Published in final edited form as:

J Acad Nutr Diet. 2014 June ; 114(6): 908–917. doi:10.1016/j.jand.2013.08.012.

Where are kids getting their empty calories? Stores, schools, and fast food restaurants each play an important role in empty calorie intake among US children in 2009-2010

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Abstract

Consumption of empty calories, the sum of energy from added sugar and solid fat, exceeds recommendations, but little is known about where US children obtain these empty calories. The objectives of this study were to compare children's empty calorie consumption from retail food stores, schools, and fast food restaurants; to identify food groups that were top contributors of empty calories from each location; and to determine the location providing the majority of calories for these key food groups. This cross-sectional analysis used data from 3,077 US children aged 2-18 years participating in the 2009-2010 National Health and Nutrition Examination Survey. The empty calorie content of children's intake from stores (33%), schools (32%), and fast food restaurants (35%) was not significantly different in 2009-2010. In absolute terms, stores provided the majority of empty calorie intake (436 kcal). The top contributors of added sugar and solid fat from each location were similar: sugar sweetened beverages (SSBs), grain desserts, and high-fat milk from stores; high-fat milk, grain desserts, and pizza from schools; and SSBs, dairy desserts, french fries, and pizza from fast food restaurants. Schools contributed about 20% of children's

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Conflict of interest: The authors have no conflicts of interest.

Financial Disclosure: Funding for this study comes from the Robert Wood Johnson Foundation (Grant 70017) and the National Institutes of Health (R01 HL104580, CPC 5 R24 HD050924, and 5T32DK007686-19).

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intake of high-fat milk and pizza. In conclusion, these findings support the need for continued efforts to reduce empty calorie intake among US children aimed not just at fast food restaurants, but also at stores and schools. The importance of reformed school nutrition standards was suggested, as prior to their implementation, schools resembled fast food restaurants in their contributions to empty calorie intake.

Keywords

store; school; fast food; empty calories; dietary intake

Introduction

The Dietary Guidelines for Americans (DGA), 2010, recommend that both children and adults reduce their intake of calories from solid fat and added sugar, collectively referred to as empty calories.^{1,2} Because solid fat and added sugar contribute calories without providing essential nutrients, excessive consumption of these empty calories has been shown to displace more nutrient-dense foods and drive energy intake above caloric needs.^{1,3-5} Solid fats (discretionary fats which are solid at room temperature) are largely composed of saturated and trans fatty acids, which are associated with increased risk of cardiovascular disease.^{1,6,7} Added sugars are defined as caloric sweeteners added to foods during processing, preparation, or at the table, but excluding natural sugars found in fruit and milk.¹ In addition to contributing to excessive calorie intake, high consumption of added sugar has been associated with increased body weight and cardiovascular disease risk factors.⁸⁻¹⁰ Therefore, the DGA specify that consumption of empty calories should be limited to 8-19% of total energy intake, depending on total calorie requirements.¹

There is great need for policy efforts and environmental changes to help American children meet these DGA recommendations, as 97% of US children had intake of energy from solid fat and added sugar that exceeded the maximum discretionary calorie allowance in 2001-2004.^{11,12} By 2009-2010, 33% of children's total energy intake came from empty calories (368 kcal from solid fat and 278 kcal from added sugar).¹³

Despite the substantial contribution of empty calories to total energy intake, little is known about where children obtain these empty calories. Retail food stores, including supermarkets, grocery stores, and convenience stores, provide the majority of overall energy intake for children (69%); we hereafter refer to all foods and beverages obtained from these locations as store-bought foods.¹⁴ Schools provide up to 47% of daily energy intake for participants in the school meals programs.¹⁵ Consumption of foods and beverages from fast food restaurants (hereafter referred to as fast foods) has increased steadily during recent decades.^{14,16} In 1996, the saturated fat density of foods consumed by children was greatest for foods from schools (14.4% of total energy intake) and fast food restaurants (13.6%) and lower for store-bought foods (11.5%).¹⁷ More recent comparisons of children's intake across locations, as well as any comparison of added sugar and solid fat consumption, are not available. The need for these updated comparisons was identified by a recent review of the dietary effects of eating outside the home.¹⁸ Previous studies identified sugar sweetened

beverages (SSBs), grain desserts, whole milk, and pizza as top contributors to empty calorie consumption for children, yet top contributors consumed specifically from stores, schools, and fast food restaurants have not been identified.^{13,19}

Thus, the purpose of this study is to compare the role of stores, schools, and fast food restaurants in the intake of empty calories among US children in 2009-2010. This analysis focuses on three research questions: Does empty calorie consumption among US children differ for intake from stores, schools, and fast food restaurants? What foods are the top contributors to added sugar and solid fat intake from each location? For these specific foods, which location provides the majority of calories? Top foods contributing to empty calorie consumption at each location can be targeted by future policy efforts to improve the food environment.

Methods

Participants

This analysis studied children aged 2-18 years from the 2009-2010 National Health and Nutrition Examination Survey (NHANES), a cross-sectional survey that uses a complex, multistage, stratified sampling design to provide nationally representative estimates of dietary intake of the civilian, non-institutionalized US population. Details about the survey methodology are available online.²⁰

Dietary Data

NHANES collected two interviewer-administered 24-hour dietary recalls using multiple-pass methodology. The first day was collected in person, and the second day was collected 3-10 days later by telephone. Recalls were completed by a proxy respondent for children less than 6 years of age and were proxy-assisted for children ages 6-11.

The calorie content of each food was determined by the US Department of Agriculture (USDA) using the Food and Nutrient Database for Dietary Studies (FNDDS) 5.0. Added sugar and solid fat content was obtained from the USDA's MyPyramid Equivalents Database (MPED) using definitions provided therein (Appendix 1).²¹ Updated MPED databases specific for NHANES 2005-2010 have not been released. Thus, MPED version 2.0 and The Center for Nutrition Policy and Promotion's MPED 2.0 Addendum were used to determine the solid fat and added sugar content of items reported in 2009-2010 using methodology employed both by previous studies and by the National Cancer Institute's Pyramid Servings Database for NHANES III Appendix 1).²²⁻²⁴ Empty calories were calculated as the sum of energy from solid fat and added sugar.^{1,13,19}

Foods were classified into mutually exclusive, nutritionally meaningful categories (Appendix Table 1) based on the University of North Carolina at Chapel Hill (UNC-CH) food grouping system, which has been described in detail elsewhere.^{13,25}

Location

This analysis defined location as the place where each food or beverage was obtained, as reported by the participant for each recalled item, regardless of the location where the item

was consumed (e.g., bread and peanut butter purchased from a grocery store, prepared at home as a sandwich, and consumed at school are classified as from a store). These locations were defined by the NHANES Dietary Interviewers Procedures Manual and were grouped into 5 categories: Stores, including supermarkets, grocery stores, and convenience stores; Schools, including school cafeterias and child care centers; Fast Food restaurants, defined by the surveys as any restaurant without a wait staff and including pizza home delivery; Restaurants with wait staff; and Other locations, including vending machines, food/ice cream trucks, foods from other people, foods grown at home, sports/recreation facilities, and community feeding programs.^{14,26} Hereafter, the term “fast food” refers to all items purchased from a fast food restaurant regardless of the item type to be consistent with the conventional definition used by previous studies.^{18,27} Based on the mean percentage of total calories consumed from each location, this analysis focused on stores (68.7%), schools (8.5%), and fast food restaurants (10.8%) because restaurants (4.7%) represented a small proportion of children's calories and other locations (7.2% collectively) represented a heterogeneous group of locations. Location food consumers are defined as children who consumed any items during the first day of recall obtained from that location.

Analytical Sample

Only the first day of dietary recall was used in this analysis because the MPED 2.0 Addendum includes only new foods reported on recall Day 1 but not Day 2, and NHANES analytic guidelines recommend using Day 1 only to generate group mean intake.²⁸ Children were excluded when missing the location for any item (n=18) or when consuming items for which empty calorie content could not be estimated (n=29) for a final sample of 3,077 children. Sociodemographic characteristics of this sample are provided in Appendix Table 2.

Statistical Analysis

Empty calorie consumption from stores, schools, and fast food restaurants was compared in absolute and relative terms. For each location, the percentage of location-specific nutrient intake provided by each food group was ranked to identify the food groups providing the largest contributions to empty calorie, added sugar, or solid fat intake for each location; analyses were performed separately for intake from stores, schools, or fast food restaurants. For these food groups, the percentage of total calories obtained from each location was determined in order to identify the location providing the majority of calories. Survey commands within Stata (version 12, 2011, StataCorp) were used to take into account complex survey design and sample weights which incorporate differential probabilities of selection, nonresponse, and noncoverage. Locations were compared using *t* tests and $P < 0.05$ with Bonferroni correction for multiple comparisons was considered significant. This secondary data analysis was deemed exempt by the UNC-CH Institutional Review Board.

Results and Discussion

The relative contributions of empty calories to total intake from stores (33%), schools (32%), and fast food restaurants (35%) were not significantly different (Figure 1). Average empty calorie intake from each location greatly surpassed recommendations, which helps explain why the total intake of almost all US children exceeds these guidelines.^{11,12} The

percentage of calories from added sugar was higher for store foods (15%) compared to school food (10%) or fast food (10%). The relative contribution from solid fat was largest for fast food (24%), but significantly higher for school foods (22%) compared to store foods (18%).

However, in absolute terms, store-bought foods contributed significantly more empty calories (436 kcal/d), added sugar (195 kcal/d), and solid fat (241 kcal/d) per capita than either school foods or fast foods (Figure 1). These per capita estimates reflect the substantially larger percentage of children who consumed store-bought foods on a single given day (99%) compared to the percentage consuming fast food (32%) or school food (24%).

The food groups providing the greatest contributions to empty calorie, added sugar, and solid fat intake differed by location, yet notable similarities occurred (Table 1 and Appendix Table 3). High-fat milk was the #1 contributor of both added sugar and solid fat for schools and also made a substantial contribution to solid fat intake from stores. SSBs were the largest contributor of added sugar from stores and fast food restaurants, but played a much lesser role at schools. Pizza was an important contributor of solid fat for both schools and fast food restaurants. Grain desserts were main contributors of added sugar and solid fat from both stores and schools. This substantial overlap across locations might explain the similarity in overall empty calorie content of foods consumed from stores, schools, and fast food restaurants.

Several major contributors of solid fat were the same at schools and fast food restaurants, including pizza, sandwiches, and Mexican dishes. These findings are consistent with previous analysis showing that pre-prepared fast-food-like items, such as pizza, sandwiches with breaded chicken, tacos, and burritos, were major sources of saturated fat in school lunches.²⁹ However, in contrast to fast food restaurants, SSBs contributed only 5.3% of the added sugar consumed from schools (Appendix Table 3). In agreement, previous studies found that, by 2004-2005, only 13.8% of children obtained and consumed SSBs at school, and by 2008, full-calorie soft drinks were rarely available.^{15,30}

Stores provided the majority of calorie intake for ¾ of the food groups identified as top contributors of empty calories, added sugar, or solid fat at any location (Appendix Table 4). Notably, stores were the predominant location where SSBs were obtained, providing over 70% of SSB calories. These findings help explain why increased access to supermarkets is not consistently associated with healthier diets among children.³¹⁻³⁴

Fast food restaurants provided the majority of intake only for french fries. Although previous studies found that fast food consumers have higher intake of SSBs, pizza, and hamburgers compared to non-consumers, our findings imply that these items are consumed not just at fast food restaurants but also largely from stores and schools.³⁵⁻³⁸

Schools provided about one-fifth of calories from pizza, high-fat milk, and low-fat milk. In agreement, a recent evaluation of school meals in 2010 found that pizza was available most or every day for 98% of secondary school students and high-fat or flavored milk was available for over 60% of students.³⁹

Implications

Previous studies of total consumption by children identified pizza, grain desserts, and whole milk as top contributors of solid fat, and SSBs and grain desserts as top contributors of added sugar.^{13,19} Our findings confirm these results, but further clarify that these food groups were important contributors of empty calories only for specific locations. Thus, strategies to reduce empty calorie intake might vary for stores, schools, and fast food restaurants.

At stores, several food manufacturers and retailers have made voluntary pledges to improve the nutritional content of packaged foods through product reformulations and introduction of lower-calorie products.⁴⁰⁻⁴² Our results suggest key contributors of empty calories from stores that these efforts could modify, such as SSBs, grain desserts, and candy.

Our data was collected prior to implementation of the Healthy, Hunger-Free Kids Act of 2010, and updated USDA nutrition standards for school meals will potentially reduce empty calorie intake.⁴³⁻⁴⁵ Our results can help identify foods to target as schools implement these new standards: high-fat flavored milk, grain desserts, and pizza. In addition, our findings can aid policy makers as they establish standards for competitive foods.

One potentially important change to the school nutrition standards will limit availability to only 1% plain milk and fat-free plain or flavored milk.⁴⁵ Our results support the need for this change, as high-fat milk was the #1 contributor of both added sugar and solid fat at school, and schools provided a substantial portion of children's high-fat milk intake. Our results are consistent with previous school-based studies finding that 56.3% of school milk was chocolate or flavored.⁴⁶ In addition, only one-third of US schools offered only lower-fat milks in 2009-2010.⁴⁷

The top contributors of empty calories from fast food restaurants were SSBs, dairy desserts, french fries, and pizza, items that are widely offered and consumed by children at fast food restaurants.^{48,49} Thus, these items could be targeted by public health efforts aimed at fast food restaurants, including recent legislation requiring menu board labeling of nutrition content, voluntary efforts by fast food restaurants to make more healthful side items the default in kid's meals, and the National Restaurant Association's Kids LiveWell program.⁵⁰⁻⁵²

Limitations

Because an updated MPED is not available for NHANES 2009-2010, added sugar and solid fat were determined using MPED 2.0 and the MPED Addendum. To examine the impact of these methods, two sensitivity analyses were performed (Appendix 1). Conclusions did not differ from the results presented here, confirming the robustness of our results. NHANES does not distinguish among different store types, although supermarkets tend to have more fresh produce and greater variety compared to smaller food stores, such as convenience stores.^{31,32} Some studies suggest that dietary misreporting varies with a child's age and weight status and that unhealthy foods are selectively underreported; however, there is no evidence of differential misreporting by location.^{53,54}

Conclusions

Foods consumed by children from stores and schools were not significantly lower in empty calorie content than fast foods in 2009-2010. This analysis therefore supports the conclusion of several previous studies that efforts to reduce children's consumption of empty calories must be made across multiple locations - not just at fast food restaurants, but also at stores and schools.^{15,55,56} Our findings identify areas for potential improvement and can inform future strategies to address specific locations and foods which are contributing to excessive consumption of empty calories by US children. In particular, high-fat flavored milk, grain desserts, and pizza were identified as top contributors to empty calorie intake from schools, and these foods should be targeted as the new federal nutrition standards for school meals are implemented and as the standards for competitive foods are finalized. Future studies should evaluate voluntary efforts by food manufacturers and retailers to improve the nutritional quality of packaged foods sold at stores, progress made by new federal nutrition standards at schools, and the effectiveness of fast food menu board labeling.

Acknowledgments

We thank the Robert Wood Johnson Foundation (Grant 70017) and the National Institutes of Health (R01 HL104580, CPC 5 R24 HD050924, and 5T32DK007686-19) for financial support. We also thank Dr. Phil Bardsley for exceptional assistance with data management and programming and Ms. Frances L. Dancy for administrative assistance.

Appendix 1

Foods were recorded as consumed using discrete foodcodes. The nutrient composition (total calories, total fat, and total sugar) of each food was determined by the US Department of Agriculture (USDA) using the Food and Nutrient Database for Dietary Studies (FNDDS) 5.0. Because FNDDS does not include added sugar and solid fat content, these values were obtained from the USDA's MyPyramid Equivalents Database (MPED).²¹ MPED version 2.0 measures discretionary solid fats as fats that are solid at room temperature and in excess of the allowable amount found in the leanest/lowest fat form of meat, poultry, fish, eggs, beans, and milk and in the basic/natural forms of grains, fruits, and vegetables.²¹ MPED version 2.0 defined added sugar as sugar used in processed and prepared foods, sugar eaten separately, or sugar added to foods at the table, but excluding naturally occurring sugars in milk (lactose) or fruit (fructose).²¹ This definition of added sugar does not include fruit juice concentrate used as an ingredient or sugar substitutes.²¹ Multi-ingredient foods are disaggregated into their basic ingredients, and the discretionary solid fat and added sugar content is calculated as the sum of solid fat or added sugar in each ingredient using a recipe retention factor method.²¹

Foodcodes used by NHANES 2003-2004 can be directly linked to MPED version 2.0. However, updated MPED databases specific for NHANES 2005-2010 have not been released. Thus, MPED version 2.0 and The Center for Nutrition Policy and Promotion's (CNPP) MPED 2.0 Addendum were used to estimate the empty calorie content of items reported in 2009-2010 using methodology employed both by previous studies and by the National Cancer Institute's Pyramid Servings Database for NHANES III.²²⁻²⁴ Conversion

factors of 9 kcal/g for solid fat and 16 kcal/tsp for added sugar were used, and empty calories were calculated as the sum of energy from solid fat and added sugar.^{1,13,19}

Most foodcodes (89%) reported in NHANES 2009-2010 were also used for NHANES 2003-2004 so that empty calorie content was obtained directly from MPED. For these exact foodcode matches, the ratio of solid fat to total fat and the ratio of added sugar to total sugar in MPED were applied to the total fat and total sugar content from FNDDS for these same foodcodes in 2009-2010. Applying these ratios allows more accurate estimation of empty calories by incorporating FNDDS updates to total fat and total sugar information that reflect changes in the food supply between 2003-2004 and 2009-2010. Approximately 9% of foodcodes reported in 2009-2010 were newly introduced in NHANES 2005-2008; these have exact added sugar and solid fat content provided by The CNPP MPED 2.0 Addendum, which uses USDA's methodology.²² The remaining 2% of foodcodes were newly introduced in NHANES 2009-2010. Of these 69 foodcodes, 44 were matched to items with similar foodcodes and food descriptions. For example, "CASHEW NUTS, DRY ROASTED, WITHOUT SALT" was reported in 2009-2010 and matched to "CASHEW NUTS, DRY ROASTED" in MPED. Matches could not be found for the remaining 25 foodcodes, so the children consuming these foods (n=29) were excluded from this analysis.

To examine the impact of these estimations, two sensitivity analyses were performed: 1) including children (n=29) who consumed foods that were not estimable but excluding only those specific food items and 2) directly using MPED values rather than applying ratios from MPED to FNDDS total sugar and fat. Conclusions did not differ from the results presented here, confirming the robustness of our results to these estimations.

Appendix Table 1

Description of food grouping system used to identify top food groups contributing to empty calorie intake among US children

Food Group Name	Food Group Description
Cheese	Includes all cheeses.
Yogurt	Includes refrigerated yogurts.
Other dairy products	Includes sour cream, whipped topping, cream, condensed milk, and evaporated milk.
Meat and meat dishes	Includes beef, pork, lamb, veal, game, and their organ meats (plain, breaded, and/or with sauce) and meat dishes.
Chicken and chicken dishes	Includes chicken, turkey, other birds, and their organ meats (plain, breaded, and/or with sauce or skin) and poultry dishes.
Processed meat and processed meat dishes	Includes processed meat and poultry; meat products cured, salted, smoked or preserved with nitrate; and processed meat dishes.
Fish and fish dishes	Includes fish and shellfish (plain, breaded, and/or with sauce) and fish/shellfish dishes.
Legumes and meat substitutes	Includes legumes, legume dishes, and meat substitutes.
Eggs	Includes eggs and egg dishes.
Nuts and seeds	Includes nuts, nut butters, and seeds.

Food Group Name	Food Group Description
Breads and rolls	Includes yeast breads and rolls, plain or as toast.
Quick breads	Includes breads not leavened with yeast.
Ready-to-eat (RTE) cereals	Includes ready-to-eat cereals.
Sandwiches	Includes sandwiches, rolls, wraps, breakfast sandwiches, and hot dogs.
Hamburgers	Includes hamburgers, cheeseburgers, and bacon cheeseburgers, both pre-prepared and home-cooked from ground meat.
Mexican dishes	Includes tortilla-based Mexican dishes.
Pasta and pasta dishes	Includes pasta, noodles, and pasta-based dishes.
Grains and grain dishes	Includes grains and grain dishes.
Pizza	Includes all types of pizzas and calzones, including frozen pizza.
Fruit	Includes fresh, frozen, canned, or dried fruit.
Vegetables	Includes fresh, frozen, or canned non-starchy vegetables (plain, with breading, with added fat in cooking, and/or sauce).
Starchy vegetables	Includes starchy vegetables (excluding fried potatoes) and all vegetable dishes.
French fries	Includes french fries and fried potatoes.
Fats and oils	Includes fats from an animal or plant source.
Salad dressings	Includes salad dressings.
Sauces and condiments	Includes sauces and condiments.
Grain desserts	Includes cookies, pastries, cakes, pies, and cereal/granola bars.
Candy	Includes candy, chocolate, and sweet snacks.
Dairy desserts	Includes dairy-based desserts.
Sweeteners	Includes sugars, sweeteners, syrups, jellies, and toppings.
Salty snacks	Includes savory salty snacks.
Dips and spreads	Includes dips and spreads.
Soups and stews	Includes broths, soups and stews (homemade, instant, and ready-to-eat).
Frozen meals	Includes frozen entrées, dinners, or breakfast meals.
Baby food and formula	Includes infant formulas, baby foods, and toddler foods.
Water	Includes tap water, plain bottled water, flavored waters, and carbonated water.
Coffee and tea	Includes coffee and tea (combined with milk, cream, and/or sweeteners) and coffee beverages.
Sugar sweetened beverages (SSBs)	Includes sodas, fruit drinks, sports drinks, and energy drinks (regular, sugar-free, and diet).
Fruit juice	Includes fruit juice (100% juice and not 100% juice).
Vegetable juice	Includes vegetable juice (100% juice and not 100% juice).
Milk – low-fat	Includes nonfat and 1% milk (plain, chocolate, or flavored).
Milk – high-fat	Includes whole and 2% milk (plain, chocolate, or flavored).
Milk shakes	Includes milk-, soy-, and yogurt-based beverages.
Meal replacement beverages	Includes milk replacement beverages.
Alcohol	Includes beer, wine, liquor, and mixed alcoholic beverages.
Other beverages	Includes all other beverages such as horchata, rice beverages, and atole.

Appendix Table 2

**Sociodemographic characteristics of consumers from
each location (stores, schools, and fast food restaurants)
among US children aged 2-18 years, NHANES
2009-2010^a**

	Total sample	Store food consumers	School food consumers	Fast food consumers
	n=3,077	n=3,040	n=697	n=1,035
Age Group, %^b				
2-5 years	23.4	23.6	17.1	21.0
6-11 years	34.9	34.7	47.5	32.8
12-18 years	41.7	41.8	35.4	46.2
Female, %	49.8	49.7	50.7	50.4
Race-ethnic status, %				
Non-Hispanic white	57.5	57.6	44.8	55.9
Non-Hispanic black	13.5	13.4	20.6	15.7
Mexican-American	14.4	14.4	19.7	13.8
Other	14.6	14.6	15.0	14.5
Household income, %^c				
130%	33.7	33.5	43.9	32.4
131 - 299%	28.5	28.6	27.0	31.5
300%	37.8	37.9	29.1	36.1
Household education, %^d				
< HS ^e	20.4	20.4	25.2	22.5
HS ^f	20.8	20.9	24.3	21.7
Some college	30.2	30.0	26.8	31.1
College degree	28.6	28.8	23.7	24.8

^aData for children and adolescents aged 2-18 years from the National Health and Nutrition Examination Survey (NHANES) 2009-2010. Location food consumers are defined as having any items recorded during the first day of dietary recall obtained from that location, such that categories are not mutually exclusive. Therefore, sample sizes for individual locations do not sum to total sample size. Location refers only to the place where food was obtained, regardless of where the food was consumed or prepared. Stores include supermarkets, grocery stores, convenience stores, and all other types of stores. Schools include school cafeterias and child care centers. Fast Food includes restaurants without a wait staff and pizza home delivery (as defined by NHANES) and refers to any items obtained from fast food restaurants, not to a particular type of food.

^bWeighted percentages have been adjusted to be nationally representative.

^cHousehold income expressed as percentage of the Federal Poverty Level.

^dEducation level of household referent.

^eHigh school (HS).

^fGraduated from high school or obtained general equivalency diploma (GED).

Appendix Table 4

Mean intake and percentage of calories from each location for food groups identified as top contributors of empty calories, added sugar, or solid fat^a among US children aged 2-18 years, 2009-2010^b

Food Group	Per Capita Food Group Intake ^c	Percentage of Food Group Intake from Each Location ^d				
	All Locations	Store ^e	School	Fast Food	Restaurant	Other
	Mean kcal ± SE	Mean % ± SE	Mean % ± SE	Mean % ± SE	Mean % ± SE	Mean % ± SE
Sandwiches	186 ± 11.4	65.9 ± 1.7 [*]	10.4 ± 1.5	17.4 ± 1.2	1.1 ± 0.4	5.2 ± 0.8
Grain desserts	134 ± 5.4	76.2 ± 1.7 [*]	6.4 ± 1.2	1.5 ± 0.4	1.8 ± 0.6	14.2 ± 1.0
SSBs ^f	132 ± 7.4	71.6 ± 1.6 [*]	1.1 ± 0.3	10.3 ± 0.9	6.7 ± 0.8	10.2 ± 1.1
Milk - high-fat ^g	123 ± 5.0	73.2 ± 1.5 [*]	21.6 ± 1.3	1.4 ± 0.6	1.9 ± 0.6	1.9 ± 0.5
Pizza	105 ± 12.8	32.8 ± 3.7	20.4 ± 3.2	31.3 ± 3.6	8.1 ± 2.0	7.3 ± 2.3
Pasta dishes	96 ± 5.7	81.1 ± 2.2 [*]	5.0 ± 1.1	2.3 ± 0.9	6.0 ± 1.4	5.7 ± 1.4
Mexican dishes	77 ± 8.8	60.7 ± 5.7 [*]	8.0 ± 2.2	19.3 ± 6.0	4.8 ± 1.4	7.2 ± 1.9
Candy	59 ± 3.9	70.7 ± 3.1 [*]	1.8 ± 0.7	0.6 ± 0.3	1.9 ± 0.6	25.0 ± 3.0
Quick breads	58 ± 4.3	72.7 ± 4.6 [*]	9.1 ± 2.4	5.3 ± 2.4	8.1 ± 2.0	4.7 ± 1.4
RTE cereal	56 ± 4.0	93.6 ± 1.1 [*]	4.7 ± 1.0	0.0 ± 0.0	0.0 ± 0.0	1.7 ± 0.4
Dairy desserts	49 ± 3.3	61.2 ± 6.3 [*]	4.3 ± 1.3	15.2 ± 3.1	4.6 ± 1.0	14.9 ± 3.5
Hamburgers	45 ± 4.7	22.4 ± 5.4	16.1 ± 4.0	45.8 ± 7.5	12.5 ± 3.2	3.3 ± 1.3
Milk - low-fat	42 ± 3.2	79.9 ± 3.1 [*]	17.3 ± 2.8	0.7 ± 0.4	0.2 ± 0.1	1.8 ± 0.5
French fries	42 ± 4.1	17.3 ± 3.0	5.2 ± 1.6	61.1 ± 2.3 [*]	11.8 ± 1.5	4.6 ± 1.0
Coffee and tea	18 ± 2.8	82.5 ± 3.6 [*]	1.4 ± 0.8	7.3 ± 1.9	3.9 ± 1.5	4.8 ± 1.2
Milk shakes	13 ± 2.4	54.3 ± 11.2	0.0 ± 0.0	36.0 ± 9.5	5.6 ± 3.2	4.1 ± 4.3

* Percentage of food group intake is significantly higher for noted location in all pair-wise comparisons of locations, $p < 0.05$ after Bonferroni correction. For food groups with no notation, no single location was significantly higher than each of the four other locations.

^a Includes any food group ranked among the top five contributors of empty calories (the sum of energy from solid fat and added sugar), added sugar, or solid fat from any location (determined as food groups with the highest percentage contribution to intake of empty calories, added sugar, or solid fat from each location).

^b Data for children and adolescents aged 2-18 years from the National Health and Nutrition Examination Survey (NHANES) 2009-2010. Values are mean ± standard error (SE).

^c Mean per capita food group intake (including both consumers and non-consumers of each food group) from all locations combined. For all food groups, mean total energy intake was 1907 kcal.

^d Mean percentage of food group intake obtained from each location. For all food groups, 68.7% of total calories came from stores, 8.5% from schools, 10.8% from fast food restaurants, 4.7% from restaurants, and 7.2% from all other locations.

^e Locations refer only to the place where food was obtained, regardless of where the food was consumed or prepared. Stores include supermarkets, grocery stores, convenience stores, and all other types of stores. Schools include school cafeterias and child care centers. Fast Food includes restaurants without a wait staff and pizza home delivery (as defined by NHANES) and refers to any items obtained from fast food restaurants, not to a particular type of food. Restaurant includes restaurants with wait staff. Other locations include vending machines, food/ice cream trucks, foods from other people, foods grown at home, sports/recreation facilities, and community feeding programs.

^f Sugar sweetened beverages (SSBs), including soda, fruit drinks, sports drinks, and energy drinks.

^gIncludes whole and 2% milk (plain, chocolate, or flavored).

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Figure 1.

Percentage of per capita energy intake from each location provided by empty calories, added sugar, and solid fat among US children aged 2-18 years, 2009-2010^a

^aData for children and adolescents aged 2-18 years from the National Health and Nutrition Examination Survey (NHANES) 2009-2010. Sample sizes: Total sample (n=3,077), Store consumers (n=3,040), School consumers (n=697), and Fast food consumers (n=1,035). Empty calories are calculated as the sum of energy from added sugar and solid fat. Pairwise *t* tests compared locations. Values without a common letter are significantly different, *p*<0.05 with Bonferroni correction.

Numbers above bars indicate per capita total energy intake from each location calculated including the entire sample, both consumers and non-consumers from each location (All locations 1,907 kcal; Restaurants 90 kcal; Other locations 137 kcal). Among consumers at each location: Store 1,324 kcal; School 670 kcal; Fast food 655 kcal; Restaurant 743 kcal; Other 391 kcal. Numbers within bars indicate per capita energy intake from non-empty calories, added sugar, or solid fat from each location (calculated including the entire sample, both consumers and non-consumers from each location). Percentages indicate the percentage of kilocalories per day (% kcal/d) from empty calories (to left of bar) and from added sugar and solid fat (to the right of bar) from each location.

Table 1
Top food groups contributing to empty calorie, added sugar, and solid fat consumption by location (stores, schools, and fast food restaurants) among US children aged 2-18 years, 2009-2010^a

	Location		
	Store	School	Fast Food Restaurant
Empty calories^b			
#1	SSBs ^c	Milk - high-fat ^d	French fries
#2	Grain desserts	Pizza	SSBs
#3	Milk - high-fat	Sandwiches	Pizza
#4	Sandwiches	Grain desserts	Sandwiches
#5	Candy	Quick breads	Hamburgers
Added sugar^e			
#1	SSBs	Milk - high-fat	SSBs
#2	Grain desserts	Grain desserts	Dairy desserts
#3	Candy	Milk - low-fat	Milk shakes
#4	RTE cereal	Sandwiches	Coffee and tea
#5	Coffee and tea	SSBs	Sandwiches
Solid fat^f			
#1	Grain desserts	Milk - high-fat	French fries
#2	Milk - high-fat	Pizza	Pizza
#3	Sandwiches	Sandwiches	Sandwiches
#4	Pasta dishes	Grain desserts	Hamburgers
#5	Mexican dishes	Mexican dishes	Mexican dishes

^aData for children and adolescents aged 2-18 years from the National Health and Nutrition Examination Survey (NHANES) 2009-2010. The percentage of location-specific nutrient intake provided by each food group was ranked to identify the food groups providing the largest contributions to empty calorie (the sum of energy from solid fat and added sugar), added sugar, or solid fat intake for each location; analyses were performed separately for intake from stores, schools, or fast food restaurants. Locations were defined only by the place where food was obtained, regardless of where the food was consumed or prepared. Stores include supermarkets, grocery stores, convenience stores, and all other types of stores. Schools include school cafeterias and child care centers. Fast Food includes restaurants without a wait staff and pizza home delivery (as defined by NHANES) and refers to any items obtained from fast food restaurants, not to a particular type of food.

^bFood groups providing the largest contributions to empty calorie consumption from stores, schools, or fast food restaurants.

^cSugar sweetened beverages (SSBs), including soda, fruit drinks, sports drinks, and energy drinks.

^dIncludes whole and 2% milk (plain, chocolate, or flavored).

^eFood groups providing the largest contributions to added sugar consumption from stores, schools, or fast food restaurants.

^fFood groups providing the largest contributions to solid fat consumption from stores, schools, or fast food restaurants.

Appendix Table 3

Top food groups contributing to empty calorie, added sugar, and solid fat consumption by location (stores, schools, and fast food restaurants) among US children aged 2-18 years, 2009-2010^a

	Location									
	Store					School				
	<i>Food Group</i>	% of SoFAS ^c	Mean SoFAS ^d	<i>Food Group</i>	% of SoFAS	Mean SoFAS	<i>Food Group</i>	% of SoFAS	Mean SoFAS	<i>Food Group</i>
Empty calories (SoFAS)^b										
#1	SSB ^e	15.8	70 ± 5.3	Milk - high-fat ^f	22.6	48 ± 2.9	French fries	16.8	38 ± 3.4	
#2	Grain desserts	13.7	61 ± 2.2	Pizza	11.3	24 ± 5.0	SSBs	15.9	36 ± 3.8	
#3	Milk - high-fat	8.7	38 ± 1.6	Sandwiches	10.9	23 ± 3.9	Pizza	12.4	28 ± 3.1	
#4	Sandwiches	7.6	34 ± 2.3	Grain desserts	10.0	21 ± 3.1	Sandwiches	12.1	27 ± 3.0	
#5	Candy	5.6	25 ± 2.3	Quick breads	4.3	9 ± 2.6	Hamburgers	8.8	20 ± 2.9	
	All other foods	48.6	214 ± 7.5	All other foods	41.0	87 ± 6.5	All other foods	34.2	77 ± 6.4	
	Total	100.0	441 ± 8.3	Total	100.0	212 ± 10.4	Total	100.0	226 ± 4.8	
Added sugar (AS)^g										
#1	SSBs	35.3	70 ± 5.3	Milk - high-fat	25.7	17 ± 1.5	SSBs	53.7	36 ± 3.8	
#2	Grain desserts	14.2	28 ± 1.0	Grain desserts	14.1	10 ± 1.5	Dairy desserts	9.7	6 ± 1.7	
#3	Candy	10.7	21 ± 1.9	Milk - low-fat	8.0	5 ± 1.0	Milk shakes	6.3	4 ± 1.5	
#4	RTE cereal	7.9	16 ± 1.2	Sandwiches	5.6	4 ± 0.7	Coffee and tea	5.1	3 ± 0.7	
#5	Coffee and tea	5.5	11 ± 2.4	SSBs	5.3	4 ± 1.1	Sandwiches	5.1	3 ± 0.4	
	All other foods	26.4	52 ± 2.0	All other foods	41.4	28 ± 3.0	All other foods	20.1	13 ± 1.0	
	Total	100.0	197 ± 5.7	Total	100.0	68 ± 4.3	Total	100.0	67 ± 4.9	
Solid fat (SoF)^j										
#1	Grain desserts	13.4	33 ± 1.3	Milk - high-fat	21.1	31 ± 2.1	French fries	23.8	38 ± 3.4	
#2	Milk - high-fat	13.1	32 ± 1.2	Pizza	15.9	23 ± 5.0	Pizza	16.8	27 ± 3.0	
#3	Sandwiches	11.2	27 ± 2.3	Sandwiches	13.3	19 ± 4.1	Sandwiches	15.0	24 ± 2.7	
#4	Pasta dishes	6.5	16 ± 1.5	Grain desserts	8.1	12 ± 1.7	Hamburgers	10.8	17 ± 2.6	
#5	Mexican dishes	6.5	16 ± 2.6	Mexican dishes	5.8	8 ± 2.9	Mexican dishes	8.3	13 ± 3.9	
	All other foods	49.4	120 ± 4.1	All other foods	35.8	52 ± 4.1	All other foods	25.3	40 ± 4.9	
	Total	100.0	244 ± 5.1	Total	100.0	144 ± 7.2	Total	100.0	159 ± 4.8	

- ^aData for children and adolescents aged 2-18 years from the National Health and Nutrition Examination Survey (NHANES) 2009-2010. The percentage of location-specific nutrient intake provided by each food group was ranked to identify the food groups providing the largest contributions to empty calorie (the sum of energy from solid fat and added sugar), added sugar, or solid fat intake for each location; analyses were performed separately for intake from stores, schools or fast food restaurants. Locations were defined only by the place where food was obtained, regardless of where the food was consumed or prepared. Stores include supermarkets, grocery stores, convenience stores, and all other types of stores. Schools include school cafeterias and child care centers. Fast Food includes restaurants without a wait staff and pizza home delivery (as defined by NHANES) and refers to any items obtained from fast food restaurants, not to a particular type of food. Mean total energy intake among consumers at each location: All locations 1,907 kcal; Store 1,324 kcal; School 670 kcal; Fast food 655 kcal.
- ^bFood groups providing the largest contributions to empty calorie consumption from stores, schools, or fast food restaurants. Empty calories are calculated as the sum of energy from solid fat and added sugar (SoFAS).
- ^cMean percent of location-specific empty calories provided by each food group.
- ^dMean location-specific empty calories (kcal) provided by each food group among consumers from each location. Calculated including consumers and non-consumers of each food group. Values are mean $\pm$ standard error (SE).
- ^eSugar sweetened beverages (SSBs), including soda, fruit drinks, sports drinks, and energy drinks.
- ^fIncludes whole and 2% milk (plain, chocolate, or flavored).
- ^gFood groups providing the largest contributions to added sugar consumption from stores, schools, or fast food restaurants.
- ^hMean percent of location-specific calories from added sugar provided by each food group.
- ⁱMean calories from added sugar (kcal) provided by each food group among consumers from each location.
- ^jFood groups providing the largest contributions to solid fat consumption from stores, schools, or fast food restaurants.
- ^kMean percent of location-specific calories from solid fat provided by each food group.
- ^lMean location-specific calories from solid fat (kcal) provided by each food group among consumers from each location.