



# Secular Trends in Meal and Snack Patterns among Adolescents from 1999 to 2010



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## ABSTRACT

**Background** Linkages between snack patterns, diet, and obesity in adolescents likely depend on the consumption of main meals, how often snacks are prepared away from home, and whether energy-dense, nutrient-poor snack foods and sugary drinks are frequently consumed. Nutrition-based interventions need to be informed by an understanding of how secular changes in the contribution of snacks to dietary intake may be related to changes in meal frequency as well as how these trends differ by socio-demographic characteristics.

**Objectives** To examine secular trends from 1999 to 2010 in meal and snack patterns among adolescents.

**Design** A repeated cross-sectional design was used.

**Participants/setting** Participants from Minneapolis/St Paul, MN, secondary schools completed classroom-administered surveys and food frequency questionnaires in 1999 (n=2,598) and 2010 (n=2,540).

**Main outcome measures** Weekly meal frequencies; number of snacks consumed on school and vacation/weekend days; frequent consumption of snacks prepared away from home ( $\geq 3$  times/week); and daily servings of energy-dense, nutrient-poor food/drinks that are commonly consumed at snack occasions.

**Statistical analyses performed** Trends from 1999 to 2010 were examined using inverse probability weighting to control for differences in sociodemographic characteristics in the two samples.

**Results** Mean frequencies of breakfast and lunch increased modestly in the overall population (both  $P$  values  $<0.001$ ), and there were decreases in the number of snacks consumed on school days ( $P<0.001$ ) and vacation/weekend days ( $P=0.003$ ). Although there was no change in the proportion of adolescents who reported frequent consumption of snacks prepared away from home, there was a secular decrease in energy-dense, nutrient-poor food/drink consumption ( $P<0.001$ ). Sociodemographic differences in the identified trends were evident.

**Conclusions** The observed pattern of sociodemographic characteristic differences in meal and snack trends among adolescents suggests the need for targeted efforts to ensure public health messages reach low-income and ethnic/racial minority population subgroups most vulnerable to poor nutrition and the development of obesity.

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**F**EW US ADOLESCENTS CONSUME A DIET CONSISTENT with the Dietary Guidelines for Americans, and one-third are overweight.<sup>1,2</sup> Secular trends in several eating patterns, including increases in portion sizes, increases in the consumption of food prepared away from home, and increases in the contribution of snacks to total energy intake may be contributing to poor nutrition and corresponding increases in the prevalence of overweight and obesity that have occurred among adolescents during the past 4 decades.<sup>3-9</sup> National survey data have documented

an increase over time in the contribution of snacks to dietary intake among adolescents as well as the contribution of energy-dense, nutrient-poor foods and drinks (eg, candy and fruit-flavored drinks) to the calories consumed at snack occasions.<sup>6</sup> Data for 2011-2012 indicate that whereas only 54% of US adolescents consume all three main meals (ie, breakfast, lunch, and dinner), approximately three out of four adolescents have two or more snacks on a given day and the food and drinks consumed at snack occasions contribute a quarter of total daily energy intake.<sup>10-12</sup>

Linkages between snacking behaviors, dietary quality, and risk for overweight in adolescents likely depend in part on the consumption of main meals and the types of food and drinks consumed at snack occasions. The food and drinks consumed at snack occasions can be a significant source of healthful nutrients that help young people meet dietary

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recommendations,<sup>10</sup> and frequent snacking may have little influence on overall daily energy intake or weight status for those who typically consume snacks in place of meals. Conversely, frequent snacking likely contributes to excess energy intake and weight gain when snacks are consumed in addition to main meals, and particularly when energy-dense, nutrient-poor foods and drinks are often selected. The source of selected snacks is also likely an important consideration because frequent consumption of food prepared away from home has been consistently linked to greater weight gain over time and diets of lower overall nutritional quality.<sup>13-15</sup> Therefore, public health policies, messages, and services for adolescents need to be informed by an understanding of how recent secular changes in snacking are related to changes in the frequency of consuming main meals as well as specific aspects of snacking behavior that may reflect on the nutrition-related contribution of snacks to overall dietary intake.<sup>16</sup> Because prior research has defined snacking in multiple ways, there is a need to examine multiple aspects of snacking together to allow for stronger comparisons across overall population groups and among subgroups at greatest risk for overweight. Describing any differences in secular trends across sociodemographic subgroups is particularly important because cross-sectional studies cannot provide information on the perpetuating or widening nature of disparities that may be critical to address by intensifying or modifying responsive interventions.

The current study was designed to help fill these gaps in the scientific literature and inform the development of more effective policies, messages, and services to support adolescents in meeting dietary recommendations for health. The aim was to examine secular trends in adolescent reports of meal (breakfast, lunch, and dinner) and snack (food or drinks between meals) patterns alongside trends in the consumption of snacks prepared away from home and energy-dense, nutrient-poor snack food and drinks. Trends were examined from 1999 to 2010 in a large, diverse sample, and therefore capture a period during which there was growing attention given to the availability of snacks on school grounds as well as the typically large portions and high energy density of foods and drinks prepared at locations outside the home.<sup>17-20</sup> In addition, the diversity of the sample allowed for investigation of these trends by sociodemographic characteristics so that any identified disparities may be used to direct health promotion efforts to population subgroups of concern. It was hypothesized, based on prior research,<sup>6,21,22</sup> that meal frequency would decrease and reports of snacking would increase between 1999 and 2010, and that observed trends would disproportionately influence adolescents from ethnic/racial minority and low-income backgrounds.

## METHODS

### Study Design and Population

A repeated cross-sectional study design was used to compare meal and snack patterns between 1999 and 2010 among adolescent participants in Project EAT (Eating and Activity in Teens). Data from 1999 are drawn from Project EAT-I, the first wave of a longitudinal study that has followed adolescents into young adulthood.<sup>23-26</sup> Data from 2010 are drawn from EAT 2010, a multicontextual study designed to examine dietary and weight-related outcomes

in adolescents.<sup>27-29</sup> These two studies were designed to allow for the examination of secular trends by administering identical survey measures to student samples from the same urban school districts at both time points.<sup>30,31</sup> As part of Project EAT-I and EAT 2010, adolescents completed a survey and the semiquantitative Youth and Adolescent Food Frequency Questionnaire (FFQ) after completing the process of assent and signing a form to indicate they understood the study procedures.<sup>32,33</sup> Consent was also obtained from the parents of adolescents before offering the opportunity to assent. Parental consent procedures were completed in accordance with the requests of the participating school districts at each time point; in some schools, passive consent procedures were used, whereas in others active consent procedures were required. Approximately 90% of adolescents who were at school on survey administration days had parental consent and chose to participate in 1999 and 2010. All study procedures were approved by the University of Minnesota's Institutional Review Board Human Subjects Committee and by the research boards of the participating school districts.

In 1999, participants included ethnically/racially diverse students from 31 public middle schools (6th through 8th grades) and high schools (9th through 12th grades) in the Minneapolis/St Paul metropolitan area of Minnesota.<sup>23,24</sup> Consideration was given to enrollment size and involvement in other research studies when recruiting school districts. In recruiting a new cohort during the 2009-2010 academic year, schools that had participated in 1999 were given priority along with demographically similar schools; however, enrolling an ethnically/racially diverse sample was also of particular concern. Therefore, for EAT 2010, only two urban school districts, which served a large number of schools and diverse students, were included. To facilitate the examination of secular trends, the earlier sample was restricted to the two school districts that participated at both time points ( $n=27$  schools in 1999 and  $n=20$  schools in 2010; 17 schools participated in both 1999 and 2010).<sup>30,34</sup> Trained research staff administered the survey measures and FFQs to all interested students in selected health, physical education, and science classes at each time point. The sample for the analysis reported here includes 2,598 adolescents (51.5% female) from 1999 and 2,540 adolescents (53.7% female) from 2010 who provided plausible and complete responses for both the survey and FFQ. The mean age of the 1999 sample was  $14.6 \pm 1.8$  years and the mean age of the 2010 sample was  $14.5 \pm 2.0$  years. Although there were demographic shifts within the participating school districts during the 11-year period, the study sample was ethnically/racially and socioeconomically diverse in both 1999 (63.5% nonwhite or 45.5% eligible for free or reduced-price school lunch) and 2010 (80.3% nonwhite, 57.7% eligible for free or reduced-price school lunch). The student sample was also similar in terms of ethnic/racial composition to the overall student population within each district in 1999 and 2010 based on data maintained by the Minnesota Department of Education.<sup>35</sup>

### EAT Survey Measures

The EAT survey was used to assess adolescent meal patterns and sociodemographic characteristics. Test-retest reliability

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