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Accuracy of drinking behavior recall: Comparing late night BAC by breath analysis to estimated BAC from linked survey responses in a residential college environment

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ABSTRACT

Assessing risk due to alcohol consumption in collegiate populations is often achieved using measures of the frequency of use and the quantity of alcohol typically consumed (number of drinks). Since body weight, gender, and the time spent consuming alcohol all influence the degree of intoxication a better measure of risk rather than number of drinks is an individual's peak blood alcohol concentration (peak BAC). BAC can be measured in field tests directly using breath test instruments or estimated from survey data responses reporting the quantity of alcohol consumed, time of consumption, personal weight and height, and gender. 2,708 random anonymous double-blind late night breath tests have been conducted along with an anonymous but individual case linked survey of alcohol use just inside the entrance to residence halls in a collegiate environment between spring 2003 and fall 2012. Several methods for computing eBAC values have been evaluated by comparing their predictions to corresponding measured BAC values. An assessment of the accuracy of drinking behavior recall has also been conducted as a function of intoxication level. Finally, mathematical models have been developed to determine the eBAC during the pre-absorptive state and to assess the time after cessation of drinking required on average to reach full absorption and peak BAC for this college population. Results will inform survey researchers on the accuracy of personal alcohol use recall and on the relative accuracy of computational methods for eBAC determination.

http://www.AlcoholEducationProject.org

METHODS FOR ESTIMATING BLOOD ALCOHOL CONCENTRATION

AUTHOR	METHOD	REFERENCE
NHTSA	Average gender TBW	National Highway Traffic Safety Administration, "Computing a BAC Estimate" Office of Program Development and Evaluation, (1994). (Note: website reporting this method is no longer available)
WATSON UPDATE TO WIDMARK	TBW estimate from gender-age-height-weight empirical algorithm	Watson, Patricia E., Ian D. Watson, and Richard D. Batt. "Prediction of Blood Alcohol Concentrations in Human Subjects." Journal of Studies on Alcohol 42 (1981): 547-556.

Brick, J. "Standardization of Alcohol Calculations in Research." Alcoholism Clinical and Experimental Research 30 (2006):1276 1286. |
| SEIDL | Distribution volume estimate from gender-weight-height-BMI matched to results from body fat analyzer. Better agreement than Watson above | Seidl S, Jensen U, Alt A. The calculation of blood ethanol concentrations in males and females. Int J Legal Med 2000; 114:71–7. |

ETHANOL CLEARANCE RATE

AUTHOR	RESULT	REFERENCE
NHTSA	0.017 g/dL/hr for moderate drinkers, 0.020 g/dL/hr for heavy drinkers (>60 drinks/month)	National Highway Traffic Safety Administration, "Computing a BAC Estimate" Office of Program Development and Evaluation (1994)
WHITFIELD AND MARTIN	BAC increases with habitual use and with peak BAC. Clearance is not zero order.	Whitfield JB and Martin NG. "Alcohol Consumption and Alcohol Pharmacokinetics: Interactions Within the Normal Population" Alcoholism: Clinical and Experimental Research 18 (1994):238-243.

Lee B-y, Yoon H-k, Baek I-h, Kwon K-I, "Population pharmacokinetics of multiple alcohol intake in humans" Alcohol 47 (2013):159-165 |
| JONES | 0.015 g/dL/hr for moderate drinkers, 0.019 for apprehended drinkers | Jones A W. Evidence-based survey of the elimination rates of ethanol from blood with applications in forensic casework. Forensic Science International 200 (2010): 1-20. |

Estimation of blood alcohol concentrations in this study will use a metabolic rate of 0.015 g/dL/hr for moderate drinkers (mBAC<0.08 g/dL/hr or <60 drinks/month and 0.019 g/dL/hr for drinkers (>=60 drinks/month and mBAC>=0.08g/dL) reflective of a synthesis of the results from the references cited here.

BAC Survey

This is an **anonymous survey**--- you will not be asked to submit your name. Please read each question carefully. There is no "right" or "wrong" answer—just give your best estimate. This survey is **voluntary**. If you do not wish to respond to a question you may leave it blank and continue on. Answering questions on this survey form constitutes your tacit agreement to participate in this study.

Information about you:

1. ◯ male
   ◯ female

Have you consumed alcohol in the last 15 minutes: ◯ yes   ◯ no

2. Age _____

3. Class Rank: ◯ 1st   ◯ 2nd   ◯ 3rd   ◯ 4th year
   ◯ graduate student

4. Current weight and height:
   Weight_____pounds   Height_____ft. _____in

5. Campus Activities (check all that apply)

☐ fraternity ☐ pledging now	☐ varsity team ☐ team in season now

6. Indicate below how many classes you have tomorrow.

   AM classes tomorrow   PM classes tomorrow
   ◯ 0 ◯ 1 ◯ 2 ◯ 3   ◯ 0 ◯ 1 ◯ 2 ◯ 3

7. Do you feel that it would be safe for you to drive an automobile right now?   ◯ yes   ◯ no

Information about your typical alcohol consumption:

8. How often do you typically consume alcohol in a week?
   _____days per week (enter 0 if you don't drink)

9. Typical number of drinks consumed per occasion:
   _____ drinks over _____ hours
   (A drink is a 12 oz bottle of beer, a 4 oz glass of wine, a wine cooler, a shot of liquor, or a mixed drink with one shot.)

What has been your drinking experience tonight?

10. Number of drinks _____   ◯ none
                                 (If none, thank you. You are done)

    Start time of first drink tonight: _____ am/pm
    Time finished most recent drink: _____ am/pm

11. What type of drinks have you consumed tonight?
                    (check all that apply)
☐ packaged beer
☐ draft beer
☐ packaged wine cooler, alcoholic lemonade, etc.
☐ wine
☐ mixed drink
☐ straight shot
☐ caffeinated drink (either with or without alcohol)
☐ 24oz packaged alcoholic beverage

12. Have you driven a car tonight after drinking?
                    ◯ yes   ◯ no

If yes, at what time did you start driving? _____

Information about your drinking environment:

13. How many people were with you while you were drinking? (check all that apply)

☐ I was alone
☐ myself and 1-2 others
☐ myself and 3-4 others
☐ myself and 5-9 others
☐ 10 or more people

14. Where were you drinking tonight? (check all that apply)

☐ my dorm room
☐ another's dorm room
☐ college owned house or apartment
☐ fraternity
☐ off campus residence
☐ bar
☐ other _____

How do you feel right now?

15. *circle one*

Sober   A little buzzed   Pretty Drunk   Wasted

16. What do you think your blood alcohol concentration is right now?

BAC: _____ %

No idea what a BAC scale is ◯

17. Which, if any, of the following has occurred tonight as a consequence of your drinking?
(check yes or no for each consequence listed, a through j)

☐ I did not drink tonight. (If checked Skip #17, 18)   Thank you for taking the survey

	No, did not happen tonight	Yes, happened tonight
a. Physical injury to yourself	○	○
b. Physical injury to others	○	○
c. Fighting	○	○
d. Damage to property	○	○
e. Damaged friendships or relationships	○	○
f. memory loss	○	○
g. Impaired driving	○	○
h. Rode with an impaired driver	○	○
i. Attempted intimate physical/sexual contact **NOT desired by other person**	○	○
j. Were sexually active when otherwise might **NOT have chosen to be**	○	○
k. throwing up	○	○
l. Trouble with campus safety or police	○	○

18. Which of the following strategies did you employ to reduce your risk when consuming alcohol tonight? (check yes or no for each strategy listed, a through g)

	No, I did not use this strategy tonight	Yes, I used this strategy tonight
a. Limit consumption to 1 drink/hour	○	○
b. Eat before and/or during consuming alcohol	○	○
c. Limit the amount of money that I bring to spend on alcohol	○	○
d. Alternate alcoholic and non-alcoholic drinks	○	○
e. Have a designated driver	○	○
f. Limit consumption so that my BAC is 0.05 or below	○	○
g. Have a friend with you	○	○

Thank you for your time.

Form 24-2013

Accuracy of drinking behavior recall: Comparing late night BAC by breath analysis to estimated BAC from linked survey responses in a residential college environment

David W. Craig and H. Wesley Perkins, Hobart and William Smith Colleges, Geneva, NY

1. Abstract

Assessing risk due to alcohol consumption in collegiate populations is often achieved using measures of the frequency of use and the quantity of alcohol typically consumed (number of drinks). Since body weight, gender, and the time spent consuming alcohol all influence the degree of intoxication a better measure of risk rather than number of drinks is an individual's peak blood alcohol concentration (peak BAC). mBAC can be measured in field tests directly using breath test instruments or estimated from survey data responses reporting the quantity of alcohol consumed, time of consumption, personal weight and height, and gender. 2,708 random anonymous double-blind late night breath tests have been conducted along with an anonymous but individual case linked survey of alcohol use just inside the entrance to residence halls in a collegiate environment between spring 2003 and spring 2013. Several methods for computing eBAC values have been evaluated by comparing their predictions to corresponding measured BAC values. An assessment of the accuracy of drinking behavior recall has also been conducted as a function of intoxication level. Finally, mathematical models have been developed to determine the eBAC during the pre-absorptive state and to assess the time after cessation of drinking required on average to reach full absorption and peak BAC for this college population. Results will inform survey researchers on the accuracy of personal alcohol use recall and on the relative accuracy of computational methods for eBAC determination.
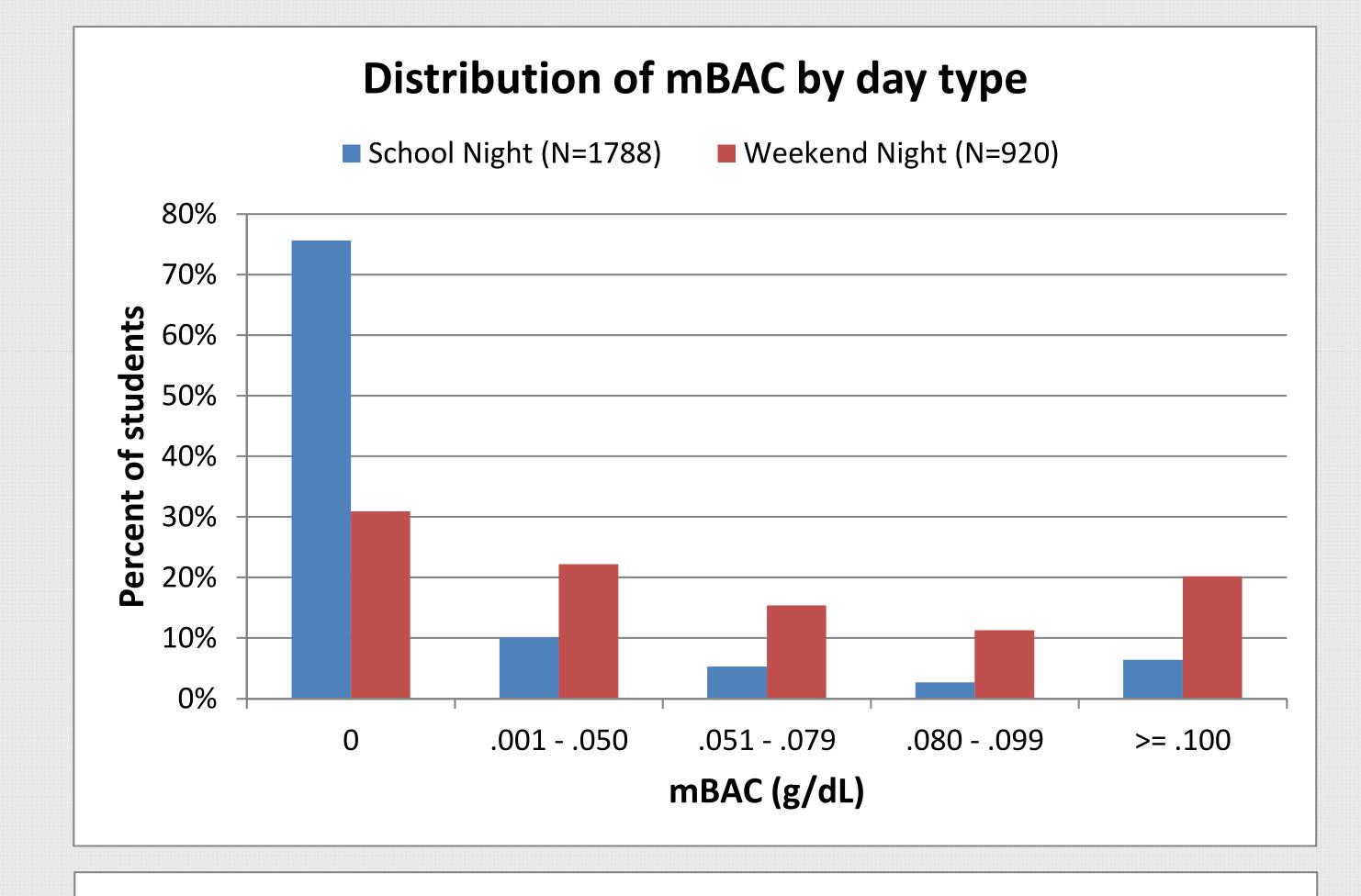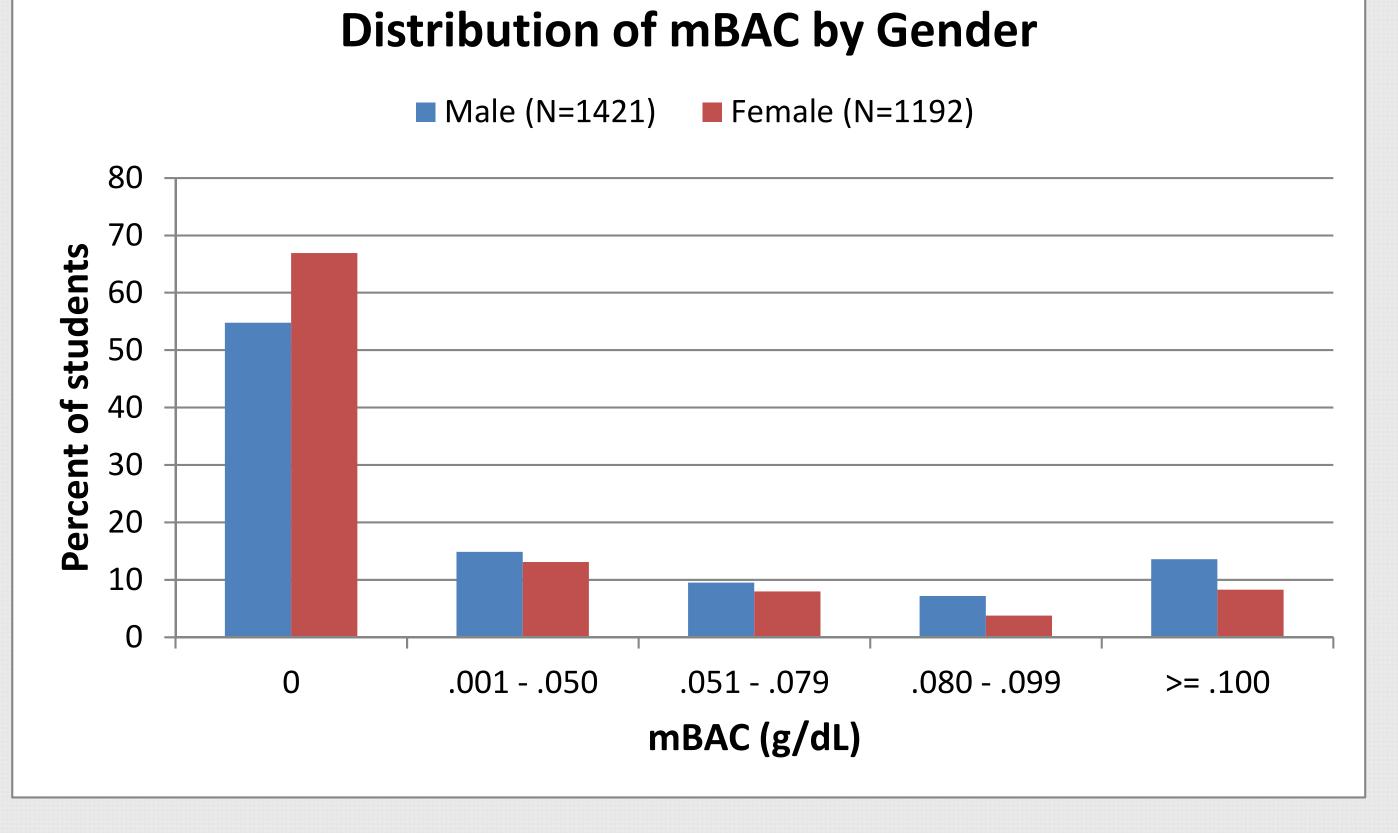
2. Protocol for Conducting a BAC Survey

♦ Data collection times were selected when the perceived greatest amount of drinking was taking place -- 11pm – 3am

♦ Measurement stations were established just inside a randomly selected residence hall each night of the week. Subjects were randomly selected as they passed through the hall entrance.

♦ Subjects were provided with an explanation of the goals of the project, the anonymity of the data collected, and asked for their voluntary participation.

♦ Subjects agreeing to participate submitted a breath sample for analysis on an instrument that displayed a sample number and stored the alcohol result internally. Subjects then completed a short two page survey.

♦ Subjects were provided with a card with their sample number and web address where they could anonymously see their BAC result the next day.

3. Data Collection Station

4. Sample Characteristics

♦ 2708 Participants through Spring 2013
♦ 81% participation of those randomly selected
♦ 54% males, 46% females
♦ 15% over 21, 85% under 21
♦ 66% from school nights and 34% from weekend nights
♦ Class rank: 49% 1st yr, 26% 2nd yr, 14% 3rd yr, and 9% 4th yr

5. BAC Distributions

Distribution of mBAC by day type

■ School Night (N=1788) ■ Weekend Night (N=920)

x-axis: mBAC (g/dL) — 0, .001 - .050, .051 - .079, .080 - .099, >= .100
y-axis: Percent of students — 0% to 80%

Distribution of mBAC by Gender

■ Male (N=1421) ■ Female (N=1192)

x-axis: mBAC (g/dL) — 0, .001 - .050, .051 - .079, .080 - .099, >= .100
y-axis: Percent of students — 0 to 80

6. Factors influencing mBAC measurement

♦ Breath measurement just minutes after drinking adds alcohol to exhaled breath from drink residue still in saliva. BAC measures high.

♦ Breath measurement prior to full absorption of alcohol into the blood and distribution into the water tissues results in a lower mBAC relative to the eBAC
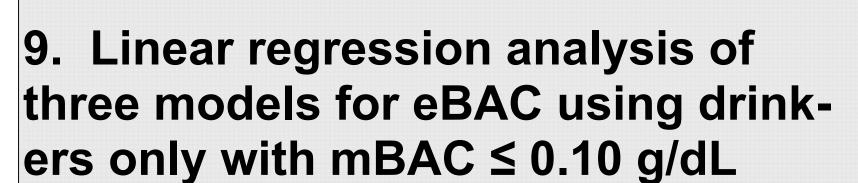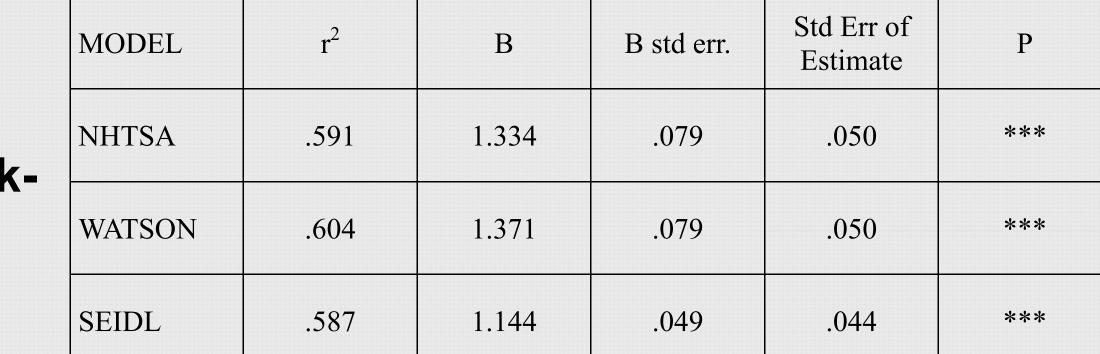
7. Possible factors influencing eBAC

♦ Intentional dishonesty in reporting drinking and body measures

♦ Recall error in number of drinks, drinking start time, drinking end time.

♦ Other subjective inaccuracies
  ◊ Subject unaware of how much alcohol is in the drinks consumed
  ◊ Weight and height unknown or inaccurate

8. Correlation of eBAC with mBAC

Subset sample (N=230) of drinkers only, breath test took place 60 minutes or more after last drink consumed, all survey records complete with weight, height, age, number of drinks, and start and end time for drinking.
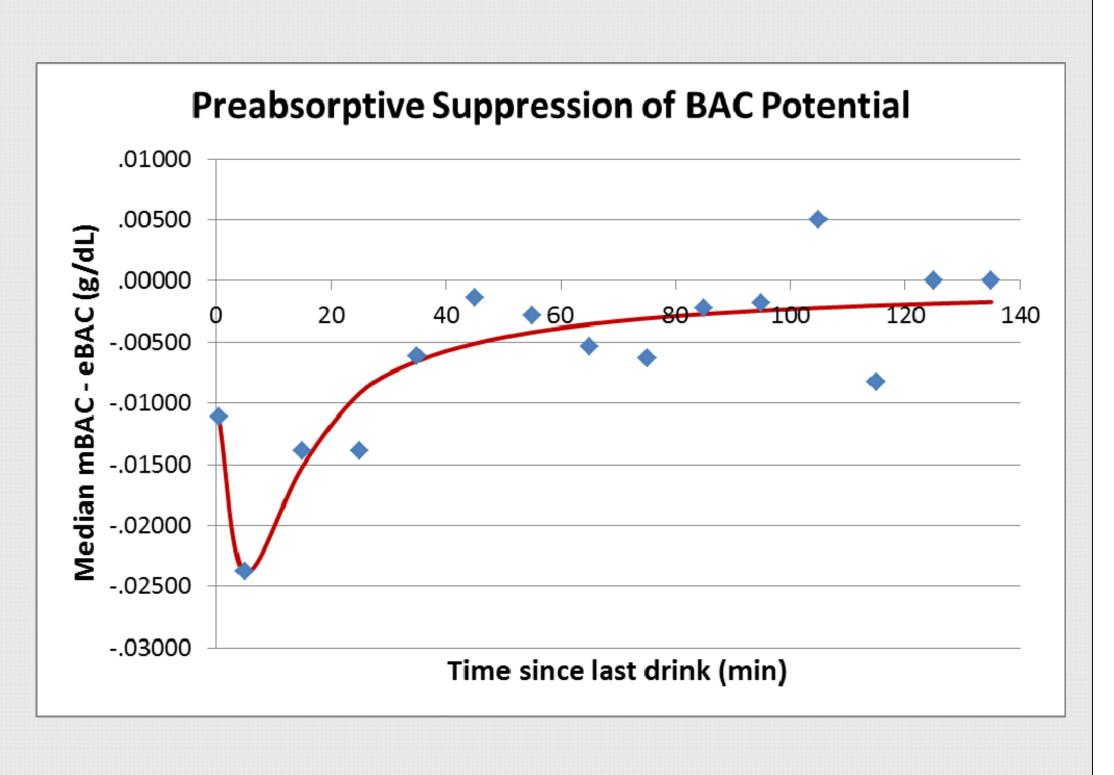
Mean eBAC by Seidl
x-axis: Measured BAC (g/dL) — 0, .001-.020, .021-.040, .041-.060, .061-.080, .081-.100, .101-.120, .121-.140, .141-.160, .161-.180, > .180
y-axis: eBAC (g/dL) — .00000 to .12000
Slope = 1

eBAC (Seidl)
x-axis: Measured BAC (g/dL) — 0 to 0.3
y-axis: eBAC (g/dL) — 0 to 0.3
Slope = 1

9. Linear regression analysis of three models for eBAC using drinkers only with mBAC ≤ 0.10 g/dL

MODEL	r^2	B	B std err.	Std Err of Estimate	P
NHTSA	.591	1.334	.079	.050	***
WATSON	.604	1.371	.079	.050	***
SEIDL	.587	1.144	.049	.044	***

10. Analysis of pre-absorptive suppression of mBAC potential

$$BAC\ suppression = \frac{A \times t}{B + t} - A + Ce^{-t/D}$$

Where t is the time elapsed between finishing the last drink and the breath test, A=1.791, B=0.129, C=0.487, and D=1.595.

Preabsorptive Suppression of BAC Potential
x-axis: Time since last drink (min) — 0 to 140
y-axis: Median mBAC- eBAC (g/dL) — -.03000 to .01000

eBAC can be adjusted for preabsorption error by adding in this BAC suppression factor. Once this is done the regression using the full data set gives an unstandardized B of 1.115 with a standard error of .043.

11. Comparing eBAC with mBAC for assessing student population drinking norms based on overall impairment levels

Prevalence of low and high impairment levels for all students (N=1835)
■ eBAC ■ mBAC
Percent ≤ .05 g/dL: 83.9, 83.9
Percent ≥ .08 g/dL: 10.0, 9.7

Prevalence of low and high impairment levels for drinkers only (N=583)
■ eBAC ■ mBAC
Percent ≤ .05 g/dL: 49.4, 49.2
Percent ≥ .08 g/dL: 31.6, 30.5

12. Social norms posters using prevalence of low BAC impairment levels

The MAJORITY are SOBER

On School Nights
Sunday thru Thursday
91% SOBER
(HWS students who blew a 0.05% or lower BAC returning home)

AND ALSO

On Weekend Nights
Friday and Saturday
57% SOBER
(HWS students who blew a 0.05% or lower BAC returning home)

Source: Data collected anonymously from 230 randomly selected students returning home to residence halls between 11p.m. and 3a.m. during Fall 2012.

Visit www.hws.edu/ for more information about this project.

Most students **(62%)** when at parties and bars, have blood alcohol concentrations below 0.08% *

(below legal DWI limit for age 21+)

*Calculation is based on drinks consumed, body weight, gender and time drinking.

SOURCE
Spring 2013 survey of all HWS students with 913 respondents (conducted by BIDS 295)

Visit www.hws.edu/JustFacts for more information about this project.