

# Energy Drinks and Youth Self-Reported Hyperactivity/Inattention Symptoms

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The authors declare that they have no conflict of interest.

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## ABSTRACT

**OBJECTIVE:** To describe patterns in sweetened beverage consumption by race/ethnicity and sex, documenting both the amount and types of sweetened beverages consumed; and to examine the association of sweetened beverage consumption with hyperactivity/inattention symptoms among middle school students in a single urban school district.

**METHODS:** Middle school students (n = 1649; 47% Hispanic and 38% black, non-Hispanic) from 12 schools, randomly selected out of 27 district schools, completed health behavior surveys in fall 2011. Students reported quantity and types of sweetened beverages consumed in the past 24 hours and completed the 5-item Hyperactivity/Inattention subscale of the Strengths and Difficulties Questionnaire to measure symptoms.

**RESULTS:** Amount and variety of reported sweetened beverage consumption (including energy drinks) were greater among boys versus girls and among black and Hispanic versus white students. Risk of hyperactivity/inattention increased by 14% for each additional sweetened beverage consumed, adjusting for age, race/

ethnicity, sex, school lunch eligibility, family structure, and sugary food consumption. Students reporting consumption of energy drinks were 66% more likely to be at risk for hyperactivity/inattention after adjusting for number of drinks, other types of drinks consumed, and other potential confounders.

**CONCLUSIONS:** Results support recommendations to limit consumption of sweetened beverages and to avoid consumption of energy drinks among children. Interventions to reduce sweetened beverage consumption should explicitly focus on energy drinks and other emerging sweetened beverages such as sports and sweetened coffee drinks. More research is needed to understand the direction of effects and the mechanisms behind the association between sweetened beverages and hyperactivity/inattention symptoms.

**KEYWORDS:** ADHD; adolescents; energy drinks; nutrition; sweetened beverages

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## WHAT'S NEW

Greater sweetened beverage consumption was associated with increased risk of hyperactivity/inattention among middle school children. Of all beverages types considered, only energy drinks had an independent association with risk of hyperactivity/inattention.

SWEETENED BEVERAGES, WHICH include any drink sweetened with sugar, high-fructose corn syrup, or other caloric sweeteners, are seemingly omnipresent beverages among children today. In a nationally representative sample of high school students, the Centers for Disease Control and Prevention reported that 62.8% of high school students drank sweetened beverages daily, and 32.9% drank these beverages 2 or more times per day.<sup>1</sup> Recently, there has been an observed shift in types of beverages consumed: sales of sodas are declining nationally while energy drink consumption is rising.<sup>2,3</sup> A recent study found that nearly one-third of 12- to 17-year-olds in the United States regu-

larly consume energy drinks,<sup>4</sup> accounting for 9% of the sugar-sweetened beverages youth consume.<sup>5</sup>

Differences in sweetened beverage consumption trends by sex, income, and race/ethnicity have been documented, indicating that caloric contribution from sweetened beverages is higher among boys and lower-income children and teens (ages 2 to 19 years)<sup>6</sup> and is increasing more rapidly among black and Hispanic children and youth relative to whites.<sup>7,8</sup> Trends in energy drink consumption are less clear in this emerging and evolving market. However, a recent review examining patterns of energy drink consumption found that consumption was consistently higher among boys, with no clear patterns by socioeconomic status or race/ethnicity.<sup>9</sup>

A link between beverage habits and increased hyperactivity/inattention symptoms such as difficulty paying attention, difficulty controlling behavior, and overactivity has been explored in some previous research. One study in Germany found that children with hyperactivity/inattention symptoms drank more sweetened beverages daily than those in a comparison group.<sup>10</sup> Another study from Norway found a dose–response relationship between

soft drink consumption and hyperactivity/inattention.<sup>11</sup> Research is limited regarding the association between sweetened beverages and hyperactivity/inattention because these studies did not account for the fact that many children consume a variety of sweetened beverages each day, and studies have not differentiated between types of beverages consumed. Further, these studies were not reflective of a diverse US population.

Children with attention-deficit/hyperactivity disorder (ADHD) have poorer academic outcomes,<sup>12</sup> more difficulties with peer relationships,<sup>13</sup> and are more prone to injuries compared to their peers.<sup>14</sup> Undiagnosed ADHD or children who do not meet criteria for ADHD also face potential harms such as reduced academic achievement<sup>15</sup> and even increased risk of alcohol abuse and violent crimes,<sup>16</sup> making hyperactive and inattentive behaviors important for all children. Although there is a noted lack of research on hyperactivity/inattention among minority children, particularly among Hispanic children,<sup>17,18</sup> some studies suggest that ADHD is underdiagnosed and undertreated among black and Hispanic children<sup>17,19</sup> so studying hyperactivity/inattention symptoms among these populations is particularly important.

The objectives of this study were, first, to describe patterns in sweetened beverage consumption among middle school students by race/ethnicity and sex, documenting both the amount and types (ie, energy drinks, sports drinks, soda, flavored milk, fruit drinks and sweetened coffee drinks) of beverages, and second, to examine the association of sweetened beverage consumption with hyperactivity/inattention symptoms. This study extends prior research by describing current consumption patterns in the changing landscape of sweetened beverages and by examining the association of both amount and type of sweetened beverages with hyperactivity/inattention symptoms. Moreover, schools were randomly selected from an urban school district, representing economically disadvantaged students who are majority Hispanic or black—groups that experience disparities in both sweetened beverage consumption and ADHD compared to more affluent and white peers. Finally, a focus on middle school students is important: they are at a pivotal age, developing independent dietary habits.<sup>20</sup>

## METHODS

Data were gathered in fall of 2011 as part of a larger study conducted by the Yale School of Public Health's Community Alliance for Research and Engagement in partnership with the New Haven Public Schools and the Yale Rudd Center for Food Policy and Obesity to assess the implementation of the district wellness policy and its impact on health and health behaviors. Twelve kindergarten through grade 8 schools were randomly selected from the 27 in the district, and all agreed to participate.

All students in grades 5, 7, and 8 across the 12 study schools were invited to complete a 30-minute online health survey (<https://www.surveymonkey.com/>) that included questions on physical and mental health as well as dietary,

physical activity, and smoking behaviors. Letters were sent in English and Spanish to parents/guardians of all students in grades 5, 7, and 8 ( $n = 1968$ ) across the 12 study schools informing them and allowing them to opt out of the study. Students with parental consent were allowed to opt out of the study without question on survey administration days. Trained research staff read the survey out loud to account for varied literacy levels while students followed along on their screens. A small gift (a water bottle) was given to each participant. All procedures were approved by the Yale University Human Subjects Committee and the local board of education.

Our sample included 1727 students, representing an 87.8% participation rate (126 opted out, and 115 were absent on the day of survey administration). Students with missing data on key indicators ( $n = 50$ ) were excluded from this study. An additional 28 students were excluded because they did not fall into 1 of the 3 major racial/ethnic categories, so the final analytical sample included 1649 students.

## MEASURES

### OUTCOME

The Hyperactivity/Inattention subscale of the Strengths and Difficulties Questionnaire (SDQ) was used as the primary outcome for these analyses. The SDQ is the most widely used instrument in child mental health research<sup>21</sup> and has been validated as internally consistent and stable upon retesting.<sup>22</sup> The subscale consists of 5 items: 1) You are restless, you cannot stay still for long; 2) You are constantly fidgeting or squirming; 3) You are easily distracted and you find it difficult to concentrate; 4) You finish the work you are doing; your attention is good; and 5) You think before you do things. For each item, respondents select an answer: not true, somewhat true, or certainly true. These were scored as 0, 1, and 2, respectively for the first 3 items and reverse coded for the last 2 items, so that higher scores reflect worsening symptoms. Following guidelines, scores between 0 and 5 were considered in the normal range, 6 was considered borderline, and scores between 7 and 10 were considered abnormal.<sup>23</sup> We analyzed the Hyperactivity/Inattention subscale as a 2-level categorical outcome variable, combining borderline and abnormal categories into an at-risk category.

### PREDICTOR VARIABLES

We documented both the number and types of sweetened beverages students consumed. The number of sweetened beverages was assessed by a single item, "Thinking about everything you drank yesterday, how many sodas or other sugar-sweetened beverages (such as sports drinks energy drinks, flavored juice drinks, or sweetened coffee drinks) did you have?" Response choices included 0 to 6 or "7 or more." Students selecting "7 or more" ( $n = 103$ ) were coded as consuming 7 sweetened beverages. This question was adapted from beverage items of the School-Based Nutrition Monitoring Questionnaire<sup>24</sup> by combining separate soda and other sugar-sweetened beverages into one

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