

Calorie Underestimation When Buying High-Calorie Beverages in Fast-Food Contexts

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We asked 1877 adults and 1178 adolescents visiting 89 fast-food restaurants in New England in 2010 and 2011 to estimate calories purchased. Calorie underestimation was greater among those purchasing a high-calorie beverage than among those who did not (adults: 324 ± 698 vs 102 ± 591 calories; adolescents: 360 ± 602 vs 198 ± 509 calories). This difference remained significant for adults but not adolescents after adjusting for total calories purchased. Purchasing high-calorie beverages may uniquely contribute to calorie underestimation among adults. (*Am J Public Health*. 2016;106:1254–1255. doi: 10.2105/AJPH.2016.303200)

Previous research has shown that people eating at fast-food restaurants underestimate the caloric content of their purchases,^{1–4} but little is known about whether purchasing beverages affects calorie estimates. Sugar-sweetened beverages are associated with obesity and chronic diseases,^{5–8} and intake of liquid calories may lead to less satiety or perceived satiety than does intake of solid calories.⁹

Because beverages are generally not the central focus of a meal and can be consumed quickly and with little effort, it is possible that people fail to account for the calories in high-calorie beverages (HCBs) more than in other foods. If this is the case, it would lend support to the idea that sugar-sweetened beverages are more problematic than are other caloric foods that are often overconsumed.

We examined the accuracy of calorie estimation among adults and adolescents dining at fast-food restaurants on the basis of whether they ordered an HCB. We hypothesized that participants would be worse at estimating the total calories of their purchase when it included an HCB.

METHODS

The methods for this article have been described previously.¹ We interviewed 1877 adults (aged 18 years or older) at dinnertime and 1178 adolescents (aged 11–20 years) at lunch or after school when dining at fast-food restaurants (6 chains, 89 restaurants) in Boston and Springfield, Massachusetts; Providence, Rhode

Island; and Hartford, Connecticut, and asked them to estimate the calories of the items they purchased. We included adults aged 18 years or older and adolescents aged 11 to 20 years.

There was a small overlap in the age range for these 2 groups, in part because we expanded the age range for adolescents to ensure maximum sample size. However, we interviewed participants in each group at different times; there was no overlap in actual participants. Forty-three percent of adults and 49% of adolescents were female. Sixty-two percent of adults and 82% of adolescents were non-White.

We determined the total calories purchased on the basis of customer receipts and calories listed on the restaurants' Web sites. Beverages included all caloric and noncaloric drinks ordered, and we considered them "high calorie" if they had 140 or more calories (the caloric content of a small, 16 fluid ounce, McDonald's Coca-Cola Classic). Using linear regression, we examined the association between purchasing an HCB and the accuracy of estimating total calories purchased. We controlled for total calories purchased because there is more room for underestimation with higher calorie meals.

Additional covariates included age, body mass index (defined as weight in kilograms divided by the square of height in meters), gender, race/ethnicity, and restaurant chain.

RESULTS

Overall, 621 adults (33%) and 451 adolescents (38%) purchased an HCB. On average, adults underestimated their purchases by 175 ± 636 calories, whereas adolescents underestimated by 259 ± 551 calories. Underestimates were greater among those who purchased an HCB than among those who did not (adults: 324 ± 698 vs 102 ± 591 calories; adolescents: 360 ± 602 vs 198 ± 509 calories; Figure 1). In the unadjusted model, purchasing an HCB accounted for a difference of -217 (95% confidence interval [CI] = $-279, -154$) calories in adults and -160 (95% CI = $-226, -94$) calories in adolescents. After adjusting for covariates, this difference remained significant for adults (-65 calories; 95% CI = $-128, -2$; $P = .04$) but became nonsignificant for adolescents (7 calories; 95% CI = $-57, 71$; $P = .83$; Table 1a, available as a supplement to the online version of this article at <http://www.ajph.org>). We obtained similar results when analyzing beverage calories as a continuous rather than a dichotomous variable.

To assess the potentially unique contribution of ordering an HCB to calorie underestimation, we examined whether ordering high-calorie side items (defined as items with ≥ 140 calories for consistency with our definition of HCB) was associated

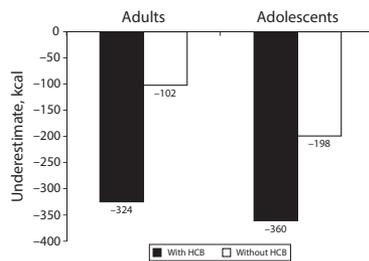
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Note. HCB = high-calorie beverage; defined as a beverage with ≥ 140 calories.

FIGURE 1—Calorie Estimation Accuracy Among Adults and Adolescents Visiting 89 Fast Food Restaurants, With and Without the Purchase of a High-Calorie Beverage: New England, 2010, 2011

with calorie underestimation. A total of 862 adults (46%) and 507 adolescents (43%) purchased at least 1 high-calorie side item. In the unadjusted model, calorie underestimation was greater among those who purchased a high-calorie side item versus those who did not (adults: 228 ± 769 vs 132 ± 499 calories; adolescents: 347 ± 653 vs 194 ± 451 calories).

After we adjusted for covariates, this difference was positive and significant for both adults (93 calories; 95% CI = 25, 161; $P = .01$) and adolescents (108 calories; 95% CI = 34, 182; $P < .01$; Table 1b, available as a supplement to the online version of this article). In this case, a positive parameter estimate indicates that customers buying side items underestimated calorie content less than if they did not buy a side. By contrast, customers buying an HCB underestimated calorie content more than if they did not buy an HCB. We obtained similar results for adults ($P = .04$) when analyzing side item calories as a continuous rather than dichotomous variable, but results became nonsignificant for adolescents ($P = .09$). This suggests that adults may have greater trouble estimating calories in HCB than in high-calorie food items and that HCBs may be influencing calorie estimation in a unique way. (Correlation matrices showing the relationship between dependent and independent variables for adults and adolescents are presented in Tables 2a and 2b, available as a supplement to the online version of this article.)

DISCUSSION

We found that adults underestimated caloric content by a larger amount when they bought

an HCB, even when controlling for total calories purchased. Adolescents also demonstrated greater underestimation when they purchased an HCB, but this association was not significant after controlling for covariates.

Several possible mechanisms may explain this association. Adults ordering an HCB may be less knowledgeable of beverage versus food calories, or they may view beverage calories differently from solid calories, leading to more inaccurate estimates. By contrast, adolescents may have greater knowledge of beverage calories, perhaps influenced by school-based policy efforts^{10,11} or curricula that address sugar-sweetened beverages.^{12,13} Because adolescents are worse overall at estimating calories, the additional calories from HCBs may play less of a role in underestimation.

This study has several limitations. Customers may have elected to participate differentially on the basis of interest and knowledge about food. Those with higher education levels may have been less persuaded to participate by the nominal monetary incentive. We did not measure some potentially important confounders, such as income and education, which could be associated with purchasing an HCB and accuracy of calorie estimation, although most of the neighborhoods we recruited from were low income, suggesting that much of our sample is likely low income.

We also assumed that the restaurant calorie information accounts for the ice in each beverage and did not make additional adjustments. We also do not have data on whether participants ordered free refills, and we may be missing data if additional beverages were purchased separately from the main order, but those receipts were not submitted. This study also has important strengths. We studied a large racially and ethnically diverse sample of adults and adolescents and examined purchases at a range of large fast-food chains at multiple locations.

Our results provide initial evidence that, among adults, purchasing HCBs may contribute to underestimating calories in restaurant meals. Future work should seek to replicate these findings and test for a causal link between HCBs and calorie estimation accuracy. **AJPH**

CONTRIBUTORS

R. L. Franckle conducted the data analyses and drafted the article. J. P. Block conceptualized the study design and the data collection strategy. J. P. Block and C. A. Roberto proposed the analyses, provided critical guidance and feedback on the analyses, and revised the article. All authors approved the final version of the article.

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HUMAN PARTICIPANT PROTECTION

This study was approved by the institutional review boards of Harvard Pilgrim Health Care and the Harvard T. H. Chan School of Public Health.

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