K30 Breath Ethanol Concentration in Obese and Underweight Humans

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After attending this presentation, attendees will learn about the effect of obesity on the breath ethanol concentration generated from dosing humans and gain insight to improve applications with this concept.

This presentation will impact the forensic science community by providing data to assist with estimating an ethanol concentration in obese and underweight humans.

Ethanol is hydrophilic and distributes at equilibrium in body fluids and tissues in proportion to their water content and has low solubility in fat (adipose) tissue. A subject with a higher proportion of body fat and concomitant lower proportion of body water is hypothesized to have a higher relative ethanol concentration in blood or breath; conversely a lower proportion of body fat and higher proportion of body water is hypothesized to have a lower relative ethanol concentration. Methods to estimate a blood ethanol concentration in humans derived from experimental data exist; however, their accuracy has not been reliably addressed with the obese (Body Mass Index (BMI) ≥30) and underweight (BMI <18.5). The prevalence of obesity has significantly increased and is now estimated by the Centers for Disease Control and Prevention (CDC) at 35% of American adults.[1] Breath samples were collected about every 15 minutes from 806 forensic human subjects (86.6% male drivers) following a controlled drinking test and analyzed using a Breathalyzer™ 900/900A or Intoxilyzer® 5000 instrument. The Ethanol Concentration per Dose (EC/D) was calculated by dividing the y-intercept of breath ethanol (alcohol) concentration versus time by the total dose of ethanol administered. The relative body-paired EC/D was determined for obese (17.3%) and underweight (1.7%) subjects that could subsequently be paired with control subjects in the target (ideal) BMI range with the same gender, age, and similar height (up to ±3cm for males, ±5cm for females). The relative body-paired ethanol concentration per dose (bp-EC/D) was calculated from the ratio of subject EC/D multiplied by the inverse ratio of their body masses, with results summarized below:

		bp-EC/D			BMI: Condition Subjects		BMI: Control Subjects	
Condition	Sex	Median	Range	N	Median	Range	Median	Range
Obese	M	1.113	0.642 to 1.711	65	32.2	30.0 to 42.0	23.5	19.7 to 24.9
Obese	F	1.154	1.049 to 1.155	3	34.9	30.2 to 46.7	21.8	20.4 to 23.8
Underweight	M	0.887	0.758 to 1.012	3	18.2	17.7 to 18.3	22.5	21.6 to 23.2
Underweight	F	0.883	0.798 to 1.015	6	17.6	16.1 to 18.4	21.4	18.5 to 22.0

These results from the body-paired groups agree (i.e., are not inconsistent) with the hypothesis for both gender (male, female) and body conditions (obese, underweight) studied. The magnitude of the effect of obesity on the ethanol concentration is similar to that generally attributed to gender. Estimation of the EC/D using equations derived by Watson et al., adjusted for mass-per-volume units of measure by the average density of blood (1.055g/mL), provided the best overall agreement with breath ethanol test results for the obese and underweight humans studied.[2] The median relative ethanol concentration per dose (experimental/theoretical) from the adjusted Watson approach was similar and close to unity for the four groups: (1) 0.984 (range: 0.724 to 1.323, N=128) for obese males; (2) 0.957 (range: 0.721 to 1.206, N=12) for obese females; (3) 0.988 (range: 0.844 to 1.066, N=6) for underweight males; and, (4) 0.999 (range: 0.845 to 1.060, N=8) for underweight females.

References:

1. C.L. Ogden, M.D. Carroll, B.K. Kit & K.M. Flegal, "Prevalence of Obesity in the United States, 2009-2010", NCHS Data Brief 82 (Jan. 2012). Online: Centers for Disease Control and Prevention, http://www.cdc.gov/nchs/data/databriefs/db82.pdf.
2. P.E. Watson, I.D. Watson & R.D. Blatt, "Prediction of Blood Alcohol Concentrations in Human Subjects" J. Stud. Alc. 42(7), 547-556 (1981).

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