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Commentary on : Artificial Sweeteners, Caffeine, and Alcohol Intoxication in Bar Patrons[Rossheim & Thombs (2011)]

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Abstract

Background—This commentary discusses the paper by Rossheim and Thombs (2011), which examined the relationship between type of alcohol mixer (regular caffeinated cola, diet caffeinated cola, energy drink or no mixer) and breath alcohol readings in bar patrons.

Methods—The significance of the findings of this study and new unaddressed questions for the field are discussed.

Results—Rossheim and Thombs (2011) reported that breath alcohol concentration (BrAC) readings were highest when patrons reported the consumption of caffeine mixers that were artificially sweetened (i.e., diet cola), after adjusting for potential confounds. Women were more likely to consume diet cola-caffeinated mixed drinks.

Conclusions—The findings from this field study raise several new interesting questions. Given the reported gender difference in consumption of diet cola-caffeinated mixed drinks, more research is needed regarding gender differences in gastric emptying time for alcoholic beverages mixed with artificially sweetened versus sucrose sweetened caffeinated drinks. In addition, the recent explosion in the energy drink market has resulted in the availability of sugar free or diet versions of most energy drink products. The implications of mixing diet energy drinks with alcohol are unknown.

Keywords

Artificial Sweeteners; Caffeine; Alcohol; Energy Drinks; Breath Alcohol Concentration

The paper by Rossheim and Thombs (2011) is an important contribution to understanding risky drink choices in young people and the results suggest many new questions that should be addressed using various methodologies. The results described in this paper come from the combined analysis of two nighttime field studies from the same bar district. As patrons left a bar, they were recruited to report what kinds and how many beverages they had consumed that evening and then were asked to provide a breath sample. The authors reported that the breath alcohol concentration (BrAC) readings were significantly associated with the number of diet cola mixed drinks, after adjusting for other potential confounds. Figure 1 of this paper highlights the key finding that BrAC readings were highest for the diet cola-caffeinated alcoholic beverage group.

A possible mechanism by which artificially sweetened caffeinated beverages would be associated with the highest intoxication rates was suggested by the result of one laboratory study that examined gastric emptying and alcohol absorption for artificially sweetened versus regular mixers (Wu et al., 2006). In that study, 8 male subjects were administered vodka twice in randomized order, with the vodka being mixed with either a sucrose

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beverage or a 'diet' mixer on each occasion. They recorded gastric half-emptying time (using ultrasound) and found it was less for the diet compared to the regular drink (i.e., 21 minutes for the diet alcoholic beverage compared to 36 minutes for the regular sucrose sweetened alcoholic beverage). The authors also reported that peak blood alcohol concentration (BAC) was greater with the diet drink (.053 g%) compared to the regular drink (.034 g%), which is consistent with the notion that rate of gastric emptying is a major determinant of the absorption of alcohol (Horowitz et al., 1989; Oneta et al., 1998). However, the Wu et al. (2006) study should be interpreted somewhat cautiously given that alcohol was not administered alone (or with an unsweetened mixer) in their study. Matthews et al. (2001) found that male rats administered alcohol mixed with sucrose had lower blood alcohol levels compared to blood alcohol levels obtained from rats that were administered alcohol mixed with saccharin or tap water. Given the limited literature addressing this issue, it may be premature to conclude whether artificial sweeteners result in higher BACs as opposed to sucrose sweeteners resulting in lower BACs. Both human and animal studies are needed to clarify this issue.

Given that Rossheim and Thombs (2011) found that women were more likely to consume diet cola-caffeinated mixed drinks and that women had higher BrACs, this paper points to a clear gap in the literature regarding gender effects on alcohol metabolism, when the alcohol is consumed with artificially sweetened versus sucrose mixers. Wu et al. (2006) did not compare men and women on gastric emptying and peak BACs for diet and sucrose mixers, since only males were recruited for their study. A comparison of peak BACs for men and women after consuming artificially and sucrose sweetened beverages is needed, particularly since women have an enhanced vulnerability to develop alcohol-related diseases, perhaps due to higher BACs achieved after drinking. The responsible mechanisms for gender differences in the pharmacokinetics of alcohol are still in debate, especially regarding the role of gastric emptying versus alcohol metabolism (Baraona et al., 2001). Clearly, researchers with expertise in the area of the pharmacokinetics of alcohol are needed to clarify the role that gender plays in the findings of the Rossheim and Thombs (2011) study.

Thombs and colleagues have stated that caffeine, regardless of its source (soft drinks or energy drinks), has a dose-response relationship with intoxication levels in naturalistic settings (Thombs et al., 2010). This statement is consistent with findings from laboratory research that suggest that the coadministration of caffeine with alcohol increases the risks of consuming alcohol by reducing perceptions of intoxication and enhancing the stimulation felt when drinking, while not altering the impairing effects of alcohol on behavior (Ferreira et al., 2006; Marczinski et al., 2011; Marczinski & Fillmore, 2003, 2006). Furthermore, prior research using other methodologies has established the associations between energy drink use and heavier drinking, underage drinking, alcohol-related problems and increased risk for alcohol dependence (Arria et al., 2010, 2011; Berger et al., 2011; O'Brien et al., 2008; Price et al., 2010). Therefore, the Rossheim and Thombs (2011) finding that consumption of diet cola-caffeinated beverages mixed with alcohol was associated with higher BrACs compared to sucrose sweetened cola-caffeinated alcoholic beverages suggests that mixing a diet or sugar free energy drink with alcohol may be particularly risky. Energy drinks have had meteoric rise in popularity and are the fastest growing U.S. beverage market, with sales expected to reach $9 billion in 2011 (Seiffert et al., 2011). Most varieties of energy drinks now have a sugar free or diet version (e.g., Amp Energy Sugar Free, Monster Energy Absolute Zero, Red Bull Sugar Free, and Rockstar Sugar Free). It is unknown if individuals are mixing these sugar free versions of energy drinks with alcohol, and if so, do these beverages elevate the risks of alcohol consumption beyond that observed with the original sucrose sweetened energy drinks?

Energy drinks contain extremely high levels of caffeine, as well as numerous other compounds, such as guarana and taurine (Howard & Marczinski, 2010; Seifert et al., 2011). The high caffeine content may drive the stimulant properties that users experience, which is of concern given that feelings of stimulation while drinking may lead to excessive drinking, increase the risks associated with drinking, and be important predictors of future alcohol problems (Arria et al., 2011; King et al., 2011; Marczinski et al., 2011; O'Brien et al., 2008). In addition, the other compounds in energy drinks are also problematic when consumed alone and especially when mixed with alcohol. A recent case report of a 17-year old boy who suffered from acute renal failure related to a taurine overdose following consumption of vodka and energy drinks, adds to the accumulating literature that these mixed drinks can lead to a variety of health complications including seizures, dangerous arrhythmias and sudden cardiac deaths (Schoffl et al., 2011; Seiffert et al., 2011). It is interesting that Rossheim and Thombs (2011) observed that the only group who had mean BrACs below the legal limit for driving (.08 g%) contained individuals who had consumed alcohol alone (see Figure 1). Clearly, more research from various points of inquiry is needed to understand the combined effects of artificial sweeteners (which might accelerate gastric emptying of alcohol leading to higher BrACs) with caffeine (which has stimulatory subjective effects and may lead to greater drinking and risky behavior).

In sum, the Rossheim and Thombs (2011) paper provided valuable data from the field that suggests that caffeine's effect of intoxication might be most pronounced when the alcohol is mixed with an artificially sweetened beverage. This study leads one to ask a variety of new research questions which would require the expertise of a broad range of researchers. As such, this paper provides an important contribution to the literature that should generate future interesting contributions answering some of the questions that the paper by Rossheim and Thombs (2011) has raised.

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