

Poor Adherence to US Dietary Guidelines for Children and Adolescents in the National Health and Nutrition Examination Survey Population



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ABSTRACT

Background Poor diet quality in childhood and adolescence is associated with adverse health outcomes throughout life, yet the dietary habits of American children and how they change across childhood and adolescence are unknown.

Objectives This study sought to describe diet quality among children and adolescents by assessing adherence to the 2010 Dietary Guidelines for Americans (DGA) and to determine whether any differences in adherence occurred across childhood.

Design, setting, and participants We employed a cross-sectional design using data from the National Health and Nutrition Examination Survey (NHANES). Of 9,280 children aged 4 to 18 years who participated in NHANES from 2005 to 2010, those with insufficient data on dietary recall ($n=852$) or who were pregnant or lactating during the time of interview ($n=38$) were excluded from the final study sample ($n=8,390$).

Main outcome measures We measured adherence to the DGA using the Healthy Eating Index 2010 (HEI-2010) and stratified participants into three age groups (4 to 8, 9 to 13, and 14 to 18 years of age). We analyzed each of 12 HEI-2010 components and total HEI-2010 score.

Results The youngest children had the highest overall diet quality due to significantly greater scores for total fruit, whole fruit, dairy, and whole grains. These children also had the highest scores for sodium, refined grains, and empty calories. Total HEI-2010 scores ranged from 43.59 to 52.11 out of 100, much lower than the minimum score of 80 that is thought to indicate a diet associated with good health.

Conclusions Overall, children and adolescents are failing to meet the DGA and may be at an increased risk of chronic diseases throughout life. By analyzing which food groups show differences between age groups, we provide data that can inform the development of dietary interventions to promote specific food groups targeting specific ages and improve diet quality among children and adolescents.

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IN COUNTRIES WHERE MALNUTRITION IS NOT A PREVAILING concern, poor dietary quality across childhood and adolescence is associated with adverse health outcomes, including early puberty (a risk factor for hormone-related cancers), high diastolic blood pressure, and possibly central obesity, although the association of dietary quality with obesity in childhood is controversial.¹⁻³ Growing evidence that dietary habits developed during childhood often persist into adulthood both raises concern and creates opportunity for intervention because poor dietary quality is recognized as a risk factor for chronic diseases among adults, including diabetes, cardiovascular disease, and cancer.^{4,5} However, we know relatively little about differences in the dietary quality of children at different ages in the developed world. Several indices exist to measure dietary quality and, although small differences exist, all focus on adherence to a diet that emphasizes vegetables, fruits, whole grains, low-fat dairy, fish, and unsaturated fatty acids.⁶ In recognition

that overall “food pattern” might be more beneficial for health than individual nutrients, the US Department of Agriculture (USDA) releases the Dietary Guidelines for Americans (DGA), which are updated every 5 years. To assess adherence to the DGA, the USDA also developed the Healthy Eating Index (HEI), which is updated to reflect changes in the DGA, with the most recent guidelines released in 2010 (HEI-2010). The HEI-2010 scores 12 component food groups. Total HEI-2010 score, ranging from 0 to 100, is a sum of these components, with a high score reflecting greater adherence to the DGA. A small Canadian study used HEI-2010 scores to assess the dietary quality of 125 youths and found that 95% of participants had an HEI-2010 score <80, the recommended minimum HEI-2010 score for disease prevention.^{7,8} Only limited analyses have been done on adherence to the HEI among US children and adolescents. Of these, studies evaluating individual dietary components have shown that children and adolescents are not eating enough dairy, whole grain, fruits,

vegetables, or fish,⁹⁻¹² and are consuming excessive empty calories in the form of soda and grain desserts.¹³ However, focusing on individual food components makes it difficult for clinicians and practitioners to assess food patterns and overall dietary quality. In addition, these results do not address whether dietary quality changes across childhood.

Dietary quality is influenced by several stable factors, including socioeconomic status, sex, and ethnic background.¹⁴⁻¹⁹ However, modifiable factors, such as beverage patterns, television-watching patterns, and meal skipping have also been shown to be associated with dietary quality, making it plausible that dietary quality can change across childhood and adolescence.²⁰⁻²² This notion is supported by a cross-sectional study of adolescents in Brazil that used an early iteration of the HEI and 24-hour recalls.²³ The authors found that overall HEI scores were lower from ages 12 to 20 years, but did not report which HEI components contributed to this change.¹⁹ NHANES is a large nationally representative sample that includes analytic methods for reducing bias in parent- and self-report nutrition data in the study method.²⁴ This allows researchers to accrue large samples needed to accurately analyze national trends, while minimizing issues surrounding self-report nutrition data. In order to provide insight into food categories that might need special attention at different ages, to improve overall diet quality, and contribute to chronic disease prevention efforts, the goals of the current analysis are to describe the diets of US children in relation to the 2010 DGA using the HEI-2010 and to evaluate whether there are differences in adherence to specific dietary components across childhood and adolescence (4 to 18 years) using data from the National Health and Nutrition Examination Survey (NHANES).

METHODS

Population

NHANES uses interviews and physical examinations to determine the health and nutrition status of a representative population of children and adults living in 15 different counties across the United States.²⁵ Certain groups, such as those older than 60 years and Hispanics, are oversampled to ensure that the data reflect current population trends.²⁵ Three cycles of NHANES data were included in the current study (2005-2006, 2007-2008, and 2009-2010) using information from participants aged 4 to 18 years. Of the children and adolescents eligible for the study (n=9,280), those with missing dietary data, those with incomplete dietary recall information (n=852), and girls who were pregnant or lactating at the time of interview (n=38) were excluded, leaving a final study sample of 8,390. This was a secondary data analysis with de-identified data; therefore, this study was exempted from full review by the MD Anderson Institutional Review Board. This study was deemed exempt under federal regulation 45 46.101 (b) CFR.

Measures

Dietary intake was collected from all three cycles using two 24-hour dietary recalls. We used the population ratio approach to control for the likelihood that participants underreported dietary intake (see Analyses section), which, when using HEI-2010 data, necessitates that only the

first-day 24-hour recall be used.²⁴ The first 24-hour recall interview was conducted at a Mobile Examination Center using a standard set of measuring guides to assist in estimating portion sizes.²⁶ Adults completed the dietary recall by proxy for children aged 2 to 5 years, although information for those aged 2 to 3 years was not used for this study.²⁷ Children aged 6 to 11 years completed the interview with help from an adult, and adolescents aged 12 to 18 years independently completed the recall interview.²⁷

Dietary intake was assessed using the HEI-2010, which assesses dietary quality using the 2010 DGA.²⁸ We chose the HEI-2010 score because this has more relevance to nutrition assessments for health used by registered dietitian nutritionists today.

Dietary Quality

Total HEI-2010 score was used as a measure of dietary quality. Total HEI-2010 score was created from 12 dietary components, which mirror aspects of the 2010 DGA.²⁹ These 12 components are total fruit, whole fruit, total vegetables, greens and beans, whole grains, dairy, total protein foods, seafood and plant proteins, fatty acids, refined grains, sodium, and empty calories. Each component has a minimum score of 0 and a maximum score between 5 and 20. Each component is scored such that a higher value indicates better adherence to dietary guidelines. To create the total HEI-2010 score, each component ratio score was summed. The total HEI-2010 and each component are represented by a score indicating intake per 1,000 kcal, which is taken forward to analysis, rather than an estimation of absolute intake. The total HEI-2010 score ranges from 0 to 100, with higher scores indicating higher diet quality. Additional details on the HEI-2010 are available elsewhere.³⁰

Daily Total Energy Intake

Daily total energy intake (kcal) is provided by the Centers for Disease Control and Prevention within the NHANES data and is used to calculate HEI-2010 scores when using the population ratio approach. Total intake was calculated by converting reported food intake into macronutrient intake values for each food using the reported serving size and the USDA's Food and Nutrient Database for Dietary Studies. The macronutrients were converted to energy using the following conversion factors: 4 kcal/g for protein and carbohydrate and 9 kcal/g for total fat and saturated fat.

Analyses

Sample-weighted data were used and all analyses were performed using SAS software (version 9.3, 2011, SAS Institute) to adjust the variance for the complex sample design. A 6-year weight variable was calculated and used in analyses of all data. The SAS code used to calculate HEI-2010 scores was downloaded from the National Cancer Institute website (<http://appliedresearch.cancer.gov/hei/tools.html>). In order to account for the underreporting associated with self-report nutrition data, nutrient-density models residualize reported intake to energy-adjusted intake and give nutrient scores that are independent of the methodological influence of underreporting.³¹ For group comparisons, nutrient-density models have been adapted in the population ratio approach, which we used to describe HEI-2010 component

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