



Multicontextual correlates of energy-dense, nutrient-poor snack food consumption by adolescents



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ABSTRACT

Frequent consumption of energy-dense, nutrient-poor snack foods is an eating behavior of public health concern. This study was designed to inform strategies for reducing adolescent intake of energy-dense snack foods by identifying individual and environmental influences. Surveys were completed in 2009–2010 by 2540 adolescents (54% females, mean age = 14.5 ± 2.0, 80% nonwhite) in Minneapolis–St. Paul, Minnesota schools. Daily servings of energy-dense snack food was assessed using a food frequency questionnaire that asked about consumption of 21 common snack food items, such as potato chips, cookies, and candy. Data representing characteristics of adolescents' environments were collected from parents/caregivers, friends, school personnel, Geographic Information System sources, and a content analysis of favorite television shows. Linear regression was used to examine relationships between each individual or environmental characteristic and snack food consumption in separate models and also to examine relationships in a model including all of the characteristics simultaneously. The factors found to be significantly associated with higher energy-dense snack food intake represented individual attitudes/behaviors (e.g., snacking while watching television) and characteristics of home/family (e.g., home unhealthy food availability), peer (friends' energy-dense snack food consumption), and school (e.g., student snack consumption norms) environments. In total, 25.5% of the variance in adolescents' energy-dense snack food consumption was explained when factors from within each context were examined together. The results suggest that the design of interventions targeting improvement in the dietary quality of adolescents' snack food choices should address relevant individual factors (e.g., eating while watching television) along with characteristics of their home/family (e.g., limiting the availability of unhealthy foods), peer (e.g., guiding the efforts of a peer leader in making healthy choices), and school environments (e.g., establishing student norms for selecting nutrient-dense snack foods).

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1. Introduction

Frequent consumption of energy-dense, nutrient-poor snack foods is an eating behavior of public health concern (Hess & Slavin,

2014; Larson & Story, 2013). Energy-dense, nutrient-poor snack foods may supplant recommended foods that supply shortfall nutrients or otherwise make important contributions to maintaining good health (2015 Dietary Guidelines Advisory Committee, 2015). If consumed in amounts that exceed caloric needs, energy-dense snack foods may also contribute to risk for obesity. Research has produced mixed evidence in regards to the relationship of energy-dense snack food consumption with weight gain and obesity (Larson & Story, 2013); however, studies in adult and adolescent populations that have accounted for underreporting suggest there

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Abbreviations

EAT 2010 study	Eating and Activity in Teens study
FFQ	food frequency questionnaires
GIS	Geographic Information System
SES	socioeconomic status
Project F-EAT study	Families and Eating and Activity among Teens study
Snack food	energy-dense, nutrient-poor snack foods

is a direct relationship (Larson, Miller, Watts, Story, & Neumark-Sztainer, 2016; Murakami & Livingstone, 2015). More information about energy-dense snack food consumption is needed to direct the refinement and development of strategies that target reduced consumption of these snack foods.

There is a particular need for information to direct the development of efforts to prevent obesity and reduce energy-dense snack food consumption among ethnic/racial minority and low-income adolescents (Larson, Story, Eisenberg, & Neumark-Sztainer, 2016; Ogden, Carroll, Kit, & Flegal, 2014). Despite ongoing efforts to limit the availability of energy-dense snack foods in schools and evidence of small secular decreases in U.S. adolescents' consumption of energy-dense snack foods (Bridging the Gap & Robert Wood Johnson Foundation, 2014; Gorski et al., 2016; Larson, Story et al., 2016), previous research by the authors found that consumption of these foods by adolescents has remained highest among those from black, Native American, and mixed/other ethnic/racial backgrounds and low-income families over the past decade (Larson, Story et al., 2016). The average daily intake of energy-dense snack foods was less than two servings among non-Hispanic white adolescents on a given day in 2010 while adolescents who identified their ethnicity/race as black or mixed/other reported an average intake of nearly three servings (Larson, Miller et al., 2016; Larson, Story et al., 2016).

Given the complexity of influences on adolescent eating behaviors, efforts to reduce consumption of energy-dense snack foods will likely be most successful if they address multiple contexts of influence (Hoelscher, Kirk, Ritchie, Cunningham-Sabo, & Academy Positions Committee, 2013; Huang, Drewnoski, Kumanyika, & Glass, 2009). Ecologic models have been developed to describe the range of potential influences on eating behavior (Story, Kaphingst, Robinson-O'Brien, & Glanz, 2008); however, most studies of influences on energy-dense snack food consumption have simultaneously assessed only a few contexts. Previous multicontextual studies have largely focused on a combination of potential home/family and peer influences with or without consideration of individual-level factors (Ball et al., 2009; De Bourdeaudhuij & van Oost, 2000; Gregori et al., 2011; Luszczynska et al., 2013; Martens, van Assema, & Brug, 2005; van Ansem, van Lenthe, Schrijvers, Rodenburg, & van de Mheen, 2014; van Ansem, Schrijvers, Rodenburg, & van de Mheen, 2015). Few, if any, studies have simultaneously assessed individual factors in combination with home/family, peer, school, and neighborhood environments and screen media exposure. It is further noteworthy that most studies of screen media exposure have focused on the influence of advertising without considering the content of television programs, which account for considerably more viewing time than relatively brief commercials (Boyland & Whalen, 2015; Boyland et al., 2016). As may be of particular significance in addressing identified disparities, there is also limited research addressing what multicontextual factors are of greatest relevance for energy-dense

snack food consumption among ethnically/racially diverse and low-income populations of youth who are at risk for obesity. Most existing studies of influences on energy-dense snack food consumption have been conducted outside the U.S., and thus the findings may not be highly relevant to the diverse cultural groups of adolescents in this country.

The current multicontextual study was designed to build on previous research through a uniquely comprehensive examination of individual-level personal and behavioral factors; characteristics of home/family, peer, school, and neighborhood environments; and aspects of screen media exposure that are associated with energy-dense snack food consumption among ethnically/racially diverse U.S. adolescents. In addition, this study sought to determine the overall and relative contributions made by individual and environmental contexts for explaining energy-dense snack food consumption among a sample of low-income adolescents from diverse ethnic/racial groups. Ecological theory and social cognitive theory were used in combination with the existing literature to identify potential correlates of consumption with a focus on modifiable characteristics. Ecological models emphasize the importance of multiple environmental contexts of influence on health behaviors like energy-dense snack food consumption and social cognitive theory is particularly useful for illuminating socio-environmental, personal, and behavioral factors that determine behaviors as well as guiding the translation of findings to interventions (Bandura, 1986; Larson & Story, 2009; McAlister, Perry, & Parcel, 2008; Sallis, Owen, & Fisher, 2008). As an example of how these theories informed the selection of potential correlates, the existing evidence base of observational and intervention studies addressing linkages between characteristics of home food environments and eating behavior was reviewed with a focus on energy-dense food consumption and food intake between meals. The review resulted in the identification of environmental characteristics that have been consistently related to adolescent eating behavior (e.g., family meal frequency, parental attitudes about healthy foods) or found to be of particular relevance to snack food consumption (e.g., home food availability, parental restriction of high-calorie food) (Campbell et al., 2007; Cutler, Flood, Hannan, & Neumark-Sztainer, 2011; Fulkerson, Larson, Horning, & Neumark-Sztainer, 2014; Larson & Story, 2009; Loth, MacLehose, Larson, Berge, & Neumark-Sztainer, 2016). Results of the current multicontextual analysis are expected to provide preliminary data relevant to the design of interventions and development of policies that will help to ensure the foods and beverages consumed by young people at snack occasions contribute to meeting dietary recommendations and not to excess energy intake.

2. Methods

2.1. Study design and population

The EAT 2010 (Eating and Activity in Teens) study was designed to examine factors associated with weight-related outcomes in adolescents (Eisenberg, Carlson-McGuire, Gollust, & Neumark-Sztainer, 2015; Graham, Larson, & Neumark-Sztainer, 2014; Larson, Wall, Story, & Neumark-Sztainer, 2013; Neumark-Sztainer et al., 2012; Wall et al., 2012). Classroom-administered surveys, food frequency questionnaires (FFQ), and anthropometric measures were completed by adolescents from 20 public middle schools and high schools in the Minneapolis-St. Paul metropolitan area of Minnesota during the 2009–2010 academic year. Following the ecological framework that guided the overall study, data were additionally collected from parents/caregivers, friends, school personnel, Geographic Information System (GIS) sources, and content analysis of favored television shows accessed through online services (e.g. network websites, Netflix) as described in detail below. All study procedures were approved by the University of

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