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A Dietary Quality Comparison of Popular Weight-Loss Plans

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Abstract

Popular weight-loss plans often have conflicting recommendations, which makes it difficult to determine the most healthful approach to weight loss. Our study compares the dietary quality of popular weight-loss plans. Dietary quality, measured by the Alternate Healthy Eating Index (AHEI), was calculated via sample menus provided in published media for the New Glucose Revolution, Weight Watchers, Atkins, South Beach, Zone, Ornish, and 2005 US Department of Agriculture Food Guide Pyramid (2005 Food Guide Pyramid) plans. The criterion for determining which weight-loss plans were the most popular was their status on the New York Times Bestseller list. Weight Watchers and the 2005 Food Guide Pyramid plan were included because they are the largest commercial weight-loss plan, and the current government recommendation, respectively. Analysis of variance was used to compare nutrient information among the weight-loss plans. The AHEI scores adjusted for energy content were also compared. Of a maximum possible score of 70, the AHEI scores for each weight-loss plan from the highest to the lowest plan were: Ornish (score 64.6), Weight Watchers high-carbohydrate (score 57.4), New Glucose Revolution (score 57.2), South Beach/Phase 2 (score 50.7), Zone (score 49.8), 2005 Food Guide Pyramid (score 48.7), Weight Watchers high-protein (score 47.3), Atkins/100-g carbohydrate (score 46), South Beach/Phase 3 (score 45.61, and Atkind45-g carbohydrate (score 42.3). Dietary quality varied across popular weight-loss plans. Ornish, Weight Watchers high-carbohydrate, and New Glucose Revolution weight-loss plans have an increased capacity for cardiovascular disease prevention when assessed by the AHEI.

Obesity is associated with an increased risk for cardiovascular disease (CVD) (1,2). Accompanying the steady rise in obesity during the past 3 decades is the proliferation of popular weight-loss plans. Although most of these weight-loss plans are efficacious for weight reduction in the short term (3-6), how the weight-loss plans compare in terms of dietary quality is unknown. Dietary quality has been defined as the degree to which a diet reduces risk for chronic diseases, specifically CVD (7).

The purpose of this study was to compare popular weight-loss plans' dietary quality as well as other nutrients associated with reduced CVD. Given that obesity is a risk factor for CVD, the optimal weight-loss plan will facilitate weight loss and CVD risk reduction.

MATERIALS AND METHODS

Diet Selection

Eight weight-loss plans were selected for comparison, including New Glucose Revolution, two Weight Watchers plans, Atkins, South Beach, Zone, Ornish (8-13), and the 2005 US

Department of Agriculture Food Guide Pyramid (2005 Food Guide Pyramid) (14). Weight-loss plans were selected because of their status on the New York Times Bestseller list during the past 5 years. Weight Watchers and the 2005 Food Guide plan were included because they are the largest commercial weight-loss plan, and the current government recommendation, respectively.

The New Glucose Revolution (8) endorses a low glycemic index weight-loss plan. The glycemic index ranks carbohydrates according to their effect on blood glucose levels. Glycemic index is the basis for food selection balanced with the selection of lean protein and healthful fats. The glycemic index score reflects how quickly a food raises blood sugar levels. The low-glycemic index plan is purported to facilitate satiety, and regulate blood glucose and insulin response levels, thereby reducing total energy intake.

The Weight Watchers plan involves a point system that assigns a value to each food based on energy, fat, and fiber content per serving (9). Fiber decreases the point value assigned to a particular food, whereas fat and energy increase the point value. Dieters are instructed to stay under a certain number of points, based on current weight and weight-loss goal. Weight Watchers has a higher-carbohydrate and higher-protein plan; both were included in the analysis. The focus of each plan's food selections is different, allowing for individual preferences.

The Atkins plan is a low-carbohydrate, high-fat diet, consisting of four phases. Phase 1, the induction phase, limits net carbohydrate intake (total carbohydrate minus dietary fiber and sugar alcohols) to 20 g/day. The Atkins plan refers to fiber and sugar alcohols as nonimpact carbohydrates, and thus not part of the total carbohydrate count. Phase 2 involves increasing net carbohydrate intake to 25 g/day, and each week thereafter net carbohydrate intake is increased by 5 g. When weight loss ceases, net carbohydrate intake is decreased by 5 g daily to reinstate weight loss (Phase 3). Lifetime maintenance (Phase 4) is based on the number of grams of carbohydrate needed for weight stability (45 to 100 g/day). Foods high in protein and good fats (ie, unsaturated, polyunsaturated, and monounsaturated) are recommended, although no limit is placed on intake of saturated fats (10). In our study, weight-loss plans with 45 g carbohydrate and 100 g carbohydrate per day were both used to represent the lowest and highest amounts of carbohydrate allowed in the maintenance phase.

Accompanying the steady rise in obesity during the past 3 decades is the proliferation of popular weight-loss plans

The South Beach plan recommends certain types of carbohydrates and fats. The South Beach plan is organized into three phases. The first 2 weeks (Phase 1, weight loss) restricts consumption of particular foods (eg, bread, rice, potatoes, pasta, baked goods, alcohol, fruit, or sugar products). The plan is liberalized in the second (continued weight loss) and third (maintenance) phases. In Phase 2, dieters are instructed to have lean protein and low-fat dairy, and gradually reintroduce whole-grain carbohydrates and fruit. In Phase 3, subjects expand the quantity and selection of whole grains and particular fruits and vegetables (11). Both Phase 2 and Phase 3 menus were used in the analyses. The 2-week introduction phase was not included because it did not represent the long-term lifestyle encouraged by this weight-loss plan.

The Zone plan is a reduced carbohydrate, low-energy diet, based on a ratio of 40% of energy from carbohydrate, 30% from protein, and 30% from fat. It is anchored on the premise that high insulin levels contribute to weight gain and must be stabilized to promote weight loss. Carbohydrate intake is restricted and limited to whole grains. The Zone plan recommends low-fat protein to be consumed at each meal. "Good" fats are emphasized such as monounsaturated fat (eg, olive oils, almonds, and avocados) and n-3 fatty acids, while saturated fat from red meat, egg yolk, organ meats, and processed foods is restricted (12).

The Ornish plan, developed with the goal of reversing and preventing heart disease, supplies <10% of energy from fat. Cholesterol and saturated fat are strictly limited, and all animal products (except egg whites and nonfat dairy products) are excluded. Oils are eliminated except negligible amounts of canola oil and n-3 fatty acids. The Ornish plan allows a moderate intake of alcohol, sugar, and salt. Energy is not restricted, but the participant is directed to confine dietary intake to the recommended foods. Legumes and high-fiber carbohydrates are the foundation of the plan (13).

The 2005 Food Guide Pyramid plan (14) was developed based on the scientific literature of nutrients and food types that prevent chronic disease and nutrient deficiency. For a 2,000-kcal/day plan, the 2005 Food Guide Pyramid recommends 2.5 cups vegetables, 2 cups fruit, 3 oz whole grains, and 5.6 oz meat and beans each day. Lean meats, poultry, fish, dry beans, peas, nuts, and seeds are emphasized. Low-fat or nonfat dairy products are encouraged, and saturated fats are discouraged.

Nutritional Analysis

We compared popular weight-loss plans as they were originally described. Meal plans were taken directly from books or Web sites. The analyses assumed that dieters are perfectly adherent to dietary recommendations. Similar to Freedman and colleagues (15), sample menus from 7 days were entered into the Nutrition Data System for Research software (version 2006, Nutrition Coordinating Center, Minneapolis, MN). Nutrient values, including total energy; percent energy from carbohydrate, fat, and protein; number of servings of vegetables, fruits, nuts, soy, meat, and cereal fiber; percent energy from saturated and monounsaturated fat, *trans* fat, and n-3 fatty acids; total fiber; and sodium of each plan were analyzed using the Nutrition Data System for Research software.

Dietary quality was estimated using the Alternate Healthy Eating Index (AHEI), a measure that isolates dietary components that are most strongly linked to CVD risk reduction (16,17). The AHEI was developed to improve upon the Healthy Eating Index (HEI), which measured adherence to the 1995 US Department of Agriculture Food Guide Pyramid dietary guidelines (7). The AHEI was found to be twice as strong a predictor of CVD as the original HEI (16, 17), and may be a better proxy of dietary quality. The AHEI has nine components for evaluating and determining dietary quality, including fruit, vegetables, nuts and soy, ratio of white to red meat, cereal fiber, *trans* fat, ratio of polyunsaturated fat to saturated fat, alcohol, and duration of multivitamin use (16). Seven of the nine AHEI components were used to calculate the AHEI score for each plan (17). Duration of multivitamin use and daily alcohol intake were not used because neither were addressed in the diet book meal plans.

Each component received a score from 0 to 10, with 10 being the best and 0 being the worst. Detailed scoring algorithms are described elsewhere (17). For example, zero vegetable servings per day was given the score of 0, and five servings per day or more was given a 10. For meat, when no red meat was consumed, the component score was set to 10.

To provide a summary view of dietary quality and enhance understanding of the AHEI, several nutrients important for CVD risk reduction are incorporated in a separate analysis. These include carbohydrate, fat, protein, percent energy from saturated and monounsaturated fat, n-3 fatty acids, total fiber, and sodium. Saturated fat has been shown to increase low-density lipoprotein cholesterol levels (18), which can increase risk of CVD (19). Monounsaturated and n-3 fatty acids, and high-fiber diets have cardio-protective effects (20-24). Elevated sodium intake is associated with hypertension (25), a CVD risk factor.

Statistical Analysis

Descriptive statistics, such as mean±standard deviation, were used to summarize the plans' AHEI and nutrient scores. Analysis of variance was used to compare AHEI scores and components of the AHEI and energy intake; percent energy from carbohydrate, fat, protein, saturated, and monounsaturated fat; n-3 fatty acids; total fiber; and sodium. *P* values from omnibus test (ie, an overall test of differences among the means) were reported. For each AHEI score, follow-up multiple comparisons with a Bonferroni correction were conducted. Because total energy was different among the plans, the AHEI scores adjusted for energy content were also compared.

RESULTS

The AHEI scores (Table) ordered from the highest to the lowest plan were: Ornish (score 64.6), Weight Watchers high-carbohydrate (score 57.4), the New Glucose Revolution (score 57.2), South Beach/Phase 2 (score 50.7), Zone (score 49.8), 2005 Food Guide Pyramid (score 48.7), Weight Watchers high-protein (score 47.3), Atkins/100-g carbohydrate (score 46), the South Beach/Phase 3 (score 45.6), and Atkin/45-g carbohydrate (score 42.3). The omnibus test revealed a statistically significant difference in AHEI scores among plans ($P<0.01$). Every possible pair was compared using multiple comparison tests. The Ornish plan was significantly different from the Atkins/100-g carbohydrate ($P=0.007$), Atkin/45-g carbohydrate ($P=0.0004$), South Beach/Phase 3 ($P=0.005$), and Weight Watchers' high-protein plans ($P=0.02$). All other comparisons were not statistically different. Although nutrient intake is directly dependent upon energy, adjusting the AHEI scores by energy content resulted in only a slight reordering of the plans. In this analysis, the highest adjusted AHEI was Ornish (score 61.9), and Atkins/45-g carbohydrate plan (score 41.6) remained the lowest.

Components of the AHEI are presented in the Table. Compared to other plans, the Atkins/45-g carbohydrate plan had fewest servings of fruit, the lowest white to red meat ratio, and was second only to the Atkins/100-g carbohydrate plan for percent of energy from *trans* fat. While the Atkins/45-g carbohydrate plan scored lowest in white to red meat ratio with a ratio of one, the Ornish plan scored the highest with a ratio of four because it is the vegetarian diet plan. The omnibus test revealed a statistically significant difference in all the plans' AHEI components ($P<0.05$) except white meat and red meat ratio ($P=0.051$). The Zone plan was lowest in energy (mean 1,025±122 kcal per day), whereas the 2005 Food Guide Pyramid plan was highest (mean 1,946±200 kcal per day).

Historically, diets have been compared on macronutrients and more recently on other components known to be associated with the prevention and treatment of CVD. Means ±standard deviation of selected nutrient scores are listed in the Table. The omnibus test revealed statistically significant differences in all these nutrients ($P<0.05$) except sodium intake ($P=0.08$).

DISCUSSION

The HEI was created by the US Department of Agriculture to identify dietary factors associated with reduced CVD risk and to evaluate a plan's potential to improve physiological states such as blood lipid levels and obesity (7). The original HEI was inadequate to predict CVD mortality because it failed to distinguish between different types of carbohydrates and fats (26,27). McCullough and colleagues (16,17) devised the AHEI, and using data from the Nurses' Health Study, found it was twice as good at predicting CVD as the HEI.

Findings using the AHEI and energy-adjusted AHEI were similar across plans. The Ornish plan, which is almost a completely vegetarian plan, scored high largely due to the amount of

vegetables, fruit, cereal fiber intake, and low *trans* fat (28-34). The Weight Watchers higher-carbohydrate and the New Glucose Revolution plans also fared well due to the emphasis on fruits and vegetables, higher whole-grain composition, and low *trans* fats.

The Atkins/45-g carbohydrate plan had the lowest AHEI, because it was the lowest in fruit and cereal fiber and the highest in red meat and *trans* fats. Recent metabolic studies showed detrimental effects of *trans* fat on inflammatory factors and indicators of insulin resistance (35). Epidemiologic studies have indicated that the magnitude of association between *trans* fat and CVD is stronger than for saturated fat (36). Over the longer term, the intake of saturated fat combined with high *trans* fat may put dieters at risk. Although short-term studies have revealed a positive effect of the Atkins plan on CVD risk factors, including triglycerides (3, 37), the extent to which this effect is mediated by weight loss has yet to be elucidated. Weight loss independent of the diet, is associated with lipid reduction (38,39). The longer-term effect of the Atkins plan on CVD risk is unknown because long-term studies have not been conducted (40).

Both versions of Atkins' plans had the highest intake of beneficial n-3 fatty acids (3.4 g/day); however, other fats affect the uptake and effect of protective n-3 fatty acids. The total saturated fat intake for the Atkins/45- and /100-g carbohydrate plans averaged 16.2% and 17.6% of total energy, respectively, in biologic competition with the beneficial effect of the n-3 fatty acids (41,42). How this might affect longer-term dieters is unknown. For low saturated fat and higher n-3 intake, the 2005 Food Guide Pyramid and the New Glucose Revolution plans (<7% saturated fat, >1.8g/day n-3 fatty acid) fared the best.

The Institute of Medicine set an Adequate Intake value for fiber of 14 g per 1,000 kcal (43) because high-fiber diets have been associated with decreased risk of CVD (22-24). All plans achieved this target value. Total fiber (from all sources) was best achieved by the New Glucose Revolution (39.8 g/day) and Weight Watchers higher-carbohydrate plans (34.7 g/day).

The 2006 American Heart Association Scientific Statement recommends an upper limit of sodium intake of 2,300 mg/day for healthy individuals and lower for individuals with concerns such as hypertension (25,44). The 2005 Food Guide Pyramid plan and the Atkins/100-g carbohydrate plan contained the highest intakes of sodium, both above the American Heart Association limit, at 2,386±704 mg/day, and 2,539±830 mg/day, respectively.

An unexpected finding was that after adjusting for energy content, the 2005 Food Guide Pyramid plan, which is based on the *Dietary Guidelines for Americans 2005* (14), fared significantly worse than the New Glucose Revolution, Weight Watchers higher carbohydrate, and Ornish plans. The 2005 Food Guide Pyramid plan was devised to prevent nutrient deficiencies. Nutrient deficiencies relate to physiological requirements, but are not an objective measure that correlates with the prevention of CVD. The intake of protective nutrients must be balanced in an overall dietary pattern that addresses both excess and deficiency. Compared to the 2005 Food Guide Pyramid plan, New Glucose Revolution, Weight Watchers high carbohydrate, and Ornish incorporate much higher levels of fruit and vegetable consumption, which accounted for much of the difference in AHEI scores. Diets rich in fruit and vegetable consumption are recommended by the American Heart Association Nutrition Committee (25), but whether or not increasing fruit and vegetable consumption from seven combined daily servings (as in the 2005 Food Guide Pyramid plan) to 11 (as in the New Glucose Revolution plan) would further reduce CVD risk is not known.

The plans assessed varied greatly in daily energy content (from 1,025 kcal to 1,946 kcal) and degree of restriction of macronutrients. The Zone and Weight Watchers high-protein plans scored high on the AHEI; however, were below 1,200 kcal, which may affect adherence. For example, in one study, participants on the Zone diet consumed 1,393 kcal daily, 368 kcal more

than the recommended 1,025 kcal (6). Although many plans work equally well for weight loss (6), dietary quality should be considered when selecting a weight-loss plan, particularly patients at risk for CVD. Both weight loss and nutrition needs maximize health potential.

Our study has several limitations. First, the analyses assumed perfect adherence to dietary recommendations. Future research should assess the quality of weight-loss plans as they are carried out, an approach that would account for deviations in adherence. Second, only eight popular weight-loss plans were analyzed. Third, dietary supplements were not included in the analyses. Fourth, in the AHEI validation study (16), the “major chronic disease” deaths were from CVD or cancer. Thus, the AHEI has not been validated for chronic disease in general. Fifth, the AHEI does not account for energy, which can affect adherence. Finally, only 7 days of menus were entered for each plan. Thus, the study may be underpowered to detect all of the plan differences, which is why an error correction procedure (eg, Bonferroni) was used in multiple comparison analyses.

CONCLUSIONS

The AHEI is a valuable tool in selecting a weight-loss plan that maximizes both weight loss and CVD prevention. None of the popular weight-loss plans studied achieved a perfect AHEI score, but the Ornish, Weight Watchers high-carbohydrate, and New Glucose Revolution plans were among the best performers using the AHEI and traditional dietary quality assessments. In light of limitations mentioned, further investigations are warranted to observe what patients actually consume when following a popular weight-loss diet plan. Patients and their health care providers must be conscious of health concerns when choosing a plan for weight loss because dietary change is meant to be a long-term process. For example, low-energy diet plans with <1,200 kcal/day, including Zone and Weight Watchers high-protein plans, are not necessarily healthful when applying conventional wisdom, but are healthful when ranked by the AHEI. Patients can lose weight with most dietary plans in the short term, but whether it is healthful for cardiovascular concerns over the long-term should be the goal for patients and their providers. Ultimately, providers could use the AHEI to establish an appropriate long-term plan for their patients with established efficacy for cardiovascular health in addition to weight loss.

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Table

standard deviation of alternate healthy eating index (AHEI) and selected nutrient scores from popular weight-loss plans

	The New Glucose Revolution	Weight Watchers High- carbohydrate	Weight Watchers High-protein	Atkins		South Beach		2005 USDA ^a Food Guide Pyramid Plan	P value ^b
				45- g carbohydrate	100- g carbohydrate	Phase 2	Phase 3		
servings core, range	57.2 ±7.1, 46.8-69.5	57.4 ±9.4, 46.3-68.0	47.3 ±6.1, 41.5-56.5	42.3 ±3.7, 28.9-49.5	46.0 ±7.8, 34.6-58.8	50.7 ±12.8, 32.7-64.2	45.6 ±11.8, 26.0-61.8	48.7 ±10.8, 33.6-66.0	<0.01
core, for energy and error percent of	54.6±3.4	60.4±3.5	51.2±3.7	41.6±3.2	42.1±3.7	53.0±3.3	46.4±3.2	44.8±3.9	<0.01
les (serving/ serving(d) soy protein (d)	6.0±1.9	6.3±1.2	3.1±0.7	6.6±1.1	6.4±2.6	11.1±5.8	6.4±3.0	3.4±1.2	<0.01
d meat (% energy)	5.1±1.4	3.1±2.8	2.4±2.3	1.9±0.3	3.0±0.4	2.8±0.9	2.5±1.2	3.6±1.1	<0.01
ber (g/d)	4.3±1.7	1.4±1.1	1.3±1.2	2.2±1.9	3.1±2.4	1.3±1.5	0.4±0.4	2.0±2.0	<0.01
1.2±1.9	3.4±1.5	3.4±1.5	2.3±2.1	1.0±0.8	1.17±1.39	2.6±1.7	2.5±2.2	2.0±2.0	0.051
0.3±0.4	0.3±0.3	0.3±0.3	0.3±0.3	1.2±0.7	1.3±0.4	0.5±0.3	0.6±0.3	1.0±0.3	<0.01
8.3±7.6	12.4±8.4	12.4±8.4	8.5±5.9	1.8±1.5	6.9±3.4	4.9±4.1	6.2±5.4	8.3±3.5	0.02
1.8±0.7	1.3±0.6	1.3±0.6	1.0±0.4	0.8±0.1	0.6±0.2	1.0±0.4	0.9±0.4	1.2±0.8	<0.01
1.7±0.133	1.204±104	1.204±104	1.118±79	1.547±218	1.858±253	1.272±263	1.404±273	1,946±200	<0.01
tion hydrate	57.0±3.1	59.0±4.6	52.9±4.1	22.2±3.4	29.5±5.1	41.4±8.7	37.0±10.2	57.6±8.8	<0.01
on	28.6±2.8	25.7±2.2	24.8±3.3	54.9±5.7	52.6±6.6	37.4±8.8	39.6±8.6	24.5±7.5	<0.01
important s	19.5±1.4	21.0±2.8	25.8±4.5	25.4±3.5	20.7±3.1	24.2±5.7	25.7±5.3	20.6±3.3	<0.01
fat fat (%)	5.6±2.5	5.6±2.5	6.0±2.6	16.2±2.2	17.6±3.5	9.6±2.6	10.4±3.1	6.4±2.2	<0.01
saturated fat (g/d)	13.5±1.9	11.2±1.7	11.6±1.2	21.9±4.3	20.8±4.7	16.0±4.3	18.37±5.8	9.0±3.9	<0.01
er (g/d)	1.2±0.7	1.2±0.7	1.0±0.9	3.4±1.3	3.4±0.7	2.7±2.3	1.78±0.7	2.1±1.2	<0.01
er (g/d)	39.6±8.0	34.7±9.3	22.9±6.8	22.1±4.4	27.6±4.2	26.0±9.0	20.36±4.4	29.7±7.5	<0.01
(mg/d)	1,749±541	1,653±356	1,790±491	2,251±545	2,539±830	1,669±789	1,815±676	2,386±704	>0.08

DA=US Department of Agriculture.

analysis of variance.

October 1.