estimate parameters in the model. These estimates were tuned to the particular device and participant using BrAC and TAC data collected at the laboratory-based alcohol-administration calibration session. In applying both of these BrAC estimation strategies, we used specific criteria recommended by Barnett (2015) for eliminating episodes likely to be associated with false positive alcohol detection (e.g., detection of alcohol vapor in the environment as opposed to alcohol as truly consumed by the participant).

Daily Self-Reports of Drinking: Participants provided daily self-reports of their alcohol consumption via ambulatory survey prompts. Specifically, participants were asked to indicate the

precise number of drinks they had consumed on the previous day on an 11-point scale, ranging from “0 drinks” to “10+ drinks.”

Momentary Drinking Data from Photographs: The photographs taken by participants together with their accompanying captions were coded for evidence of drinking (e.g., people drinking and/or drinking paraphernalia displayed in photographs and/or text indicative of alcohol consumption in captions). One research assistant coded all photographs, and a second coded a random sub-sample for reliability. The average agreement across coders was 95%.

Data Analysis Plan

Multilevel modelling was used to examine associations between estimates of BrAC (eBrAC) and daily self-reports of drinking (Raudenbush & Bryk, 2002). In order to calculate daily transdermal alcohol consumption, we summed the area under the eBrAC curve (AUC), for all drinking episodes that had begun on the previous day.¹ We parsed between- from within-subject effects by centering AUC for each individual at level-1, and then entering individual-level averages at level-2 (Raudenbush & Bryk, 2002; Yang, Fairbairn, & Cohn, 2013). Both predictors (AUC) and outcome (daily self-reports) were standardized for analysis.

In the examination of momentary drinking data, the precise estimated BrAC value was calculated for the moment a photograph was taken. Receiver operating characteristic curves (ROC-Curves) were examined in order to identify a threshold for the continuous estimated BrAC values. Contingency tables were then examined to determine the sensitivity and specificity of BrAC estimates with respect to momentary drinking data.

¹ We chose the threshold of 4am (instead of midnight) for distinguishing between days for episodes because late night drinking is not uncommon among younger drinkers and we wanted to ensure that we captured all drinking that occurred before the participant went to bed. Note that, if a drinking episode *began* before 4am on the previous day, then the entirety of that drinking episode would be counted as previous day drinking, until eBrAC values again reached zero.

Results

Laboratory Alcohol-Administration: The average peak BrAC on laboratory sessions was .074% (SD=.01), which was reached about 60 minutes after the end of beverage administration. For 8 participants, TAC values had not yet begun to descend before transdermal recording ceased, and therefore it was unclear whether their laboratory-based readings captured their peak TAC value for that episode. For the remaining (N=40) participants, the average peak TAC on laboratory sessions was .065% (SD=.04), which was reached about 178 minutes after the end of beverage administration.

Ambulatory Descriptives: Participants responded to an average of 93.1% of ambulatory prompts overall (SD=10.6), submitting a total of 1544 photographs and 291 daily self-reports of their drinking. All but 3 participants (94%) reported engaging in at least one drinking episode outside the laboratory over the 7-day ambulatory assessment period. On daily drinking self-reports, participants reported drinking on 3.3 days (SD=1.56), not counting drinks consumed during the laboratory visit. Six participants indicated drinking 10 or more drinks on a single day at least once during the ambulatory assessment period. In total, across all participants, 129 photos/captions were coded as depicting drinking, with 81% (N=39) of participants submitting at least one photo/caption indicating a drinking setting.

Daily Self-Reports of Drinking: There were strong associations between daily self-reports of drinking and (daily) AUC for both Individual Calibration BrAC Estimates, $\beta = 0.75$, $t = 5.98$, $p < .0001$, as well as Population Parameter BrAC Estimates, $\beta = .84$, $t = 8.45$, $p < .0001$.²

² In line with recommendations of Simmons and colleagues (2011), we present alternative analyses here speaking to the generalizability of our effects across different analytic strategies. First, since prior publications have examined associations between self-reports of drinking and transdermal data using traditional correlation indexes, above we report models using multilevel models assuming a normal distribution in order to facilitate comparison across studies. Nonetheless, alcohol consumption was positively skewed, with “0” being the most frequent quantity of alcohol consumed on any given day. We therefore repeated the above analyses within a generalized linear modeling

Multivariate analyses did not reveal evidence for significant differences in the strength of the association between self-reports and Individual Calibration vs. Population Parameter BrAC Estimates, $p=.39$.

We next parsed between-subject from within-subject associations, allowing us to examine whether individuals who self-reported average higher levels of alcohol consumption also showed higher average BrAC estimates (between-subject effects) and further whether an increase in a given individual's alcohol consumption from one day to the next corresponded to an increase in BrAC (within-subject effects). Both Population Parameter and Individual Calibration models produced significant associations with self-reports of drinking at both between and within-subject levels, all of which were strong in magnitude (see Table 1 for results of models parsing between from within-subject effects).

Finally, we repeated these associations while excluding the 8 participants who had incomplete laboratory TAC curves (see above section on Laboratory Alcohol-Administration), which might have impacted the strength of the associations for Individual Calibration Estimates. In the subsample of 40 participants for whom a peak TAC was recorded in laboratory calibration, associations between self-reports of drinking and AUC were as follows: Individual Calibration BrAC Estimates, $\beta = .90$, $t = 7.98$, $p < .0001$; Population Parameter BrAC Estimates, $\beta = .91$, $t = 7.34$, $p < .0001$.

framework assuming Poisson distributed errors and accounting for overdispersion of residuals at level-1: Individual Calibration BrAC Estimates, $B = 0.23$, $t = 4.58$, $p < .0001$; Population Parameter BrAC Estimates, $B = .24$, $t = 5.81$, $p < .0001$. Second, we also repeated analyses while excluding days during which participants reported consuming "10 or more" drinks (N=11 total days), since this category doesn't distinguish between drink numbers greater than 10 and thus might skew associations when drinking was at more extreme levels. Associations were largely consistent with those reported above, Individual Calibration BrAC Estimates, $\beta = 0.75$, $t = 5.29$, $p < .0001$, as well as Population Parameter BrAC Estimates, $\beta = .91$, $t = 5.23$, $p < .0001$.

Momentary Drinking Data: In order to examine the validity of eBrAC values for a given moment in time, we compared photographic indices of drinking with Population Parameter and Individual Calibration estimates of BrAC for that same time point. An inspection of ROC curves mapping transdermal eBrAC values to momentary photographic drinking data indicated that a .01% eBrAC cutoff for determining drinking episodes maximized sensitivity and specificity across both methods of estimating BrAC. Note that we viewed our photographic/caption index of drinking as likely to be relatively insensitive, since we did not ask participants specifically to capture alcohol-related elements of environments (see above descriptives). Nonetheless, when a photograph taken at a given time point showed evidence of drinking, BrAC's estimated for that same moment in time were $>.01\%$ over 50% of the time. Conversely, when a photograph taken at a given time point showed no evidence of drinking, BrAC's estimated for that same moment in time were $<.01\%$ over 90% of the time. Results of these momentary drinking analyses were similar for both Population Parameter and Individual Calibration estimates of BrAC (see Table 2).

Discussion

The current study employed a combined laboratory-ambulatory protocol in order to examine the validity of various strategies for estimating BrAC from transdermal data. Results indicated strong associations between daily self-reports of drinking quantity and estimates of BrAC derived from transdermal sensors, yielding standardized regression coefficients as large as .9 in magnitude. Significant positive associations emerged at both between-subject (i.e., subjects who self-reported more alcohol consumption showed higher overall estimated BrAC) and within-subject (within a given subject, days characterized by more self-reported drinking were associated with higher estimated BrAC) levels. Further, in the current sample, both the

Individual Calibration (idiographic) as well as the Population Parameter (nomothetic) methods for estimating BrAC from transdermal data emerged as strong predictors of self-reported drinking, with no detectable differences emerging between these approaches.

Beyond daily self-reports of drinking, the current study also featured prompts in which participants were asked to submit information about their contexts and behaviors at random intervals throughout the day, enabling us to assess the validity of momentary transdermal BrAC estimates. Note that these random prompts did not directly ask for information on participants' drinking—a decision made in an effort to avoid measurement effects on alcohol consumption—and information on momentary drinking was inferred based on photographs and text entries in which participants were asked to depict their current surroundings and activities. Thus, the current study may have been better suited to assessing transdermal BrAC estimates on a daily basis vs. on a momentary basis. Nonetheless, in light of the potential insensitivity of our photo/text measure of drinking, it is notable that there was still a relatively high correspondence between this measure and both Individual Calibration and also Population Parameter estimates of drinking taken at the same point in time.

The results of the current study seem to indicate the Population Parameter technique as a promising new method for estimating BrAC from transdermal data. Previously proposed methods—i.e., the Individual Calibration method—require laboratory alcohol-administration procedures that can be burdensome and potentially impractical in many settings. In contrast, the Population Parameter method converts TAC into BrAC by using population norms based on previously collected transdermal data, and therefore no individual calibration session is required. It's worth noting that this result emerged in spite of the fact that the current study used a relatively early and unsophisticated version of Population Parameter Estimation (Barnett et al.,

2015), and newer iterations of this model are being developed that include credible bands around the estimates and incorporate person- and environmental-level covariates, which may prove to have even greater validity (Sirlanci et al., under review b, under review a; Sirlanci, Luczak, & Rosen, 2017). The results of this study indicate potential validity for these newer population-based estimates, which may ultimately facilitate the implementation of transdermal sensors into a wider array of clinical and research settings.

While results of this study seem to offer promise for currently proposed BrAC estimation strategies, we wish to emphasize that, when it comes to the precise estimation of drinking from transdermal data, the research literature to this point presents us with more questions than it does answers. For example, some laboratory data indicates that the relationship between TAC and BrAC may change at higher doses of alcohol (Karns-Wright et al., 2016). However, the precise nature of this changing relationship is as yet unknown and, further, the "highest" doses administered in these laboratory studies is still well below what many individuals drink outside the lab (Karns-Wright et al., 2016). More research is needed to understand the relationship between BrAC and TAC across a range of BrAC levels, including very high alcohol doses. Further, the vast majority of research to date has measured transdermal alcohol using the SCRAM bracelet. Although well suited to the binary categorization of drinking episodes within a forensic context, this bracelet may be suboptimal for assessing continuous real-time BrAC in voluntary populations. Not only may the SCRAM be uncomfortable and embarrassing for some participants, but its precise position with respect to the surface of the skin may be variable and thus potentially impact the precision of TAC readings. Although alternative devices have been developed (e.g., WrisTAS) and are being developed (e.g., Skyn, PROOF), more research is required to establish the validity and reliability of these novel sensors. Finally, while researchers

have frequently pointed to the potential importance of individual difference factors in modifying the relationship between BrAC and TAC, it is worth noting that situation-level factors also affect this relationship. Research is needed that systematically varies the context of alcohol consumption (e.g., the degree of physical exertion, ambient temperature, humidity) in order to better understand the relationship between TAC and BrAC across a range of contexts.

In sum, the current study aims to further the development of methods for the transdermal estimation of drinking. Clinicians and researchers have long called for unobtrusive methods for the continuous and objective measurement of alcohol consumption, and transdermal sensors offer enormous promise in this domain. By exploring the validity of estimation strategies for translating TAC into BrAC, the current research aims to develop further the arsenal of techniques available to those seeking to better understand drinking patterns and thereby potentially diagnose and combat problematic drinking.

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Table 1.

Models predicting daily reports of drinking from transdermal BrAC estimates parsing within from between subject associations

<i>Individual Calibration BrAC Estimates</i>			
	β	t	p
Between-Subject BrAC Estimates	0.74	4.97	<.0001
Within-Subject BrAC Estimates	0.75	6.08	<.0001
<i>Population Parameter BrAC Estimates</i>			
	β	t	p
Between-Subject BrAC Estimates	0.93	7.56	<.0001
Within-Subject BrAC Estimates	0.79	6.31	<.0001

The association between daily self-reports of drinking and area under the curve for same-day BrAC estimated using Individual Calibration and Population Parameter methods. Between-subject and within-subject associations were parsed by: 1) Creating average eBrAC scores for each individual (between-subject predictors) and; 2) Centering eBrAC scores according to these individual average (within-subject predictors), and then entering both of these variables into the same model (Raudenbush & Bryk, 2002)

Table 2.
Correspondence between BrAC estimates and indications of alcohol consumption derived from photographs/captions provided at the same time point

	<i>Individual Calibration BrAC Estimates</i>	
	Photo/Caption Indicates Drinking	
	No <i>N (%)</i>	Yes <i>N (%)</i>
eBrAC <.01%	1308 (92.4%)	62 (48.1%)
eBrAC >.01%	107 (7.6%)	67 (51.9%)

	<i>Population Parameter BrAC Estimates</i>	
	Photo/Caption Indicates Drinking	
	No <i>N (%)</i>	Yes <i>N (%)</i>
eBrAC <.01%	1343 (94.9%)	61 (47.3%)
eBrAC >.01%	72 (5.1%)	68 (52.7%)

% values represent proportion within columns.