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Dietary Intake Modification in Response to Participation in a Resistance Training Program for Sedentary Older Adults with Prediabetes: Findings from the Resist Diabetes Study

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Abstract

Engagement in one type of health behavior change may exert a “spillover” effect resulting in other behavior changes. Few studies have examined dietary intake following prolonged training, and none have evaluated spontaneous dietary changes beyond alterations in energy or macronutrient intake following initiation of strength/resistance training (RT). The purpose of this observational investigation was to determine if spontaneous dietary intake modifications occur in response to initiation of an RT program, among older adults. Previously sedentary adults with prediabetes (n=

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Author Disclosures

Statement 3: Conflict of Interest

The authors do not have conflicts of interest relevant to this article to disclose.

Contributors

Brenda Davy, Richard Winett and Jyoti Savla were all involved in the original design of the Resist Diabetes study and responsible for obtaining funding. Tanya Halliday and Brenda Davy designed the current study. Tanya Halliday, Adrienne Clark, Mary Elizabeth Baugh, Valisa Hedrick, Elaina Marinik, and Kyle Flack were involved in the data collection. Sheila Winett is responsible for the study website development and maintenance, and data management. Tanya Halliday, Jyoti Savla and Brenda Davy analyzed the data. Tanya Halliday, Brenda Davy, and Richard Winett developed the manuscript. All authors contributed to and have approved the final version of the manuscript.

134, age = 59±1 yrs) were enrolled in a supervised 12-week RT program. Participants were not given dietary advice or encouraged to change eating behaviors. Three non-consecutive 24-hour dietary recalls were collected at baseline and after 12 weeks of RT. Reductions in intake of energy (1914 ± 40 kcal vs. 1834 ± 427 kcal, $p=0.010$), carbohydrate (211.6 ± 4.9 g vs. 201.7 ± 5.2 g, $p=0.015$), total sugar (87.4 ± 2.7 g vs. 81.5 ± 3.1 g, $p=0.030$), glycemic load (113.4 ± 3.0 vs. 108.1 ± 3.2 , $p=0.031$), fruits and vegetables (4.6 ± 0.2 servings vs. 4.1 ± 0.2 servings, $p=0.018$), and sweets and desserts (1.1 ± 0.07 servings vs. 0.89 ± 0.07 servings, $p=0.023$) were detected over time. No changes in other dietary intake variables were observed. Mode of exercise and disease state may be important factors in determining whether dietary modifications occur with exercise initiation, among previously sedentary adults. Successful initiation of RT may represent an opportunity for health care professionals to promote beneficial changes in dietary habits, among older adults with prediabetes.

Keywords

dietary modification; resistance training; prediabetes; behavior change

1. Introduction

Less than 20% of middle-aged and older adults meet national physical activity and dietary guidelines (US Department of Health and Human Services, 2008, 2011a, 2011b), yet optimal strategies for behavior change remain uncertain. Engagement in one type of health-related behavior (e.g. exercise) may exert a “spillover” effect resulting in changes to another (e.g. diet) (Mata et al., 2009). Additionally exercise may influence dietary intake by altering gut peptides that influence appetite and satiety (Broom et al., 2009; Martins et al., 2008; Sim et al., 2013). Although findings are conflicting, aerobic exercise generally reduces appetite and/or energy intake while resistance training (RT) does not (Avila et al., 2010; Bales et al., 2012; Broom et al., 2009).

To date, most investigations have focused on the influence of an acute exercise bout on reported hunger/satiety and alterations in gut peptides, rather than longer term trials with comprehensive analyses of dietary intake. The few studies which have examined dietary intake following prolonged (10+ weeks) RT have not evaluated dietary changes beyond energy or macronutrient intake (Avila et al., 2010; Bales et al., 2012). Due to the importance of consuming specific nutrients, food components and food groups for optimal health and disease prevention (Freeland-Graves & Nitzke, 2013; Johnson et al., 2009; US Department of Health and Human Services, 2011a), more comprehensive investigations are warranted.

RT is recommended for the treatment and prevention of type 2 diabetes (American Diabetes Association, 2013; Grontved et al., 2012), yet, only 13.7% of older US adults regularly engage in RT (Kruger et al., 2007). Exercise in general may be a more challenging behavior to adopt compared to dietary changes, particularly when dietary change is already underway (King et al., 2013), and it is possible that successful adoption of an exercise program first may increase self-efficacy for other beneficial lifestyle changes, such as improving dietary habits (King et al., 2013; Mata et al., 2009). The purpose of this observational trial was to

determine if sedentary, overweight individuals with prediabetes who complete an intervention targeting a single health behavior, initiating RT, spontaneously alter their dietary intake.

2. Methods and Materials

2.1 Participants

This investigation utilized data from the “Resist Diabetes” clinical trial in which participants engaged in a supervised 12-week RT program, but were not provided with personalized dietary advice or recommendations to alter eating habits. Overweight/obese (BMI 25 – 39.9 kg/m²), middle-aged and older (50–69 years), weight-stable ($\pm$ 2kg in past year), sedentary or minimally active (i.e., <120 min/week of moderate intensity physical activity) adults with prediabetes (impaired fasting glucose $\geq$ 95 and <126 mg/dl and/or impaired glucose tolerance 140 and <200 mg/dl) (Genuth et al., 2003; Knowler et al., 2002; Perreault et al., 2009) were eligible. The Virginia Tech Institutional Review Board approved the study protocol and participants provided written informed consent prior to enrollment.

2.2 Measurements and Resistance Training Protocol

Detailed methods for the “Resist Diabetes” trial are published elsewhere (Marinik et al., 2013). The current analysis utilized dietary intake and anthropometric results from baseline and week 12 (post intervention initiation). Baseline dietary intake was assessed during the two-week period following initial eligibility screening for prediabetes status, and after 12 weeks of RT, using the average of three multiple-pass 24-hr recalls collected on non-consecutive days (one weekend day included) by trained research dietitians/technicians. This method is able to determine energy intake to within 8–10% of actual energy intake (Conway et al., 2004; Conway et al., 2003). To exclude potential under-reporters, participants (n=25) that reported an energy intake <80% of estimated resting metabolic rate (Mifflin-St.Joer equation (Weijs, 2008)) were excluded from final analysis.

Average daily servings using recommendations from the USDA (US Department of Health and Human Services, 2005) (when available) or FDA (US Food and Drug Administration, 2009) of specific food groups were calculated for: drinking water; no/low-calorie beverages; sugar-sweetened beverages; fruits and vegetables (FV); FV excluding juices; savory snacks; high/medium-fat meats; and sweets/desserts. Recommendations from the Dietary Guidelines for Americans 2005 and the USDA Food Guide Pyramid guided decisions regarding the inclusion of foods within the NDSR NCC Food Group Serving Count System (*NDSR User Manual*, 2010).

Participant’s height and weight were determined without shoes, in light clothing to the nearest 0.1 cm and 0.1 kg, respectively using a wall-mounted stadiometer and a digital scale. Body fat percent, fat mass (FM) and fat-free mass (FFM) were assessed using dual energy X-ray absorptiometry (DXA – GE Lunar Prodigy, software version 11.40.004, Madison, WI).

Following baseline assessments, participants completed a 12-week RT program, 2 sessions per week, supervised by American College of Sports Medicine (ACSM)-certified personal

trainers. Additionally, an information packet was provided to participants, which contained their anthropometric measurements and dietary intake analysis compared to national dietary reference intakes (DRI). No dietary advice or encouragement to alter eating behaviors was given.

2.3 Statistical analyses

Statistical analyses (SPSS v. 12.0, SPSS Inc, Chicago, IL) included descriptive statistics, paired-sample t-tests to assess changes from baseline to week 12 for anthropometric and dietary variables, and independent sample t-tests to assess sex differences in mean change from baseline to week 12. Effect size was determined by calculating Cohen's d ($d = \text{paired differences mean} / \text{paired differences standard deviation}$) and conventional interpretation was utilized (Howell, 2010). Continuous data are expressed as mean $\pm$ SEM. Alpha was set at 0.05.

3. Results and Discussion

3.1 Participant Characteristics, RT Session and Recall Completion

Participants ($n=134$; age = 59.8 ± 0.5 years, 70% female, 94% white) completed 90% of sessions during the RT program. No change in body weight occurred (93.1 ± 1.2 kg vs. 93.1 ± 1.2 kg, $p=0.975$) from baseline to week 12, respectively. FM declined (40.0 ± 0.7 kg vs. 39.4 ± 0.7 kg, $p < 0.001$) and FFM increased (52.5 ± 0.9 kg vs. 53.0 ± 0.9 kg, $p=0.001$). Most participants completed all three possible dietary recalls (pre: 96%, post: 86%). Self-reported energy intake was within 8% of estimated energy needs (Mifflin-St. Joer $\times$ 1.3 activity factor) (pre: 6%, post: 10%), suggesting minimal underreporting.

3.2 Energy, Macronutrient and Food Group Intake

Table 1 summarizes energy, macronutrient, selected micronutrients and food group intake at baseline and week 12. Reductions in intake of total energy ($p=0.010$, Cohen's d effect size [d] = 0.22), carbohydrate ($p=0.015$, $d=0.21$), total sugar ($p=0.030$, $d=0.19$), glycemic load ($p=0.031$, $d=0.19$), FV excluding juices ($p=0.018$, $d=0.21$), and sweets/desserts ($p=0.023$, $d=0.20$) were observed from baseline to week 12. Although the effect size is small, reduced intake of sweets/desserts in this population following initiation of an exercise program is a beneficial dietary modification consistent with the recommendation to reduce dessert consumption in the Dietary Guidelines for Americans (DGA) 2010 (US Department of Health and Human Services, 2011a). No changes in percent of energy intake from macronutrients (carbohydrate: $43.3 \pm 0.7\%$ vs. $42.8 \pm 0.8\%$; fat: $37.0 \pm 0.6\%$ vs. $37.0 \pm 0.6\%$; protein: $17.6 \pm 0.3\%$ vs. $18.0 \pm 0.3\%$, $p>0.05$) or other dietary intake variables were observed. No sex differences ($p>0.06$) in dietary changes were noted (data not shown).

Although the reduction in FV intake is contrary to DGA 2010 recommendation for weight management, participants' intake remained within that recommended (i.e., 4 – 4.5 servings of FV for an 1,800 – 2,000 kcal eating pattern) (US Department of Health and Human Services, 2011a). Further dietary modifications, including replacement of sweets/desserts with FV could be warranted, in order to increase dietary fiber intake and reduce total fat intake to DGA 2010 recommendations (22–28g and 20–35% of total calories, respectively)

(US Department of Health and Human Services, 2011a). While speculative, it is possible that participants reduced fruit consumption based upon media coverage of research portraying fructose as harmful, without understanding the differences between amount of fructose naturally present in fruit and that present in foods as added sugars, and the amounts of fructose associated with adverse metabolic effects (Johnson et al., 2009; Ludwig, 2013).

Research is inconsistent, but accumulating evidence suggests that the glycemic response as well as the effect on blood pressure, blood lipids, and inflammation differ between added and naturally occurring sugars (Johnson et al., 2009; Ludwig, 2013; Weickert & Pfeiffer, 2008). Food labels currently do not distinguish between naturally occurring and added sugar content, making it difficult for consumers to differentiate the two. While decreases in glycemic load and total sugar intake were noted, the American Diabetes Association currently does not have specific recommendations for these dietary components for type 2 diabetes prevention, due to inconsistent and insufficient information (American Diabetes Association, 2013; Sheard et al., 2004).

These findings are contrary to previous reports that RT does not result in decreased energy intake (Avila et al., 2010; Bales et al., 2012). A similar study by Bales and colleagues of overweight/obese adults with dyslipidemia reported a reduction in total fat intake from baseline to post RT (8 months) (Bales et al., 2012). Avila and colleagues saw no significant decrease in energy intake in a group of relatively healthy overweight/obese subjects following ten weeks of RT (Avila et al., 2010). However, given their small sample size (n=15), we would suggest that their reported ~50 kcal reduction in energy intake is comparable to the ~80 kcal reduction noted in the current study and supportive of our finding that initiation of RT may cause modest decreases in energy intake. Reductions in total and saturated fat intake are components of the Therapeutic Lifestyle Change diet recommended for treatment of hyperlipidemia ("Executive Summary of The Third Report of The National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, And Treatment of High Blood Cholesterol In Adults (Adult Treatment Panel III)," 2001; Krauss et al., 2000) whereas controlled carbohydrate intake is recommended for management of type 2 diabetes (American Diabetes Association, 2013).

3.3 Strengths and Limitations

To our knowledge, this is the first investigation to include a comprehensive analysis of dietary intake changes in response to initiation of an exercise program, among previously sedentary adults. Dietary intake was collected using recommended methods (Centers for Disease Control and Prevention, 2008a, 2008b), with a high recall completion rate and low degree of potential underreporting. This investigation provides novel information on changes in food choices which may spontaneously occur in a prediabetic population, upon participation in an RT initiation program. Nevertheless, we acknowledge several limitations. This investigation was observational, lacked a control group and focused specifically on initiating RT. Thus, we cannot determine if dietary changes observed result from exercise mode, prediabetes status, and/or educational information provided in baseline feedback packets. However, most participants were aware of their prediabetes status prior to enrollment, since being at high-risk for diabetes was listed in study recruitment materials.

Additionally, participants were informed of their OGTT results (i.e., prediabetes status) the day of the assessment clinic yet food recalls were completed in the 2 weeks following the OGTT. If prediabetes diagnosis alone was an impetus for dietary modifications, they likely would have occurred in that two-week time frame, before completion of the baseline dietary records and prior to beginning RT. Thus it is unlikely that dietary changes occurring from the baseline to week 12 could be attributed to knowledge of prediabetes status, as this was communicated to participants prior to completion of the baseline dietary records. Although trained research staff collected dietary data and potential under-reporters were excluded prior to analyses, reliance on self-reported dietary intake rather than objective measures is a limitation (Johnson, 2008). However, accuracy is likely relatively high as predictable social desirability changes, such as a large increase in reported FV intake, did not occur (rather a small decrease was noted). Providing subjects with results packets following baseline testing containing their anthropometric measurements and dietary intake compared to DRIs may be sufficient to prompt some to initiate dietary behavior changes. However, dietary behavior change is a difficult process that may not occur with education alone (Petersen et al., 2013) and is unlikely to occur with the provision of passive educational materials and information (Wing et al., 2013). Finally, the duration of our initial supervised training phase does not provide information on whether changes persisted beyond 12 weeks; however future investigations should address this possibility.

Findings from this observational trial suggest a “spillover” effect of health-related behavior change may exist as successful initiation of an exercise program may result in spontaneous dietary modifications. This information may be meaningful to health professionals, as successful initiation of an RT program may represent an opportunity to encourage and support beneficial changes in dietary habits, among older, previously sedentary clients and patients with prediabetes. Future studies should investigate timing and sequence of changing health behaviors, and include assessments of changes in health behavior constructs (i.e., self-efficacy), in order to develop lifestyle intervention strategies for health promotion and disease prevention.

4. Conclusions

Previously sedentary, prediabetic individuals who completed 12 weeks of RT without receiving dietary counseling reported decreasing total energy and carbohydrate (g) intake. Reduction in FV and sweets/desserts likely explains the reduction in energy and carbohydrate intake. To the best of our knowledge, this is the first investigation to assess spontaneous dietary changes in response to RT beyond energy and macronutrient intake. Mode of exercise (aerobic vs. RT) and disease state may be important factors in determining whether dietary modifications occur with exercise initiation. Additional research assessing success of exercise programs when coupled with dietary modifications, and the timing and sequence of initiating these changes, is warranted.

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References

- American Diabetes Association. Executive summary: Standards of medical care in diabetes-- 2013. *Diabetes Care*. 2013; 36(Suppl 1):S4–S10. [PubMed: 23264424]
- Avila JJ, Gutierrez JA, Sheehy ME, Lofgren IE, Delmonico MJ. Effect of moderate intensity resistance training during weight loss on body composition and physical performance in overweight older adults. *Eur J Appl Physiol*. 2010; 109(3):517–525. [PubMed: 20169360]
- Bales CW, Hawk VH, Granville EO, Rose SB, Shields T, Bateman L, Kraus WE. Aerobic and resistance training effects on energy intake: the STRRIDE-AT/RT study. *Med Sci Sports Exerc*. 2012; 44(10):2033–2039. [PubMed: 22525775]
- Broom DR, Batterham RL, King JA, Stensel DJ. Influence of resistance and aerobic exercise on hunger, circulating levels of acylated ghrelin, and peptide YY in healthy males. *Am J Physiol Regul Integr Comp Physiol*. 2009; 296(1):R29–R35. [PubMed: 18987287]
- Centers for Disease Control and Prevention. National Health and Nutrition Examination Survey (NHANES) Phone Follow-Up Dietary Interviewer Procedures Manual. 2008a
- Centers for Disease Control and Prevention. National Health and Nutrition Examination Survey (NHANES): MEC In-Person Dietary Interviewers Procedures Manual. 2008b
- Conway JM, Ingwersen LA, Moshfegh AJ. Accuracy of dietary recall using the USDA five-step multiple-pass method in men: an observational validation study. *J Am Diet Assoc*. 2004; 104(4): 595–603. [PubMed: 15054345]
- Conway JM, Ingwersen LA, Vinyard BT, Moshfegh AJ. Effectiveness of the US Department of Agriculture 5-step multiple-pass method in assessing food intake in obese and nonobese women. *Am J Clin Nutr*. 2003; 77(5):1171–1178. [PubMed: 12716668]
- Executive Summary of The Third Report of The National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, And Treatment of High Blood Cholesterol In Adults (Adult Treatment Panel III). *JAMA*. 2001; 285(19):2486–2497. [PubMed: 11368702]
- Freeland-Graves JH, Nitzke S. Position of the academy of nutrition and dietetics: total diet approach to healthy eating. *J Acad Nutr Diet*. 2013; 113(2):307–317. [PubMed: 23351634]
- Genuth S, Alberti KG, Bennett P, Buse J, Defronzo R, Kahn R, Zimmet P. Follow-up report on the diagnosis of diabetes mellitus. *Diabetes Care*. 2003; 26(11):3160–3167. [PubMed: 14578255]
- Grontved A, Rimm EB, Willett WC, Andersen LB, Hu FB. A prospective study of weight training and risk of type 2 diabetes mellitus in men. *Arch Intern Med*. 2012; 172(17):1306–1312. [PubMed: 22868691]
- Howell, David C. *Statistical Methods for Psychology*. Wadsworth: Cengage Learning; 2010.
- Johnson RK, Appel LJ, Brands M, Howard BV, Lefevre M, Lustig RH, Wylie-Rosett J. Dietary sugars intake and cardiovascular health: a scientific statement from the American Heart Association. *Circulation*. 2009; 120(11):1011–1020. [PubMed: 19704096]
- Johnson, Rachel K. Dietary Assessment and Validity. In: Monsen, ER.; Van Horn, L., editors. *Research: Successful Approaches*. 3rd ed. American Dietetics Association; 2008.
- King AC, Castro CM, Buman MP, Hekler EB, Urizar GG Jr, Ahn DK. Behavioral Impacts of Sequentially versus Simultaneously Delivered Dietary Plus Physical Activity Interventions: the CALM Trial. *Ann Behav Med*. 2013
- Knowler WC, Barrett-Connor E, Fowler SE, Hamman RF, Lachin JM, Walker EA, Nathan DM. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med*. 2002; 346(6):393–403. [PubMed: 11832527]
- Krauss RM, Eckel RH, Howard B, Appel LJ, Daniels SR, Deckelbaum RJ, Bazzarre TL. AHA Dietary Guidelines: revision 2000: A statement for healthcare professionals from the Nutrition Committee of the American Heart Association. *Circulation*. 2000; 102(18):2284–2299. [PubMed: 11056107]
- Kruger J, Carlson SA, Buchner D. How active are older Americans? *Prev Chronic Dis*. 2007; 4(3):A53. [PubMed: 17572957]
- Ludwig DS. Examining the health effects of fructose. *JAMA*. 2013; 310(1):33–34. [PubMed: 23732692]

- Marinik EL, Kelleher S, Savla JT, Winett RA, Davy BM. The Resist Diabetes trial: Rationale, design, and methods of a hybrid efficacy/effectiveness intervention trial for resistance training maintenance to improve glucose homeostasis in older prediabetic adults. *Contemp Clin Trials*. 2013
- Martins C, Morgan L, Truby H. A review of the effects of exercise on appetite regulation: an obesity perspective. *Int J Obes (Lond)*. 2008; 32(9):1337–1347. [PubMed: 18607378]
- Mata J, Silva MN, Vieira PN, Carraca EV, Andrade AM, Coutinho SR, Teixeira PJ. Motivational "spill-over" during weight control: increased self-determination and exercise intrinsic motivation predict eating self-regulation. *Health Psychol*. 2009; 28(6):709–716. [PubMed: 19916639]
- NDSR User Manual. University of Minnesota; 2010.
- Perreault L, Kahn SE, Christophi CA, Knowler WC, Hamman RF. Regression from pre-diabetes to normal glucose regulation in the diabetes prevention program. *Diabetes Care*. 2009; 32(9):1583–1588. [PubMed: 19587364]
- Petersen KS, Torpy DJ, Chapman IM, Guha S, Clifton PM, Turner K, Keogh JB. Food label education does not reduce sodium intake in people with type 2 diabetes mellitus. A randomised controlled trial. *Appetite*. 2013; 68:147–151. [PubMed: 23665299]
- Sheard NF, Clark NG, Brand-Miller JC, Franz MJ, Pi-Sunyer FX, Mayer-Davis E, Geil P. Dietary carbohydrate (amount and type) in the prevention and management of diabetes: a statement by the american diabetes association. *Diabetes Care*. 2004; 27(9):2266–2271. [PubMed: 15333500]
- Sim AY, Wallman KE, Fairchild TJ, Guelfi KJ. High-intensity intermittent exercise attenuates ad-libitum energy intake. *Int J Obes (Lond)*. 2013
- US Department of Health and Human Services. Dietary Guidelines for Americans, 2005. 2005 Retrieved from USDA, Dietary Guidelines for Americans 2005.
- US Department of Health and Human Services. 2008 Physical Activity Guidelines for Americans. 2008. Retrieved from <http://www.health.gov/paguidelines/guidelines/default.aspx>.
- US Department of Health and Human Services. Dietary Guidelines for Americans. 2011a. Retrieved from <http://www.health.gov/dietaryguidelines/2010.asp>.
- US Department of Health and Human Services. Healthy People 2010 Final Review. 2011b. Retrieved from http://www.cdc.gov/nchs/data/hpdata2010/hp2010_final_review.pdf.
- US Food and Drug Administration. Guidance for Industry: A Food Labeling Guide. 2009. Retrieved from <http://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/LabelingNutrition/ucm2006828.htm>.
- Weickert MO, Pfeiffer AF. Metabolic effects of dietary fiber consumption and prevention of diabetes. *J Nutr*. 2008; 138(3):439–442. [PubMed: 18287346]
- Weijs PJ. Validity of predictive equations for resting energy expenditure in US and Dutch overweight and obese class I and II adults aged 18– 65 y. *Am J Clin Nutr*. 2008; 88(4):959–970. [PubMed: 18842782]
- Wing RR, Bolin P, Brancati FL, Bray GA, Clark JM, Coday M, Yanovski SZ. Cardiovascular effects of intensive lifestyle intervention in type 2 diabetes. *N Engl J Med*. 2013; 369(2):145–154. [PubMed: 23796131]

Highlights

- We assessed dietary changes among adults with prediabetes, after strength training.
- A resistance training program was initiated; nutrition counseling was not provided.
- Participants decreased energy, carbohydrate and total sugar intake.
- Reduced consumption of fruits/vegetables and sweets/desserts was also noted.

Table 1

Reported energy, macronutrient, micronutrient and food group intake at baseline and after 12 weeks of supervised resistance training among previously sedentary, older, prediabetic adults

	Baseline	Week 12
Total energy, Kcal *	1,914 ± 40	1,834 ± 37
Energy density, Kcal/g	0.7 ± 0.02	0.7 ± 0.02
Macronutrients		
Carbohydrates, g *	211.6 ± 4.9	201.7 ± 5.2
Total sugar, g *	87.4 ± 2.7	81.5 ± 3.1
Added sugar, g	56.7 ± 2.6	52.3 ± 2.7
Total fiber, g	19.2 ± 0.6	18.3 ± 0.6
Fat, g	81.9 ± 2.5	77.9 ± 2.0
Saturated fat, g	27.2 ± 0.8	25.4 ± 0.8
Monounsaturated fat, g	29.9 ± 1.1	28.6 ± 0.9
Polyunsaturated fat, g	18.3 ± 0.7	17.4 ± 0.2
Trans fat, g	3.2 ± 0.2	2.9 ± 0.1
Protein, g	81.8 ± 2.0	79.9 ± 1.8
Animal protein, g	56.2 ± 1.7	54.5 ± 1.6
Vegetable protein, g	25.6 ± 0.8	25.4 ± 0.8
Alcohol, g	6.2 ± 1.0	6.3 ± 1.1
Micronutrients		
Calcium, mg	815 ± 22	781 ± 22
Iron, mg	14.7 ± 0.4	13.8 ± 0.4
sodium, mg	3,364 ± 86.1	3,317 ± 84
Vitamin A, IU	7,261 ± 395	7,351 ± 492
Vitamin B ₁₂ , mcg	4.8 ± 0.2	4.7 ± 0.2
Vitamin C, mg	78.1 ± 4.1	75.8 ± 3.9
Vitamin E, Iu	14.0 ± 0.7	13.5 ± 0.7
Food Group Servings		
Drinking water, servings	3.7 ± 0.2	3.8 ± 0.2
No-and low-calorie beverages, servings	6.7 ± 0.3	6.7 ± 0.2
Sugar sweetened beverages, servings	0.5 ± 0.07	0.6 ± 0.08
Total fruits and vegetables, servings	4.9 ± 0.19	4.5 ± 0.2
Fruits and vegetables excluding juices, servings *	4.6 ± 0.2	4.1 ± 0.2
Savory snacks, servings	0.14 ± 0.03	0.14 ± 0.03
High-and medium-fat meats, servings	2.2 ± 0.16	2.3 ± 0.15
Sweets and desserts *	1.1 ± 0.07	0.89 ± 0.07

* Significant change from Baseline to week 12, p<0.05