Self-Reported Dietary Intake of Youth with Recent Onset of Type 2 Diabetes: Results from the TODAY Study

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ABSTRACT

Despite the widely recognized importance of diet in managing diabetes, few studies have documented usual dietary intake in young people with type 2 diabetes. The objectives of our study were to assess dietary intake among a large, ethnically diverse cohort of young people with type 2 diabetes and compare intake to current recommendations. The Treatment Options for Type 2 Diabetes in Adolescents and Youth (TODAY) study is a multicenter randomized clinical trial of 699 youth aged 10 to 17 years. At baseline, following a run-in period that included standard diabetes education, diet was assessed using a food frequency questionnaire between 2004 and 2009. Analysis of variance and nonparametric tests were used to compare mean and median nutrient intakes; logistic regression was used to compare the odds of meeting predefined dietary intake recommendation cutpoints between subgroups of age, sex, and race–ethnicity. Percent of energy from saturated fat was consistently 13% to 14% across all subgroups—substantially exceeding national recommendations. Overall, only 12% of youth met Healthy People 2010 guidelines for intake of <10% of energy from saturated fat and only 1% of youth met American Diabetes Association recommendations for intake of <7% of energy from saturated fat. Dietary intake fell substantially below other Healthy People 2010 targets; only 3% met calcium intake goals, 11% met fruit consumption goals, 5% met vegetable consumption goals, and 67% met grain intake goals. Overall, dietary intake in this large cohort of young people with type 2 diabetes fell substantially short of recommendations, in ways that were consistent by sex, age, and race–ethnicity. The data suggest a critical need for better approaches to improve dietary intake of these young people.
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THE AMERICAN DIABETES ASSOCIATION NUTRITION recommendations for young people with type 2 diabetes emphasize the importance of meeting targets for glycemic control, blood pressure, and lipid levels and the role of medical nutrition therapy in achieving these goals.[1,2] Medical nutrition therapy recommendations focus on cessation of excessive weight gain while promoting normal linear growth through reduced intake of high-fat, high-energy-density foods, saturated fat, and cholesterol together with increased physical activity. The American Diabetes Association models food intake recommendations for people with type 2 diabetes on the Dietary Guidelines for Americans[3-5] and Institute of Medicine Dietary Reference Intakes,[6,7] along with evidence-based nutrition research conducted in study participants with type 2 diabetes. To date, most reports describing youth with and without diabetes indicate intakes of higher than recommended levels of total fat and saturated fat, with fewer than 50% of young people meeting recommendations for calcium, fiber, fruits, and vegetables.[8-11]

Despite the widely recognized importance of diet in management of diabetes, few studies to date have documented usual dietary intake in such a large, diverse sample of youth with type 2 diabetes.[11-13] The Treatment Options for type 2 Diabetes in Adolescents and Youth (TODAY) trial provides the opportunity to assess dietary intake among a large, ethnically and regionally diverse cohort of young people with recently diagnosed type 2 diabetes after participation in a standard diabetes education program. Our report describes estimated intake of nutrients and foods in the TODAY cohort according to age, sex, and race–ethnicity, and compares intake to current recommendations and to similarly aged populations without diabetes, and compares the odds of meeting these recommendations among subgroups. It was hypothesized that most young people would not meet nutrition recommendations regardless of age, sex, or ethnicity.

METHODS

The TODAY trial is a randomized, double-blind, parallel-group clinical trial designed to evaluate the relative efficacy and safety of three treatments for type 2 diabetes in youth: metformin alone, metformin plus rosiglitazone, or metformin plus intensive lifestyle intervention.[14,15] The primary objective was to compare the three treatment arms on time to treatment failure, defined as loss of glycemic control (either a glycated hemoglobin 8% or greater over a 6-month period or inability to wean from temporary insulin therapy within 3 months after metabolic decompensation).

A detailed description of TODAY study methods is published elsewhere.[14] Following individual institutional review board approval, participants were recruited at 15 clinical centers and provided informed consent; minor children confirmed assent according to local guidelines. Participants were aged 10 to 17 years, with <2 years of type 2 diabetes, and a body mass index (BMI) ≥85th percentile at time of diagnosis or at screening.

Before randomization, a run-in period was performed to ensure that participants were able to tolerate therapy with metformin, accomplish mastery of a standard diabetes education curriculum, and demonstrate ability to adhere to study requirements for pill taking and visit attendance. The standard diabetes education curriculum included dietary strategies to reduce energy intake to avoid excessive weight gain and maintain linear growth in those still growing and to promote weight loss in young people who had stopped growing.[14,16] The standard diabetes education program[14,16] was designed specifically for TODAY participants to provide diabetes knowledge and self-management skills with the aim of all participants having equivalent baseline diabetes knowledge at time of randomization; only 1% of youth did not proceed to randomization due to inability to master the standard diabetes education program.[17] Youth who successfully completed the run-in period were randomized to one of three treatment arms and entered the main clinical trial and completed baseline measures.

Assessment of Dietary Intake

At baseline, following a run-in period that included a standard diabetes education program, diet was assessed using a food frequency questionnaire (FFQ) between 2004 and 2009. Semiquantitative FFQ methodology was chosen for use in the TODAY trial based on its low cost and reduced participant burden compared with multiple 24-hour dietary recalls. Although FFQs provide less specific information than 24-hour dietary recalls, national surveys such as the National Health Interview Survey[18] and other major national studies have similarly used FFQ data to describe dietary intake in the study population[11,19,20]; FFQs have also detected significant change in dietary intake over time in the context of clinical trials.[19] FFQs are known to underestimate total energy intake overall, particularly with increasing BMI in both children and adults, but do well when examining relative quantities such as percent intake of various nutrients.[9-11,21]

The TODAY FFQ was a modified version of the SEARCH for Diabetes in Youth FFQ,[11] which was derived from the Block Kids' Food Questionnaire.[22] Psychometric evaluation of the Block Kids' Food Questionnaire, which included test–retest reliability and validation against two 24-hour dietary recalls, was conducted in a sample of children as young as age 8 years, including African American youth living in a low-income neighborhood[22] and in an ethnically diverse cohort of youth aged 10 to 17 years.[23] The SEARCH FFQ included additional food lines based on items commonly consumed by participating minority ethnic and racial groups. The TODAY FFQ was further modified to add an option for participants to report extra-large portion sizes (eg, to allow participants to identify the bigger size choices available in fast-food restaurants). The original Block Kids' Food Questionnaire included about 75 food lines; the TODAY FFQ included about 100 food lines. These additions were based primarily on foods identified for inclusion for the SEARCH Study and the Diabetes Prevention Program, which have similar participant diversity.[11,19] For each line item, participants were asked if the food item was consumed during the past week ("yes/no") and if yes, how many days, and average portion. Portion size was queried for each line item either as a number or as "very small," "small," "medium," "large," or "very large" relative to pictures of food in bowls or plates provided with the form. Other modifications included a small number of questions designed to understand more fully if the period of recall (1 week) reflected "usual" intake for the individual, use of dietary supplements, use of low-fat products, and frequency of eating out. These modifications did not change the core structure or content of the Block Kids FFQ instrument, which is designed to permit adding items relevant to each study. The nutrient and portion-size databases for this instrument were modified from SEARCH FFQ databases, using the Nutrition Data System for Research (database 3 version 4.05/33, 2002, Nutrition Coordinating Center, University of Minnesota) and industry sources.

Quality Control

Certified research staff members administered the FFQ via interview with direct entry of participant responses into a computer, using software provided by University of South Carolina Diet Assessment Center. The FFQs were edited initially at clinical sites, and additional editing and quality control checks (eg, for internal consistency and range) were conducted at the Diet Assessment Center using edit checks based on the National Cancer Institute Health Habits and History Questionnaire/DietSys program (version 4.01) followed by staff review of FFQs in which a food or nutrient value was found to be extreme.

Anthropometric Measures

All anthropometric measures were taken by a certified research staff member with the participant wearing lightweight clothing and without shoes. A single height measurement was recorded using a clinical stadiometer. Stadiometer brand varied by site but a single stadiometer was used to measure height at each site. Weight was measured in duplicate using a Seca scale (model 882; Seca USA) with a third measurement made only if the first measurements differed by >0.2 kg. Height was measured to the nearest 0.1 cm and weight was measured to the nearest 0.1 kg. BMI was calculated as weight in kilograms divided by height in meters^2.

Statistical Methods

Ethnicity was determined by self-report. For data analysis, 25 (3.6%) participants who reported belonging to more than one

racial group were assigned to a racial–ethnic group according to the following priority of risk for type 2 diabetes in young people: American Indian greater than Hispanic greater than non-Hispanic black greater than non-Hispanic white.[24] Tests performed excluded the American Indian group due to small numbers. Data are reported as mean, standard deviation, median, 25th percentile, and 75th percentile of the distribution or percents, as appropriate. Analysis of variance and nonparametric tests were used to compare mean and median nutrient intakes and logistic regression was used to compare the odds (odds ratio and 95% CI) of meeting predefined cutpoints, by age, sex, and self-reported race–ethnic group. To not confuse energy requirements for weight maintenance with energy requirements for weight loss in these overweight and obese young people, servings from each food group were not based on energy intake but rather the lower end of the recommended range of servings per day for the various food groups as described in dietary guidelines.[3,4] Using the minimum standard as a basis for determining the percent of youth meeting the dietary guidelines was appropriate to our goals of not overstating the inadequacy of the diet and ease of comparison with earlier reports.[11,19,20] Due to the number of statistical tests conducted, α=.015 was used to test for statistical significance. Analyses were conducted using the Statistical Analysis System (version 9.2, 2008, SAS Institute, Inc).

RESULTS AND DISCUSSION

Baseline characteristics of the randomized participants have been reported elsewhere.[17] Briefly, the study population was largely of minority racial–ethnic background, with 19.6% non-Hispanic white, 41.1% Hispanic, 31.5% non-Hispanic black, 6.1% American Indian, and 1.7% Asian, and came from families of low education level and low annual household income. An annual household income <$25,000 was reported by 41.5% of parent/guardians; 26% of parent/guardians reporting <12th grade education. Overall, participants were evenly distributed between younger (aged 10 to 14 years) and older (aged 15 to 18 years) adolescents and there were more female than male participants (64.9% vs 35.1%). A majority were obese (86.9%) and 10.7% were overweight but not obese.

Of 699 TODAY cohort participants, 672 baseline FFQs were received; 24 were excluded for the following reasons: excessive energy intake (>8,000 kcal) (n=0), reporting <3 average foods per day or reporting eating "a lot more/a lot less than usual" (n=18), reporting between 3 and 3.5 foods per day and having inconsistent responses to cold cereal quality control questions (n=3), forms for which the values were 0.5 sex-specific standard deviations or more from the nearest neighbor for highest energy among boys and girls separately (n=2), and comment from interviewer (n=1). Therefore, 3.6% of forms were excluded in the final data set and nutrition analysis was conducted using FFQ data from 648 TODAY participants. Of these youth, 91% reported that what they ate was typical of usual eating habits and 9% reported that what they ate was "a little more than usual" or "a little less than usual."

Baseline Dietary Intake

During a typical week, most young people (88%) reported eating 3 to 5 times per day; 31% ate the school breakfast or lunch 4 to 5 times per week. In addition, 33% of young people reported eating fast food once per week and another 31% ate fast food 2 or more times per week; 33% reported eating out at other types of restaurants at least once per week. There were no significant differences by sex or by racial ethnic group in the reported frequency of eating out at fast food or other types of restaurants at least once per week (data not shown).

Reported nutrient intake and food group consumption patterns for girls and boys are shown in Table 1. Overall, young people reported diets that were low in energy; high in total and saturated fat; low in fiber, fruits, vegetables, and sweetened drinks; and high in grains. Compared with girls, boys reported more energy, protein, cholesterol, calcium, magnesium, and iron as evidenced through more dairy and meat, poultry, and fish consumption. There were no significant differences in median macronutrient intake between boys aged 10 to 14 years and boys aged 15 to 18 years. However, girls aged 15 to 18 years reported higher median energy intake (1,197 kcal vs 1,073 kcal; P=0.012), and more dietary fiber (9.0 g vs 7.7 g; P=0.003), vitamin C (56 mg vs 44 mg; P=0.005), vitamin E (4.0 mg vs 3.3 mg α-tocopherol; P<0.001), and magnesium (151 mg vs 132 mg; P=0.008) than girls aged 10 to 14 years. In terms of food group servings per day, the only differences between older and younger boys were that younger boys reported more servings of dairy (median 5.1 vs 3.4; P=0.009), and more sweets and desserts (median 1.2 vs 0.6; P=0.011). Younger girls reported fewer daily servings of vegetables (0.7 vs 0.9; P=0.008), more daily servings of grains (median 9.0 vs 7.3; P=0.007), and fewer sweetened drinks (median 0.0 vs 0.1; P=0.001).

Table 2 compares reported nutrient intake and food group consumption patterns by race–ethnicity. All racial–ethnic groups reported high fat and saturated fat intakes; low dietary fiber, fruit, vegetable, and sweetened drink consumption; and high intake of grains. Total fat, saturated fat, monounsaturated fat, polyunsaturated fat, vitamin E, dairy intake, fats, and oils and sweetened drink consumption were significantly different among ethnic groups. American Indian youth had the highest and Hispanic youth the lowest percent saturated fat intake. Dietary intake patterns for girls and boys by ethnic group were similar to the overall patterns in Table 2 except that, when girls and boys were considered separately, there were no significant differences in saturated fat intake, vitamin E intake, or intake of fats and oils among racial–ethnic groups. Food group consumption patterns for girls by race–ethnicity were similar to the overall results in Table 2 in terms of sweetened drinks; however, dairy consumption did not reach statistical significance. There were no significant differences in daily food group servings among boys by ethnicity.

Table 3 shows current nutrition recommendations for youth with diabetes based on American Diabetes Association, American Heart Association, Institute of Medicine, Food Guide Pyramid, and Healthy People 2010 guidelines[1-7,25,26]; the percent of youth who met dietary recommendations at baseline after completion of standard diabetes education by sex and race–ethnicity; and the odds of compliance between subgroups. Overall, very few youth with type 2 diabetes met nutrition recommendations for total fat, saturated fat, calcium, fruit, and vegetable intake. Girls were less likely to meet goals for daily servings of dairy and meat; however, they were more likely to meet goals for cholesterol intake. There were no significant differences in percent meeting dietary recom-

Table 1. Comparison of TODAY[a] youth and adolescents' self-reported estimated daily nutrient and food group intake, by sex

Intake	Girls (n=422)		Boys (n=226)		Test of medians (*P* value)	Test of means (*P* value)
	Median (25th, 75th percentile)	Mean±SD[b]	Median (25th, 75th percentile)	Mean±SD		
Nutrient						
Total energy (kcal)	1,121.0 (839.0, 1438.3)	1,181.5±490.2	1,214.8 (925.0, 1599.0)	1,323.7±573.5	0.002	0.001
Total fat (%)	38.6 (34.2, 42.8)	38.4±6.6	38.6 (34.3,42.8)	38.6±6.4	NS[c]	NS
Saturated fat (%)	13.2 (11.5, 15.0)	13.3±2.9	13.1 (11.7, 14.9)	13.3±2.6	NS	NS
Monounsaturated fat (%)	15.1 (13.0, 17.1)	15.0±2.9	14.9 (13.4, 17.0)	15.4±3.0	NS	NS
Polyunsaturated fat (%)	6.3 (5.3, 7.5)	6.6±1.9	6.2 (5.2, 7.4)	6.4±1.8	NS	NS
Protein (%)	17.7 (15.5, 19.7)	17.7±3.6	18.2 (16.1, 20.6)	18.6±3.5	0.007	0.001
Cholesterol (mg)	171.6 (118.3, 231.8)	188.8±106.3	195.3 (135.6, 287.5)	222.4±123.2	0.0004	0.0003
Fiber (g)	8.1 (5.8, 11.2)	9.0±4.3	8.9 (6.1, 12.3)	9.7±4.9	NS	NS
Calcium (mg)	496.4 (332.2, 689.3)	545.1±298.4	569.1 (390.3, 736.7)	615.8±338.6	0.004	0.006
Vitamin C (mg)	48.6 (29.5, 80.9)	62.3±46.5	44.3 (30.0, 70.7)	62.1±61.2	NS	NS
Vitamin E (mg α-tocopherol)	3.6 (2.7, 5.0)	4.1±2.1	3.8 (2.7, 5.4)	4.4±2.6	NS	NS
Vitamin A (μg retinol equivalents)	365.4 (256.1, 573.7)	452.2±285.1	377.9 (295.7, 580.3)	463.6±286.3	NS	NS
Iron (mg)	7.2 (5.3, 9.6)	7.9±3.6	8.1 (6.0, 10.9)	8.9±4.0	0.001	0.0008
Magnesium (mg)	139.0 (102.6, 183.4)	148.9±64.8	153.8 (116.9, 205.2)	170.6±81.1	0.001	0.0002
Food group (servings/d)						
Dairy	3.2 (1.1, 6.2)	4.3±4.1	4.4 (1.6, 7.0)	5.2±4.6	0.009	0.018
Meat, poultry, fish, dry beans, eggs, nuts	2.1 (1.4, 3.0)	2.4±1.4	2.7 (1.9, 3.8)	3.0±1.8	<0.0001	<0.0001
Fruit	0.8 (0.4, 1.4)	1.0±0.8	0.7 (0.3, 1.4)	1.0±1.0	NS	NS
Vegetables	0.8 (0.5, 1.4)	1.1±0.9	0.9 (0.5, 1.5)	1.2±0.9	NS	NS
Fruits and vegetables	1.7 (1.1, 2.7)	2.1±1.3	1.8 (1.1, 2.7)	2.2±1.6	NS	NS
Bread, cereal, rice, pasta	8.0 (4.7, 12.8)	9.5±6.1	8.4 (4.4, 13.9)	9.7±6.4	NS	NS
Fats and oils	1.8 (0.4, 3.7)	2.7±3.1	1.3 (0.3, 3.4)	2.4±3.0	NS	NS
Sweets and desserts	0.6 (0.2, 1.9)	1.6±2.2	0.8 (0.3, 2.3)	2.0±3.1	NS	0.042
Sweetened drinks	0.0 (0.0, 0.4)	0.3±0.7	0.0 (0.0, 0.4)	0.3±0.7	NS	NS

[a]TODAY=Treatment Options for Type 2 Diabetes in Adolescents and Youth study.
[b]SD=standard deviation.
[c]NS=nonsignificant *P* value.

mendations among ethnic groups, except that Hispanic youth were more likely than non-Hispanic white youth to meet goals for the percent energy from fat and saturated fat, but were less likely than non-Hispanic white youth to meet the <200 mg cholesterol intake goal. Non-Hispanic black young people were less likely than Hispanics and non-Hispanic white youth to meet the dairy goal.

The TODAY study represents the largest and most ethnically diverse group of adolescents and youth with type 2 diabetes ever described. Despite participating in a standard diabetes education program that focused on weight loss and a healthful diet targeting this demographic,[16] the reported dietary intake of these young people with type 2 diabetes fell substantially short of national nutrition recommendations irrespective of sex, age, and race–ethnicity. The percent of energy intake from total fat and saturated fat remained higher than recommendations in both younger and older girls and boys and in all ethnic groups. Overall, only 10% and 12% of youth met the ≤30% total of total energy from fat and ≤10% of total energy from saturated fat recommendations, respectively. Furthermore, a pattern of low intake of dietary calcium, fiber, fruits, and vegetables and high intake of grains was evident in each of these groups. When compared with Healthy People 2010 guidelines, this cohort of young people fell significantly below dietary targets: only 3% met calcium intake goals, 11% met fruit consumption goals, 5% met vegetable consumption goals, and 67% met grain intake goals.

Intake of total fat and saturated fat in TODAY participants exceeded the average intake reported for a broad population of overweight and nonoverweight similarly aged American youth without diabetes in both girls and boys and for non-Hispanic black youth and Hispanic youth (4% to 6% higher and 1% to 2% higher, respectively).[9]

The SEARCH study, which used a similar FFQ instrument to assess dietary intake in youth aged 10 to 14 years and aged 15 and older with either type 1 or type 2 diabetes of at least 1 year's duration, is an appropriate comparison group for intake of some nutrients.[11] Dietary fat intake among youth with type

Table 2. Comparison of TODAY[a] youth and adolescents' self-reported estimated daily nutrient and food group intake, by race–ethnicity

Intake	American Indian (n=40)		Non-Hispanic Black (n=209)		Hispanic (n=254)		Non-Hispanic White (n=134)		Test of medians (*P* value)	Test of means (*P* value)
	Median (25th, 75th percentile)	Mean±SD[b]	Median (25th, 75th percentile)	Mean±SD	Median (25th, 75th percentile)	Mean±SD	Median (25th, 75th percentile)	Mean±SD		
Nutrient										
Total energy (kcal)	1,090.2 (876.8, 1436.5)	1,227.4±547.0	1,175.9 (910.1, 1521.9)	1,290.7±583.5	1,099.6 (829.8, 1439.5)	1,163.2±482.0	1,252.2 (923.7, 1549.0)	1,284.9±495.6	0.015	0.016
Total fat (%)	41.5 (36.2, 44.8)	40.9±6.7	39.5 (34.3, 43.8)	39.0±6.8	36.8 (33.4, 40.9)	37.0±6.2	40.0 (36.0, 44.0)	39.9±6.2	<0.0001	<0.0001
Saturated fat (%)	14.0 (12.4, 15.3)	14.0±2.5	13.2 (11.4, 15.0)	13.3±3.0	12.8 (11.1, 14.8)	12.9±2.7	13.4 (12.0, 15.1)	13.8±2.6	0.022	0.012
Monounsaturated fat (%)	16.0 (14.1, 18.1)	16.2±2.8	15.5 (13.3, 17.4)	15.3±3.0	14.5 (12.9, 16.2)	14.6±2.7	15.7 (13.8, 17.7)	15.8±2.9	0.0002	0.0002
Polyunsaturated fat (%)	6.3 (5.5, 7.9)	6.8±2.2	6.6 (5.7, 7.8)	6.8±1.9	5.8 (5.1, 7.0)	6.1±1.7	6.4 (5.5, 7.9)	6.8±2.0	<0.0001	<0.0001
Protein (%)	16.7 (15.5, 20.4)	17.8±4.3	17.9 (15.5, 19.8)	18.0±4.0	18.2 (16.1, 20.4)	18.3±3.3	17.6 (15.6, 19.5)	17.8±3.4	NS[c]	NS
Cholesterol (mg)	198.3 (139.4, 275.8)	227.7±129.5	174.1 (123.2, 237.9)	200.1±123.1	191.1 (124.2, 257.0)	201.5±105.0	165.0 (121.0, 239.2)	190.1±105.5	NS	NS
Fiber (g)	8.3 (6.2, 11.1)	8.9±4.1	8.1 (5.8, 11.4)	9.0±4.3	8.2 (5.8, 11.6)	9.3±4.6	9.1 (6.2, 12.1)	9.7±4.9	NS	NS
Calcium (mg)	403.3 (307.7, 621.8)	476.8±240.5	472.0 (334.0, 722.8)	568.5±346.2	522.8 (352.6, 710.6)	568.4±312.3	565.2 (440.9, 742.0)	613.3±285.7	0.042	NS
Vitamin C (mg)	43.9 (30.6, 65.7)	59.2±49.0	50.6 (30.6, 89.2)	69.9±64.6	44.2 (29.6, 73.2)	58.0±44.8	47.2 (28.4, 71.6)	59.8±44.0	NS	0.041
Vitamin E (mg α-tocopherol)	3.6 (2.7, 5.0)	4.0±1.8	3.8 (2.8, 5.4)	4.4±2.3	3.4 (2.4, 4.7)	3.8±2.1	4.0 (2.8, 5.7)	4.6±2.7	0.001	0.002
Vitamin A (μg retinol equivalents)	325.8 (259.0, 521.2)	423.1±261.1	350.0 (256.2, 568.8)	459.4±323.4	384.9 (273.7, 561.0)	452.1±266.5	388.7 (267.6, 632.4)	469.3±264.7	NS	NS
Iron (mg)	6.7 (5.5, 8.9)	7.7±3.5	7.5 (5.8, 9.8)	8.5±4.0	7.5 (5.2, 10.0)	8.1±3.7	7.8 (5.7, 10.5)	8.4±3.6	NS	NS
Magnesium (mg)	129.4 (97.2, 168.5)	140.6±59.1	140.4 (108.0, 198.6)	161.1±73.8	140.8 (103.7, 180.4)	151.6±70.6	157.9 (116.7, 202.5)	164.6±73.5	NS	NS
Food group (servings/d)										
Dairy	2.6 (0.7, 5.2)	3.3±3.1	2.7 (1.0, 5.7)	4.1±4.4	4.4 (1.4, 7.0)	5.0±4.3	4.4 (1.9, 7.0)	5.2±4.3	0.002	0.044
Meat, poultry, fish, dry beans, eggs, nuts	2.8 (2.0, 3.2)	2.8±1.3	2.5 (1.6, 3.2)	2.7±1.7	2.1 (1.4, 3.0)	2.4±1.5	2.3 (1.4, 3.3)	2.7±1.7	NS	NS
Fruit	0.6 (0.4, 1.1)	0.9±0.8	0.9 (0.4, 1.4)	1.1±1.0	0.8 (0.4, 1.3)	1.0±0.8	0.7 (0.3, 1.4)	0.9±0.8	NS	NS
Vegetables	1.1 (0.6, 1.5)	1.2±0.7	0.8 (0.5, 1.4)	1.1±0.9	0.9 (0.5, 1.5)	1.1±0.9	0.9 (0.5, 1.5)	1.2±0.9	NS	NS
Fruits and vegetables	1.9 (1.3, 2.6)	2.1±1.2	1.7 (1.1, 2.9)	2.1±1.5	1.7 (1.1, 2.7)	2.1±1.3	1.8 (1.1, 2.5)	2.1±1.4	NS	NS
Bread, cereal, rice, pasta	9.7 (4.6, 18.1)	11.4±7.6	7.8 (4.5, 12.9)	9.5±6.4	8.2 (4.7, 12.1)	8.9±5.3	8.5 (4.3, 15.0)	10.3±6.9	NS	NS
Fats and oils	1.6 (0.5, 5.2)	3.4±4.3	1.9 (0.4, 4.1)	2.8±3.1	1.2 (0.3, 3.1)	2.1±2.4	1.9 (0.4, 4.0)	3.0±3.5	0.042	0.011
Sweets and desserts	0.6 (0.1, 1.4)	1.1±1.4	0.6 (0.2, 2.0)	1.9±3.2	0.6 (0.2, 2.1)	1.7±2.4	0.8 (0.3, 2.1)	1.6±2.0	NS	NS
Sweetened drinks	0.2 (0.0, 0.7)	0.5±0.8	0.1 (0.0, 0.5)	0.5±0.9	0.0 (0.0, 0.3)	0.3±0.6	0.0 (0.0, 0.1)	0.2±0.5	<0.0001	0.001

[a]TODAY=Treatment Options for Type 2 Diabetes in Adolescents and Youth study.
[b]SD=standard deviation.
[c]NS=nonsignificant *P* value.

Table 3. Percent of TODAY[a] youth and adolescents meeting daily nutrition recommendations for diabetes and odds of compliance (odds ratio [OR] and 95% [CI), by sex and by race–ethnicity

Daily nutrition recommendations	Healthy People 2010[b] target	Total	Girls	Boys	OR (95% CI) Girls vs Boys	NHB[c]	H[d]	NHW[e]	OR (95% CI) NHB vs H	OR (95% CI) NHB vs NHW	OR (95% CI) H vs NHW
	← % →					← % →					
Nutrient											
Energy from fat ≤30%[f]	75	9.6	10.7	7.5	1.5 (0.8-2.6)	10.0	12.2	5.2	0.8 (0.4-1.4)	2.0 (0.8-4.9)	**2.5 (1.1-5.9)**[i]
Energy from saturated fat <10%[f]		11.6	13.3	8.4	1.7 (0.9-2.9)	11.5	16.1	5.2	0.7 (0.4-1.2)	2.3 (0.9-5.6)	**3.5 (1.5-8.0)**
Energy from saturated fat <7%[g]	75	1.1	1.4	0.4	3.2 (0.4-27.1)	0.9	1.2	0.7	0.8 (0.1-4.9)	1.3 (0.1-14.3)	1.6 (0.2-15.4)
Cholesterol <300 mg[f]		84.6	88.1	77.9	**2.1 (1.4-3.2)**	85.6	84.2	86.6	1.1 (0.7-1.9)	0.9 (0.5-1.7)	0.8 (0.5-1.5)
Cholesterol <200 mg[g]		58.9	62.3	52.6	**1.5 (1.1-2.1)**	62.2	53.9	66.4	1.4 (0.9-2.0)	0.8 (0.5-1.3)	**0.6 (0.4-0.9)**
Calcium ≥1,300 mg[f]	75	2.8	2.3	4.0	0.5 (0.2-1.3)	3.8	3.1	1.5	1.2 (0.4-3.3)	2.6 (0.5-12.6)	2.1 (0.4-10.2)
Food group[h]											
Dairy ≥2 servings		66.4	63.0	72.6	**0.6 (0.4-0.9)**	58.8	70.9	74.6	**0.6 (0.4, 0.9)**	**0.5 (0.3, 0.8)**	0.8 (0.5, 1.3)
Meat, poultry, fish, dry beans, eggs, nuts ≥2 servings		58.3	52.4	69.5	**0.5 (0.3-0.7)**	61.7	52.8	58.2	1.4 (0.9-2.1)	1.2 (0.7-1.8)	0.8 (0.5-1.2)
Fruit ≥2 servings	75	11.3	10.9	11.9	0.9 (0.5-1.5)	13.4	8.7	12.7	1.6 (0.9-2.9)	1.1 (0.6-2.0)	0.6 (0.3-1.3)
Vegetables ≥3 servings	50	5.1	4.5	6.2	0.7 (0.3-1.5)	5.3	4.3	6.7	1.2 (0.5-2.9)	0.8 (0.3-1.9)	0.6 (0.3-1.6)
Bread, cereal, rice, and pasta ≥6 servings	50	67.0	67.8	65.5	1.1 (0.8-1.6)	66.0	66.1	69.4	1.0 (0.7-1.5)	0.9 (0.5-1.4)	0.9 (0.5-1.4)
Fats and oils ≤1 serving		16.0	14.9	18.1	0.8 (0.5-1.2)	15.3	15.8	17.2	1.0 (0.6-1.6)	0.9 (0.5-1.6)	0.9 (0.5-1.6)

[a]TODAY=Treatment Options for Type 2 Diabetes in Adolescents and Youth study.
[b]Based on Healthy People target for 2010.[26]
[c]NHB=non-Hispanic black.
[d]H=Hispanic.
[e]NHW=non-Hispanic white.
[f]Source of daily dietary recommendations for boys and girls aged 9-18 years for each nutrient and food group is Institute of Medicine.[6,7]
[g]Source of daily dietary recommendations for boys and girls aged 9-18 years for each nutrient and food group is American Diabetes Association[1,2] and American Heart Association.[25]
[h]Source of daily dietary recommendations for boys and girls aged 9-18 years for each nutrient and food group is Food Guide Pyramid.[3,4]
[i]Significant confidence intervals (not overlapping 1) are shown in boldface.

2 diabetes in SEARCH (n=186) was 37% to 38% and saturated fat intake was 13% to 14%, very similar to the TODAY cohort. The pattern of low intake of fruits and vegetables was also apparent in SEARCH. The TODAY cohort was heavier than the youth with type 2 diabetes in the SEARCH cohort, and reported consuming about three times the amount of grains and dairy and double the amount of desserts and sweets compared with the SEARCH group.

Of great concern is the observation that only 12% of TODAY youth met the Institute of Medicine and Healthy People 2010 recommendation of consuming <10% of total daily energy as saturated fat, and only 1% met the more stringent American Diabetes Association/American Heart Association recommendation of <7%. By comparison, in a large population-based sample of urban youth aged 11 to 18 years, in which 13% were obese and 33% were overweight, 45% of girls and 36% of boys met the 10% saturated fat intake goal, whereas 46% of girls and 45% of boys met fruit consumption goals and 18% of girls and 16% of boys met vegetable consumption goals.[10] It is possible that reducing saturated fat intake to recommended targets is more challenging for patients with type 2 diabetes due to the common focus on carbohydrate counting and reduced sweets, which may reinforce an existing pattern of eating less fruits and vegetables and shift eating habits toward greater consumption of low-carbohydrate foods such as cheese and meats, which are also high in fat, cholesterol, and saturated fat.

High fat intake during youth is associated with increased risk for heart disease in adulthood[27] and low calcium intake leads to low bone density in adolescents and possible osteoporosis in later life.[28] Fruits and vegetables are high in dietary fiber, low in energy density, high in antioxidants and other phytochemicals, and have important implications for management of weight, blood pressure, and lipid levels. A recent study[29] found that a pattern of low consumption of fruits and vegetables is related to arterial stiffness in young adulthood.

Failure to meet nutrition standards in this population is likely underestimated because dietary assessment was completed after a standard diabetes education program and the run-in process, which may have biased the cohort by selecting youth who were more highly motivated or interested in healthier behaviors and outcomes. Almost all American Indian youth (n=40) in this report originated from a single, predominantly rural state (Oklahoma). Thus, it is possible that effects attributed to American Indian ethnicity are a result of rural living and available dietary options rather than dietary selections specific to American Indian youth. Additional research on dietary habits of American Indian youth is warranted.

The absolute energy intake was lower than anticipated based on the SEARCH findings, which may be related to several factors. The low energy intake in part may reflect dietary changes or increased socially desirable responses resulting from dietary education provided to the TODAY cohort during the run-in period, whereas the SEARCH participants had no educational intervention. Underestimation of absolute energy intake may occur, especially in children with obesity when captured by the FFQ instrument.[9,11,23] Assuming nondifferential under-reporting, in general, such under-reporting of overall intake would bias the findings toward overestimation of inadequate intake in terms of consumption of foods (eg, number of servings of fruits and vegetables). Differential under-reporting due to obesity is unlikely to create any additional bias in our data because, by design, all participants were overweight or obese. Adequacy expressed in terms of energy density (eg, percent of kilocalories from saturated fat) would not be biased. There could also be some degree of underestimation of inadequacy due to bias related to social desirability such that reported intake could be "healthier" than actual intake.

Nevertheless, the evaluation of food and nutrient intake demonstrates that overall these young people with type 2 diabetes are not meeting recommended food and nutrient intake guidelines and are consuming diets that may exacerbate cardiovascular and other disease risks. In addition, it is likely that the nutrition gaps we identified underestimate the true nutritional deficits typical of youth with recent-onset type 2 diabetes because the food and nutrient intake for youth who failed the run-in period were not included in the analyses.

CONCLUSIONS

Changing nutrition and lifestyle habits is often challenging due to a variety of individual, environmental, physiologic, cultural, and social factors and most families need assistance in overcoming these barriers to dietary change. At the time of entry into the TODAY trial, the diet quality of participants was very poor, with remarkably high intake of saturated fat and very low fruit and vegetable intake. The TODAY study results will provide an opportunity to evaluate the incremental influence of a long-term evidence-based nutrition and lifestyle intervention[15] on dietary intake and health outcomes of these high-risk youth with type 2 diabetes.

References

1. American Diabetes Association. Type 2 diabetes in children and adolescents. *Diabetes Care*. 2000;23(3);381-389.
2. Bantle JP, Wylie-Rosett J, Albright AL, et al. Nutrition recommendations and interventions for diabetes: A position statement of the American Diabetes Association. *Diabetes Care*. 2008;31(suppl 1):S61-S78.
3. *Nutrition and Your Health*: *Dietary Guidelines for Americans, 2000*. 6th ed. Washington, DC: US Government Printing Office; 2000.
4. *The Food Guide Pyramid*. Washington, DC: US Department of Agriculture Center for Nutrition Policy and Promotion 2000. Home and Garden Bulletin No. 252.
5. *Nutrition and Your Health: Dietary Guidelines for Americans, 2010*. 7th ed. Washington, DC: US Government Printing Office, 2010.
6. Institute of Medicine, Food and Nutrition Board. *Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein and Amino Acids (Macronutrients)*. Washington, DC: National Academies Press; 2002.
7. Institute of Medicine, Food and Nutrition Board. *Dietary Reference Intakes for Calcium and Vitamin D*. Washington, DC: The National Academies Press; 2011.
8. Munoz KA, Krebs-Smith SM, Ballard-Barbash R,Cleveland LE. Food intakes of US children and adolescents compared with recommendations. *Pediatrics*. 1997;100(3 Pt 1):323-329.
9. Troiano RP, Briefel RR, Carroll MD, Bialostosky K. Energy and fat intakes of children and adolescents in the United States: Data from the National Health and Nutrition Examination Surveys. *Am J Clin Nutr*. 2000;72(suppl 5):1343S-1353S.
10. Neumark-Sztainer D, Story M, Hannan PJ, Croll J. Overweight status and eating patterns among adolescents: Where do youths stand in comparison to Healthy People 2010 objectives? *Am J Public Health*. 2002;92(5):844-851.

11. Mayer-Davis EJ, Nichols M, Liese AD, et al. Dietary intake among youth with Diabetes: The SEARCH for Diabetes in Youth Study. *J Am Diet Assoc*. 2006;106(5):689-697.
12. Gunther ALB, Liese AD, Bell RA, et al. Association between the dietary approaches o hypertension diet and hypertension in youth with diabetes mellitus. *Hypertension*. 2009;53(1):6-12.
13. Liese AD, Bortsov A, Gunther ALB, et al. Association of DASH diet with cardiovascular risk factors in youth with diabetes mellitus: The SEARCH for diabetes in youth study. *Circulation*. 2011;123(13):1410-1417.
14. Zeitler P, Epstein L, Grey M, et al. Treatment options for type 2 diabetes in adolescents and youth: A study of the comparative efficacy of metformin alone or in combination with rosiglitazone or lifestyle intervention in adolescents with type 2 diabetes. *Pediatr Diabetes*. 2007;8(2):74-87.
15. TODAY Study Group. Design of a family-based intervention for youth with type 2 diabetes: The TODAY study. *Int J Obes*. 2010;34(2):217-226.
16. Grey M, Schreiner B, Pyle L. Development of a diabetes education program for youth with type 2 diabetes. *Diabetes Educ*. 2009;35(1):108-116.
17. Copeland KC, Zeitler P, Geffner M et al. Characteristics of adolescents and youth with recent-onset type 2 diabetes: The TODAY cohort at baseline. *J Clin Endocrinol Metab*. 2011;96(1):159-167.
18. Breslow RA, Subar AF, Patterson BH, Block G. Trends in food intake: The 1987 and 1992 National Health Interview Surveys. *Nutr Cancer*. 1997;28(1):86-92.
19. Mayer-Davis EJ, Sparks KC, Hirst K, Costacou T, Lovejoy J, Regensteiner JG. Dietary intake in the Diabetes Prevention Program cohort: Baseline and 1-year post-randomization. *Ann Epidemiol*. 2004;14(10):763-772.
20. Vitolins MZ, Anderson AM, Delahanty L, et al. Action for Health in Diabetes (Look AHEAD) trial: Baseline evaluation of selected nutrients and food group intake. *J Am Diet Assoc*. 2009;109(8):1367-1375.
21. Hill RJ, Davies PS. The validity of self-reported energy intake as determined using doubly labeled water technique. *Br J Nutr*. 2011;85(4):415-430.
22. Block G, Murphy M, Roullet J, Wakimoto P, Crawford P, Block T. Pilot validation of a FFQ for children 8-10 years. Paper presented at: Fourth International Conference on Dietary Assessment Methods; September 17, 2000; Tucson, AZ.
23. Cullen KW, Watson K, Zakeri I. Relative reliability and validity of the Block Kids Questionnaire among youth aged 10-17 years. *J Am Diet Assoc*. 2008;108(5):862-866.
24. Liese AD, D'Agostino Jr RB, Hamman RF, et al. The burden of diabetes mellitus among US youth: Prevalence estimates from the SEARCH for Diabetes in Youth Study. *Pediatrics*. 2006;118(4):1510-1518.
25. Lichtenstein AH, Appel LJ, Brands M, et al. Diet and lifestyle rcommendations revision 2006: A scientific statement from the American Heart Association Nutrition Committee. *Circulation* 2006;114(1):82-96.
26. Nutrition and overweight. In: *Healthy People 2010*. 2nd ed. Washington, DC: US Government Printing Office; 2000:19-1-19-44.
27. The *Surgeon General's Report on Nutrition and Health*. Washington, DC: US Public Service, Office of the Surgeon General:1988.
28. Sandler RB, Slemenda CW, Laporte RE, et al. Postmenopausal bone density and milk consumption in childhood and adlolescence. *Am J Clin Nutr*. 1985;42(2):270-274.
29. Aatola H, Koivistoinen T, Hutri-Kähönen N, et al. Lifetime fruit and vegetable consumption and arterial pulse wave velocity in adulthood: The Cardiovascular Risk in Young Finns Study. *Circulation*. 2010;122(24):2521-2528.

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STATEMENT OF POTENTIAL CONFLICT OF INTEREST

Dr Copeland is on the National Advisory Committee and a consultant with Honoraria to Novo Nordisk and Daiichi Sankyo Inc; Dr Kelsey is an investigator for type 2 diabetes sponsored by Daichii Sankyo, Bristol-Myers Squibb, and Merck; Ms Milaszewski is a consultant for Medtronic insulin pumps; the other authors have indicated they have no financial relationships relevant to this article to disclose.

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