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Missing Lunch Is Associated with Lower Intakes of Micronutrients from Foods and Beverages among Children and Adolescents in the United States

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ABSTRACT

Background In the United States, the lunch meal contributes more than 20% of the daily intakes of most micronutrients for children and adolescents consuming lunch. Seven percent to 20% of children and adolescents in the United States do not eat lunch on a given day.

Objective To identify differences in total micro- and macronutrient intakes of children consuming and missing lunch on a given day.

Design Cross-sectional secondary analysis of the combined National Health and Nutrition Examination Surveys 2009-2010 and 2011-2012. Dietary intake was assessed using the first day 24-hour recall of each respondent.

Participants and settings The National Health and Nutrition Examination Survey sample represents the total noninstitutionalized civilian population residing in the United States. The sample used in this study included 4,755 children aged 4 to 18 years with complete data for all analyses.

Main outcome measures Total day, lunch, and nonlunch micronutrients, macronutrients, solid fats, and added sugar intakes were examined.

Statistical analyses performed Linear regression models controlling for age, sex, race/ethnicity, household poverty status, and weekend were used to compare dietary intakes of lunch consumers and nonconsumers. Intakes from nonlunch sources were examined to determine the extent to which differences between lunch consumers and nonconsumers could be attributed to the lunch meal.

Results Missing lunch was associated with lower micronutrient intakes, with the lunch meal primarily responsible for the higher micronutrient intakes of lunch consumers compared with nonconsumers. Missing lunch was also associated with lower energy, fiber, and sodium intakes. Added sugar and solid fat intakes of lunch consumers and nonconsumers were not significantly different.

Conclusions This study identifies potential concerns for children missing lunch with respect to micronutrient intakes and shows that the lunches consumed by children in the United States are an important source of essential nutrients, but also less healthful dietary components.
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LARGE PERCENTAGES OF CHILDREN AND ADOLESCENTS have usual intakes of key micronutrients that fall below estimated average requirements.[1,2] Excessive intakes of empty calories (eg, solid fats and added sugars)[3-5] and sodium[6] have also been identified as poor dietary habits of public health concern. Currently, dietary behavior studies relating meal patterns to dietary intake have focused on breakfast skipping[7-12] and consumption of snacks[13,14] with few studies investigating the potential for missing lunch to contribute to less healthful dietary intakes.

An analysis of the National Health and Nutrition Examination Survey (NHANES) 2011-2012, from the US Department of Agriculture (USDA), showed that the lunch meal contributes more than 20% to daily intakes of most micronutrients for US children and adolescents consuming lunch.[15] Studies examining the National School Lunch Program (NSLP) have

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shown that nonparticipation in the NSLP is associated with higher prevalence of micronutrient inadequacies,[16] higher intakes of sugar-sweetened beverages, candy, and salty snacks, but lower intakes of baked goods and french fries.[17] A limitation of these analyses is that nonparticipants in the NSLP included both children missing lunch and children who brought lunches from home. According to data from the USDA, 7% to 20% of children and adolescents in the United States do not consume lunch on a given day[15]; therefore, examining differences in the diets of lunch consumers and nonconsumers is needed to provide insight into the extent to which missing lunch is a less healthful dietary behavior than consuming lunch.

The primary objective for this analysis was to determine whether missing lunch was associated with lower daily intakes of micronutrients among US children and adolescents. Prevalence of micronutrient inadequacies is higher among older children and school-aged girls[1,16]; therefore, the analysis of micronutrients was stratified by age and sex to identify subpopulations of particular concern for low micronutrient intakes. A secondary objective was to determine whether consuming lunch was associated with higher intakes of solid fats, added sugars, and total energy intake. The dietary intakes of micro- and macronutrients from nonlunch sources were examined to determine the extent to which consuming lunch explained any differences in daily intakes between lunch consumers and nonconsumers.

METHODS

Study Population

The 2009-2010 and 2011-2012 NHANES[18-22] were combined for this analysis. The survey design is a multistage, stratified area probability sample of noninstitutionalized individuals that is weighted to provide nationally representative estimates for the US population. The sample included 5,155 individuals aged 4 to 18 years of whom 4,755 had complete data for all covariates included in the regression models. This study used publicly available NHANES de-identified data and was exempt from institutional review board approval.

Dietary Intakes

Dietary intakes were obtained from Day 1 interviewer-administered 24-hour dietary recalls using the Automated Multiple-Pass Method.[23,24] Recalls were collected by trained interviewers in English or Spanish. Survey participants aged 12 years and older completed the dietary interview on their own, proxy-assisted interviews were conducted with children aged 6 to 11 years, and proxy respondents reported for children aged 5 years and younger. Intakes of 19 vitamins and minerals, total energy, protein, carbohydrate, fat, total sugar, saturated fat, and fiber were analyzed using the Dietary Interview—Individual Foods, First Day data files.[25,26] Added sugar and solid fats intakes were analyzed using the 2009-2010 and 2011-2012 Food Patterns Equivalents Databases, which link to the NHANES dietary intake files.[27] Micronutrient intakes of lunch consumers and nonconsumers were separated by source to capture two dietary behaviors: food and beverage intake and dietary supplement use. Dietary supplements included vitamins, minerals, herbals, and other dietary supplements as well as nonprescription antacids. Dietary supplement use on the day of the first 24-hour recall was identified using the Dietary Supplement Use 24-hour—Total Dietary Supplements, First Day data files.[28,29]

Lunch Consumption Status

Respondents self-reported names for eating occasions in the 24-hour recall. Those reporting "brunch" or "lunch" (in English) and "*comida*" or "*almuerzo*" (in Spanish) were considered to be lunch consumers for the purpose of this analysis. The USDA previously defined lunch consumers in an analysis of the NHANES 2011-2012 dataset[15] as those reporting "brunch," "lunch," and "*comida*." We also included "*almuerzo*" due to the similarity between the time and size of the meal when compared with other eating occasions reported as "lunch."

Nutrient Adequacy Ratios

Nutrient Adequacy Ratios (NARs)[30] were calculated as the percentage of the Recommended Dietary Allowance (RDA).[31] The RDA is the average daily intake sufficient to meet the needs of 97% to 98% of the population.[31] The NAR values for a given micronutrient were calculated to provide context on the potential biological effect for the mean micronutrient intakes of lunch consumers and nonconsumers reported in this study. Comparisons between an RDA value and group averages from a single 24-hour dietary recall are not appropriate to estimate the percentage of individuals in a population who have inadequate usual intakes of a micronutrient.[32] For example, wide variability in the micronutrient intake of a group can result in misinterpreting an NAR value of 100% as indicative of low prevalence of nutrient inadequacy. For this study, NAR values are used as a guide to distinguish between the micronutrients where missing lunch had a minimal biological influence (eg, an NAR value >200%) vs micronutrients where missing lunch could have an effect (eg, an NAR value <50%); with greater caution placed on the interpretation of NAR values as they approach 100%.

Statistical Analysis

Analyses were conducted using survey commands in Stata (version 13.1, 2013, StataCorp), which accounted for the complex survey design of the NHANES datasets. Analytical weights based on probabilities of selection and participation in the first 24-hour recall were used, resulting in estimates representative of the US population. Primary sampling units (geographic area) and strata from the first stage of the sampling design were accounted for in estimation of the standard errors. A criteria of ($P<0.05$) was used for all tests of statistical significance. Results are presented as means or percentages±standard errors. Analyses were conducted for each of the three age groups (4 to 8 years, 9 to 13 years, and 14 to 18 years) separately. On weekends and weekdays, the percentages of children and adolescents missing lunch were calculated using the following formula: (number of children who missed lunch on a weekday/number of children with a dietary recall on a weekday)×100. The use of dietary supplements on the day of the recall was compared between lunch consumers and nonconsumers using logistic regression models. Linear regression models were used to determine associations of lunch consumption status (lunch consumer vs nonconsumer) with nutrient intakes (ie, are nutrient intakes of lunch consumers different from nonconsumers?). All models were adjusted for age, sex, race/