

Amount of Food Group Variety Consumed in the Diet and Long-Term Weight Loss Maintenance

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Abstract

Objective: Decreases in variety of foods consumed within high-fat-dense food groups and increases in variety of foods consumed within low-fat-dense food groups are associated with lower energy intake and greater weight loss during obesity treatment and may assist with weight loss maintenance. This study examined food group variety in 2237 weight loss maintainers in the National Weight Control Registry, who had lost 32.2 ± 18.0 kg (70.9 ± 39.5 lbs) and maintained a weight loss of at least 13.6 kg (30 lbs) for 6.1 ± 7.7 years.

Research Methods and Procedures: At entry into the registry, registry members completed a food frequency questionnaire from which amount of variety consumed from different food groups was assessed. To provide a context for interpreting the level of variety occurring in the diet of registry participants, food group variety was compared between registry participants and 96 individuals who had recently participated in a behavioral weight loss program and had lost at least 7% of initial body weight.

Results: Registry members reported consuming a diet with very low variety in all food groups, especially in those food

groups higher in fat density. Registry participants consumed significantly ($p < 0.001$) less variety within all food groups, except fruit and combination foods, than recent weight losers after 6 months of weight loss treatment.

Discussion: These results suggest that successful weight loss maintainers consume a diet with limited variety in all food groups. Restricting variety within all food groups may help with consuming a low-energy diet and maintaining long-term weight loss.

Key words: diet, variety, food group, weight loss maintenance, fat density

Introduction

Due to the current obesity epidemic in the United States (1), improving outcomes for weight reduction and weight loss maintenance has become of paramount importance (2,3). Although weight loss occurs in many obese individuals, most weight loss is not maintained (3,4). Concern about weight loss maintenance has led to investigations identifying strategies used by long-term weight loss maintainers (2,5). The National Weight Control Registry, established in 1994, is the largest ongoing observational study examining proven weight loss maintainers (6). To enter the registry, participants must have maintained a weight loss of ≥ 13.6 kg (30 lb) for ≥ 1 year.

Information from the registry has identified three factors used by these successful weight loss maintainers. First, registry participants report consuming a low-energy, low-fat (LF),¹ high-carbohydrate diet (7) and regularly consuming breakfast (3). Additionally, registry participants describe engaging in high levels of regular physical activity, approx-

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¹ Nonstandard abbreviations: LF, low fat; HF, high fat; FGP, Food Guide Pyramid; HHHQ, Health Habits and History Questionnaire; FFQ, food frequency questionnaire; LFB, LF bread, cereal, rice, and pasta; LFV, LF vegetables; LFM, LF meat, poultry, fish, dry beans, eggs, and nuts; HFF, HF foods from the five main groups of the FGP; FOS, fats, oils, and sweets.

imately 1 hour of moderately intense physical activity per day, during their weight loss and maintenance periods (6). Finally, over 75% of registry members report weighing themselves at least once a week (8).

Another dietary factor that may be related to successful weight loss maintenance is the amount of variety consumed from different food groups. Although experimental animal studies show that greater variety, particularly from energy-dense, highly palatable foods, is associated with increased consumption, body weight, and/or body fat (for review, see 9), there has been very little research on the effects of dietary variety consumed over an extended time on energy intake and weight status in humans. As with animals, food type may be an important variable in the relationship among dietary variety, energy intake, and body weight/fat in humans (10,11). Greater variety consumed within high-fat (HF)-dense food groups may increase overall energy intake more so than increased variety consumed within LF-dense food groups. Human cross-sectional data do provide support for this hypothesis; a diet with greater variety in HF-dense food groups (e.g., sweets, snacks, and carbohydrates) and with limited variety in LF-dense food groups (e.g., vegetables) was related to increased energy intake and body fat (12).

A diet consisting of less variety within HF-dense food groups may help reduce overall intake, assisting in weight loss and/or weight loss maintenance. Previously, we examined the relationship between changes in food group variety consumed and weight loss among participants in a behavioral weight loss program who were prescribed a low-energy, LF diet. These participants reported an increase in consumption of variety in LF-dense food groups (e.g., LF breads, LF vegetables) and a decrease in consumption of variety in HF-dense food groups [e.g., HF foods; fats, oils, and sweets from the Food Guide Pyramid (FGP) (13)] during treatment (14). Moreover, greater increases in consumption of variety in LF breads and decreases in consumption of variety in HF foods were related to larger decreases in energy intake and percentage energy from fat, and better weight loss at 18-month follow-up.

The purpose of this investigation was to describe the level of food group variety occurring in the diets of registry participants, who are proven weight loss maintainers. We hypothesized that food group variety consumed, particularly within HF-dense food groups, would be limited in registry participants, thereby helping them to maintain a lower energy intake and aiding in long-term weight loss maintenance. Next, to provide a context for interpreting the level of variety occurring in the diet of registry participants, we contrasted food group variety consumed in registry participants with food group variety consumed in recent weight losers, participants who had lost 7% or more body weight by the end of a weight loss intervention. Although these recent weight losers had lost a significant amount of weight during

treatment (15), they were not yet proven in long-term weight loss maintenance. It was hypothesized that registry participants would consume less variety within HF-dense food groups (e.g., HF foods; fats, oils, and sweets) and greater variety within LF-dense food groups (e.g., LF vegetables) than recent weight losers.

Research Methods and Procedures

Participants

Informed consent was obtained from all participants. The Institutional Review Boards of the University of Minnesota and Miriam Hospital approved this research.

Registry Participants

Registry participants were recruited predominantly through local and national media coverage of the registry. Complete demographic information, weight history, and baseline self-reported height and weight and dietary measures were collected from 2280 registry members. Of these participants, 2177 (95.5%) were white, and 1807 (79.3%) were women. To be eligible for the registry, participants needed to be ≥ 18 years of age, have lost ≥ 13.6 kg (30 lb), and maintained the weight loss for ≥ 1 year.

Recent Weight Losers

Recent weight losers were participants recruited for weight loss treatment by public advertisements by two institutions, the University of Minnesota School of Public Health and Brown Medical School/The Miriam Hospital. On signing consent forms, 202 participants were randomized into one of two standard behavioral weight loss interventions. The two interventions had identical dietary goals, 4184 to 6276 kJ/d (1000 to 1500 kcal/d) with $<20\%$ energy from fat, but had differing physical activity prescriptions [4184 kJ/wk (1000 kcal/wk) or 10,460 kJ/wk (2500 kcal/wk)]. Treatment meetings were held weekly during the first 6 months of treatment and were led by interventionists trained in behavioral therapy. Results from this full investigation have been previously published (16).

At the end of 6 months of weekly treatment, 97 of these participants had lost at least 7% of their initial weight, had complete dietary data at 6 months, and were included in this analysis as recent weight losers (15). Of the 97 successful weight losers, 88 (90.7%) were white, and 52 (53.6%) were women, with a mean age of 41.7 ± 5.9 years, mean weight loss of 13.4 ± 5.0 kg (29.5 ± 10.9 lbs), and a mean BMI of 26.7 ± 2.3 kg/m² after 6 months of the weight loss intervention.

Design and Procedures

Registry participants were compared with recent weight losers, with evaluations made between entry into the registry measures of registry participants and baseline and

6-month measures of recent weight losers. The primary dependent variables in these analyses were percentage variety consumed in seven food groups.

Measures

Demographic and Weight Information. At baseline, all participants provided basic demographic information (e.g., age, education level, ethnicity, gender, and marital status). In addition, registry participants completed a questionnaire reporting their lifetime maximum adult weight, total weight loss, current weight and height, and dates at each weight so that duration of weight loss of ≥ 13.6 kg could be calculated. BMI (kilograms per meter squared) was calculated from this information. For the recent weight losers, weight (baseline and 6 months) and height (baseline) were measured using standard procedures. BMI was computed from this information. Each participant's weight change from baseline to 6 months was calculated, and those participants who had lost at least 7% of their initial weight were classified as recent weight losers (15).

Dietary Intake. Dietary intake was assessed at entry in registry participants using the scannable Health Habits and History Questionnaire (HHHQ) (17), a self-administered, 97-item, semiquantitative food frequency questionnaire (FFQ). The recent weight loser's diet was assessed at baseline and 6 months using the 60-item version of the same food frequency questionnaire. Items from the longer version that contribute least to population nutrient intake, according to data from the National Health and Nutrition Examination Survey II (18,19), are excluded in the shorter version of the questionnaire. The different versions of the FFQ, long and short, correlate very highly, from 0.90 to 0.99, for energy and macronutrients consumed (20). To compare food group variety consumed between registry participants and recent weight losers, only food items contained on both versions of the FFQs were counted.

The questionnaire asks about normal intake of various foods eaten, with frequency of consumption ranging from never to more than two times a day and portion sizes categorized as small, medium, or large. The HHHQ has been validated in many different populations (21–25). Registry participants were asked to indicate frequency of consumption of food items on the questionnaire during the last 12 months, whereas recent successful weight losers indicated frequency of consumption over the last 6 months. Energy and macronutrient content of the diet were calculated using the Block nutrition analysis program (HHHQ-DIETSYS Analysis Software, version 3, 1993; National Cancer Institute, Bethesda, MD) (26).

Assessment of Food Group Variety. As in a previous study (14), food group variety consumed was defined as the percentage of food items consumed in a food group on at least a weekly basis. To assess food group variety con-

sumed, foods from the HHHQ were divided into food groups, based on the food grouping classification of the FGP (13) and on the fat density (LF food groups containing items with $<30\%$ energy from fat, and HF food groups containing items with $\geq 30\%$ energy from fat or ≥ 8 grams fat/oz of meat). Seven food groups were established: LF bread, cereal, rice, and pasta (LFB), which contained seven items; fruits, which contained six items; LF vegetables (LFV), which contained eight items; LF meat, poultry, fish, dry beans, eggs, and nuts (LFM), which contained seven items; HF foods from the five main groups of the FGP (13) (HFF), which contained 14 items; fats, oils, and sweets (FOS), which contained nine items; and combination foods, which contained four items. The seven food groups and the foods items within each group are listed in Table 1.

Some items from the questionnaire were not included in the food groups. These items included calorie-free items (e.g., water, coffee, lemon in tea) and alcohol. Alcohol items were not included due to their difference in habitual usage and the limited number of items (12), which reduced the variability that could occur in this group. Additionally, skim milk was not included in any food group; with the removal of HF items from the milk, yogurt, and cheese group, only one LF item, skim milk, remained, and variety consumed could not be calculated.

Variety consumed within each food group was expressed as a percentage, calculated as the number of different food items within a food group that were consumed on at least a weekly basis out of the total number of food items within the food group. Scores for food group variety ranged from 0 to 100, with higher scores reflecting greater variety consumed. Similar to prior studies of dietary variety, serving size information was not included in the calculations (12,14,27). This allowed the calculation to emphasize the number of different food items consumed, rather than the quantity of food consumed.

Due to potential problems of underreporting dietary intake, participants reporting less than a daily caloric intake of 2092 kJ/d (500 kcal/d) at any measurement were excluded from the analyses (registry participants, $n = 30$; recent successful weight losers, $n = 1$). Although participants from both groups may be continuing to lose weight and, thus, may have an energy intake below energy requirements, even those participants reducing energy intake for continued weight loss reporting a daily intake below 2092 kJ/d during the previous year would most likely indicate severe underreporting of intake (28,29), which may also cause underreporting of dietary variety consumed. Additionally, outliers in the sample overreporting caloric intake (>3 SD above the mean) at any measure were excluded from the analyses (registry participants, $n = 13$) due to potential overreporting of dietary variety consumed. This left a sample size of 2237 registry participants and 96 recent weight losers.

Table 1. Food groups from the HHHQ

1. LF bread, cereal, rice, and pasta
High-fiber cereals; highly fortified cereals; other cold cereals; cooked cereal or grits; rice; white bread (including sandwiches, bagels, etc., crackers); and dark bread, including whole wheat, rye, pumpernickel
2. Fruits
Apples, applesauce, pears; cantaloupe (in season); oranges; grapefruit; orange juice or grapefruit juice; and other fruit juices, fortified fruit drinks
3. LF vegetables
Tomatoes, tomato juice; broccoli; spinach; mustard greens, turnip greens, collards; carrots, or mixed vegetables containing carrots; green salad; sweet potatoes, yams; and other potatoes, including boiled, baked, mashed, and potato salad
4. LF meat, poultry, fish, dry beans, eggs, and nuts
Eggs; beans, such as baked beans, pintos, kidney, limas, or in chili; beef (steaks, roasts); liver, including chicken livers; pork, including chops, roasts; chicken or turkey (roasted, stewed, or broiled); and other fish (baked or boiled)
5. HF foods from the five main food groups of the FGP
Corn bread, corn muffins, corn tortillas; doughnuts, cookies, cake, pastry; pies; french fries and fried potatoes; cheeses and cheese spreads, not including cottage cheese; ice cream; whole milk and beverages with whole milk; 2% milk and beverages with 2% milk; sausage; fried chicken; fried fish or fish sandwich; hot dogs and ham, lunch meats; peanuts, peanut butter
6. Fats, oils, and sweets
Bacon; sugar in coffee or tea or on cereal; regular salad dressing and mayonnaise, including on sandwiches; butter on bread or rolls; margarine on bread or rolls; salty snacks (such as chips, popcorn); chocolate candy; regular soft drinks; and milk or cream in coffee or tea
7. Combination foods
Hamburgers, cheeseburgers, meat loaf; beef stew or pot pie with carrots or other vegetables; spaghetti, lasagna, other pasta with tomato sauce; and vegetable soup

LF food groups have food items with <30% energy from fat, whereas HF food groups have $\geq 30\%$ energy from fat or ≥ 8 g fat/oz of meat. In the HHHQ, a few of the grouped items are different in terms of fat composition (e.g., other potatoes, including boiled, baked, mashed, and potato salad), a component used in differentiating food groups. HHHQ, Health Habits and History Questionnaire.

Data Analysis

Independent Student's *t* tests, comparing registry participants with recent weight losers (baseline and 6 months), examined differences between the groups on continuous baseline characteristics. Differences in categorical variables (e.g., education level, marital status, and sex) were analyzed by the χ^2 test of independence.

Food group variety consumed by registry participants was compared with variety consumed by recent weight losers at baseline and 6 months using analyses of covariance using the GLM univariate procedure in SPSS, which tests both balanced and unbalanced models (30). Covariates in the analyses were those variables that were significantly different between the groups and related to the primary dependent variables. Finally, Pearson product-moment correlations were conducted to explore the relationship between food group variety consumed and energy intake and percentage energy from fat in registry participants.

Results

Participant Characteristics

Characteristics of registry participants ($n = 2237$) are presented in Table 2. At entry into the registry, participants' mean age was 46.1 ± 12.3 years, with a baseline BMI of 24.9 ± 4.7 kg/m². These individuals were clearly successful weight loss maintainers; they had a mean weight loss of 32.2 ± 18.0 kg (70.9 ± 39.5 lbs), with a weight loss of ≥ 13.6 kg maintained for 6.1 ± 7.7 years.

Table 2 also compares registry participants to the recent weight losers ($n = 96$) before and after 6 months of treatment. Registry participants were significantly older ($p < 0.001$) and were more predominantly white ($p < 0.05$) and female ($p < 0.001$) than recent weight losers. As expected, compared with recent weight losers before treatment, registry participants consumed significantly ($p < 0.001$) less energy and percentage dietary fat and significantly more ($p < 0.001$) percent carbohydrate and protein. However, after treatment, there were no significant differences in energy intake and percentage energy from carbohydrate, protein, and fat between the two groups. Before and after treatment, recent weight losers had a significantly higher ($p < 0.001$) BMI (31.3 ± 2.3 at baseline and 26.7 ± 2.3 at 6 months) than registry participants (24.9 ± 4.6). Of the variables that were different between registry participants and recent weight losers, age; BMI; energy and percentage energy from carbohydrate, protein, and fat consumed (used only in comparisons of registry participants with recent weight losers before treatment); and sex were also significantly related to food group variety consumed and, consequently, were used as covariates in analyses of intake of food group variety.

Table 2. Baseline characteristics of registry participants and characteristics of recent weight losers before and after a weight loss intervention (mean \pm SD)

	Registry participants (<i>n</i> = 2237)	Recent weight losers (<i>n</i> = 96)		Comparisons (<i>p</i>)	
		Before	After	R-before	R-after
Age (years)	46.1 \pm 12.3	41.6 \pm 5.9		<0.001	
Sex (women/men)	1776/461	52/44		<0.001	
Weight (lbs)	155.3 \pm 32.9	201.5 \pm 22.3	172.1 \pm 20.6	<0.001	<0.001
BMI (kg/m ²)	24.9 \pm 4.6	31.3 \pm 2.3	26.7 \pm 2.3	<0.001	<0.001
Energy intake (kJ)	5853 \pm 2146	8556 \pm 2113	5996 \pm 1849	<0.001	NS
Energy intake from fat (%)	25.9 \pm 9.5	36.1 \pm 6.5	27.1 \pm 6.2	<0.001	NS
Energy intake from carbohydrate (%)	54.1 \pm 10.7	45.2 \pm 6.7	52.8 \pm 7.7	<0.001	NS
energy intake from protein (%)	18.4 \pm 4.0	16.9 \pm 2.4	19.0 \pm 3.2	<0.001	NS

R-before, registry vs. recent weight losers before treatment; R-after, registry vs. recent weight losers after treatment; NS, no significance.

Dietary Intake

Registry participants reported consuming from 12.0 \pm 10.8% (HFF) to 46.7 \pm 27.3% (fruits) of the foods within a food group, with the greatest amount of variety occurring in the food groups at the bottom of the FGP (13) (see Table 3 for food group variety in registry participants). Registry participants were also divided into three categories to evaluate whether length of weight loss maintenance influenced food group variety consumed at entry into the registry. The categories were weight loss maintenance of \leq 2 years (*n* = 778), $>$ 2 and \leq 4 years (*n* = 614), and $>$ 4 years (*n* = 845). No significant difference among the groups was found (data not shown).

To give a context for food group variety consumed in the registry, food group variety was compared between registry participants and recent weight losers. Before treatment, food group variety in recent weight losers ranged from 31.8 \pm 14.1% (HFF) to 52.8% \pm 17.4 (FOS) and after treatment from 18.2 \pm 12.6% (HFF) to 57.6 \pm 21.8% (LFB) (see Table 3). As has been reported previously (14), significant changes (*p* < 0.01) in food group variety occurred during treatment, with an increase in variety consumed within LFB and LFV and a decrease in variety consumed within HFF, FOS, and combination foods. Energy intake and percentage energy from fat consumed also significantly (*p* < 0.001) decreased during treatment.

Table 3. Percentage of food items consumed in seven food groups assessed by an FFQ in registry participants and recent weight losers before and after a weight loss intervention (mean \pm SD)

	Registry participants (<i>n</i> = 2237)	Recent weight losers (<i>n</i> = 96)		Comparisons (<i>p</i>)	
		Before	After	R-before	R-after
LF bread, cereal, rice, and pasta	45.6 \pm 20.4	49.0 \pm 20.2	57.6 \pm 21.8	NS	<0.001
Fruits	46.7 \pm 27.3	48.4 \pm 26.5	49.5 \pm 23.5	NS	NS
LF vegetables	45.4 \pm 18.5	44.9 \pm 20.6	51.3 \pm 19.1	NS	<0.001
LF meat, poultry, fish, dry beans, eggs, and nuts	30.0 \pm 17.4	35.6 \pm 18.9	36.5 \pm 18.1	NS	<0.001
HF foods from the five main food groups of the FGP	12.0 \pm 10.8	31.8 \pm 14.1	18.2 \pm 12.6	<0.001	<0.001
Fats, oils, and sweets	19.1 \pm 16.4	52.8 \pm 17.4	38.5 \pm 18.2	<0.001	<0.001
Combination foods	27.1 \pm 21.5	41.9 \pm 23.6	32.6 \pm 20.3	<0.05	NS

LF food groups have food items with <30% energy from fat, whereas HF food groups have food items with \geq 30% energy from fat or \geq 8 g fat/oz of meat. Significant changes (*p* < 0.05) were found between recent weight losers before and after treatment in all food groups except fruits and LF meats. R-before, registry vs. recent weight losers before treatment; R-after, registry vs. recent weight losers after treatment; NS, no significance.

Registry participants generally consumed less variety than recent weight losers, both before and after treatment. In the comparison of registry participants with recent weight losers before treatment, after controlling for differences between the groups in demographic and dietary variables, registry participants consumed significantly less food group variety within HFF, $F(1,2324) = 109.0, p < 0.001$; FOS, $F(1,2324) = 188.0, p < 0.001$; and combination foods, $F(1,2324) = 5.4, p < 0.05$, with effect sizes (η_p^2) ranging from 0.002 (combination foods) to 0.08 (FOS). Registry participants consumed significantly less food group variety than recent weight losers after treatment, after controlling for differences in demographic variables: within LFB, $F(1,2328) = 26.8, p < 0.001$; LFV, $F(1,2328) = 14.8, p < 0.001$; LFM, $F(1,2328) = 15.0, p < 0.001$; HFF, $F(1,2328) = 21.3, p < 0.001$; and FOS, $F(1,2328) = 114.5, p < 0.001$. The effect sizes (η_p^2) ranged from 0.006 (LFV and LFM) to 0.05 (FOS). Table 3 shows percentage food group variety in the diets of registry participants and recent weight losers before and after 6 months of a standard behavioral intervention. Additionally, Figure 1 shows the pattern of percentage food group variety consumed in the LF-dense food groups, using LFV as an example, and in the HF-dense food groups, using FOS as an example, in registry participants and recent weight losers before and after treatment.

Pearson product-moment correlations indicated significant ($p < 0.001$) positive associations between percentage variety consumed in all food groups and energy intake, with correlations ranging from $r = 0.16$ (fruits) to $r = 0.36$ (HFF). LFB, LFV, and fruits had significant ($p < 0.001$) negative correlations with percentage energy from fat, ranging from $r = -0.20$ (LFV) to $r = -0.28$ (LFB), whereas all other food groups had significant ($p < 0.001$) positive associations with percentage energy from fat, ranging from $r = 0.09$ (combination foods) to $r = 0.48$ (FOS).

Discussion

This investigation examined the level of food group variety consumed within LF- and HF-dense food groups in registry members. Comparisons of food group variety in the diet were made between registry participants, proven weight loss maintainers, and weight losers who had recently lost a significant amount of weight (15), but who were unproven in weight loss maintenance. Previous research has found an association between greater variety consumed within HF-dense food groups and less variety consumed within LF-dense food groups and greater energy intake and poorer weight loss maintenance (14). Therefore, it was hypothesized that registry participants would report consuming less variety within HF-dense food groups and greater variety within LF-dense food groups than recent weight losers.

Results from this study indicate that food group variety, regardless of fat density, was lower in the diet of registry

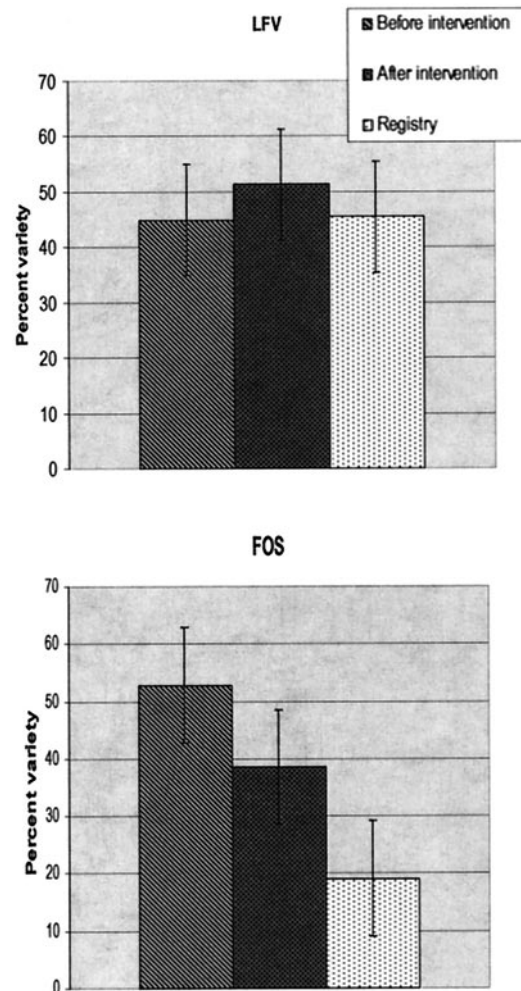


Figure 1: Percent variety consumed in an LF-dense food group (LF vegetables) and an HF-dense food group (fats, oils, and sweets) in recent weight losers before and after a standard weight loss intervention ($n = 96$) and registry participants ($n = 2237$) (mean \pm SEM).

participants than in weight losers after treatment. Although it was anticipated that variety consumed in HF-dense food groups would be lower in registry participants, the finding that variety consumed in LF-dense food groups was also lower was surprising. Previously, we have found that during obesity treatment, variety consumed in LF-dense food groups (e.g., LF breads and vegetables) increases and that increases in variety consumed within LF breads were related to better long-term weight loss maintenance (14). The finding that registry participants consumed less variety from LF-dense food groups than recent weight losers suggests that reducing overall variety in the diet may be an important strategy for long-term weight loss maintenance. In this investigation, variety consumed in all food groups was positively related to overall energy intake in registry members. The finding that overall dietary variety is related to

energy intake is also consistent with experimental animal research (9) and cross-sectional investigations with humans (12,31,32). This study suggests that reducing overall dietary variety may help maintain lower levels of energy intake, thereby aiding in long-term weight loss maintenance.

Registry participants generally report consuming a low-energy diet, with women consuming approximately 5439 kJ/d (1300 kcal/d) and men consuming approximately 7113 kJ/d (1700 kcal/d) (7). There are several strategies, including reducing portion size and energy density of the diet (10,11), which can be used to help reduce energy intake. This study also suggests that limiting dietary variety may be helpful for reducing energy intake over an extended time. Although limiting overall dietary variety may help registry participants sustain a low energy intake for long periods, it is important to observe the percentage of variety that is occurring in the different food groups to provide a sense of the types of foods that registry participants are most likely to include in their regular eating pattern. The food groups with the greatest amount of variety are the LF food groups from the bottom of the FGP (e.g., LF bread, cereals, rice, and pasta; fruits; and LF vegetables), whereas foods that are less nutrient-dense and closer to the top of the FGP have less variety (fats, oils, and sweets; and HF foods from the five main food groups). Indeed, the largest difference in food group variety between registry members and recent weight losers was found in the food group from the top of the FGP, fats, oils, and sweets (13). Therefore, although overall dietary variety is low in registry participants, they are consuming more variety in nutrient-dense and LF-dense foods than in other food groups. With respect to levels of variety consumed in the different food groups, this style of eating is in accordance with current dietary recommendations (33), including the FGP (13).

These findings suggest that a behavioral strategy that proven weight loss maintainers in the registry may use to help preserve a low-energy intake is to consume very little dietary variety. Reducing variety consumed may increase the structure of the diet, simplifying the diet, potentially making it more consistent and more boring. It has been proposed that decreased intake associated with reduced dietary variety is due to sensory-specific satiety (34). Sensory-specific satiety occurs when there is a reduction in hedonics of a food(s) being consumed (35). As the pleasantness of a food being consumed decreases, so does the ingestion of that food (9). However, if other foods with different sensory qualities are offered, eating will resume causing an overall increase in consumption (34).

A limitation of this investigation is the use of an FFQ to determine dietary variety. Due to the nature of FFQs, often foods of similar nutrient composition [e.g., white bread (including sandwiches, bagels, burger rolls, French or Italian bread)] are grouped together as one item. Consequently, an individual may have consumed more than one of these

foods, but the item is counted as one food. Therefore, it is most likely that the amount of variety consumed within this population is greater than what is currently reported. Additionally, the time frame used in the questionnaire was different for registry participants (12 months) and recent weight losers (6 months). However, it would be expected that measures of dietary intake over a longer time frame would produce greater variety consumed, especially due to seasonal influences on intake (36); consequently, the recent weight losers might have consumed more food group variety than what was reported if they had been able to use a 12-month recall time. Dietary assessment methods that provide more detailed information, such as 24-hour dietary recalls or food records, with equal time measurement frames, would allow more accurate determinations of dietary variety consumed.

Additionally, the generalization of this information to all proven weight loss maintainers is unknown. The registry sample may not be representative of individuals who have maintained reductions in weight. Finally, although the comparisons between the two groups, which differed in their length of time maintaining a significant weight loss, provide stronger evidence than cross-sectional data, a causal relationship between food group variety in the diet and weight status cannot be determined. Studies directly manipulating food group variety are needed to determine whether a causal relationship exists between dietary variety and weight status.

In conclusion, the results of this investigation suggest that successful weight loss maintainers consume a diet with limited variety in all food groups. Restricting the number of different foods, particularly fat-dense foods, in the diet may help reduce energy intake, thereby helping to sustain weight loss over a long period of time.

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