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Nutrient Composition and Anti-inflammatory Potential of a Prescribed Macrobiotic Diet

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Despite nutrient adequacy concerns, macrobiotic diets are practiced by many individuals with cancer and other life-threatening illnesses. This study compared the nutrient composition and inflammatory potential of a macrobiotic diet plan with national dietary recommendations and intakes from a nationally representative sample. Nutrient comparisons were made using the 1) macrobiotic diet plan outlined in the Kushi Institute's *Way to Health*; 2) recommended dietary allowances (RDA); and 3) National Health and Nutrition Examination Survey (NHANES) 2009–2010 data. Comparisons included application of the recently developed dietary inflammatory index (DII). Analyses focused on total calories, macronutrients, 28 micronutrients, and DII scores. Compared to NHANES data, the macrobiotic diet plan had a lower percentage of energy from fat, higher total dietary fiber, and higher amounts of most micronutrients. Nutrients often met or exceeded RDA recommendations, except for vitamin D, vitamin B12, and calcium. Based on DII scores, the macrobiotic diet was more anti-inflammatory compared to NHANES data (average scores of −1.88 and 1.00, respectively). Findings from this analysis of a macrobiotic diet plan indicate the potential for disease prevention and suggest the need for studies of real-world consumption as well as designing, implementing, and testing interventions based on the macrobiotic approach.

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INTRODUCTION

Complementary and alternative medical treatments continue to be used with increasing frequency in the United States (1–5), and especially by people with cancer and other life-threatening illnesses (6–11). Macrobiotics is one popular alternative or complementary lifestyle approach. Its centerpiece is a predominantly vegetarian, whole-foods diet that has gained popularity because of reports, which attribute recovery from cancers with poor prognoses to macrobiotics (11–14). The macrobiotic diet (MBD) has been shown to reduce total body fat and overall body mass and to produce favorable changes in certain metabolic/biochemical indicators such as serum glucose and lipids (15) as well as immunologic parameters (16). In addition, there is accumulating evidence that many of the dietary factors recommended by macrobiotics are associated with decreased inflammation (17), which may reduce cancer risk and recurrence (11, 18–20).

Despite its relative popularity, there have been only 129 references in the National Library of Medicine database from 1948 to the time of our review (October 2, 2014) in which "Diet, Macrobiotic" appeared as a Medical Subject Heading or "macrobiotic diet" or "macrobiotic" or "macrobiotics" appeared as text words. Of these, 18 specifically mentioned nutrient sufficiency or deficiency with most questioning the safety of the MBD, either on the growth requirements of young children or as part of extreme cleansing regimens (e.g., Zen Macrobiotic) (21–25). Concerns have centered primarily on the nutrient content of the diet, especially energy density, fat, protein, vitamin B12, and iron (26–29).

Analyses of actual dietary intake are hindered by variations in the prescriptions made by MBD leaders, geographic location and seasonal variations, and the varying prognoses of practitioners (14, 30–34). This variability is compounded by variations in real-world practice, which can depart considerably from recommendations based on individual interpretation, commitment, and availability of ingredients (35). Although a particular diagnosis might require a specific kind of food restriction, there has evolved a standard MBD for disease prevention and promotion of health (14). Because of the strict requirements of this prescribed diet (12, 35), there is concern that beneficial reports in the literature represent departures from these guidelines and mask potential nutrient deficiencies.

The purpose of this study was to examine the nutrient content of a MBD plan intended for disease prevention, compare the plan's nutrient content to the nutrient content in the average American diet, compare both nutrient profiles to national nutrient recommendations, and use a novel index to assess the anti-inflammatory potential of the macrobiotic and average American diets.

METHODS

The average daily nutrients consumed while following a MBD prescribed for disease prevention were estimated using recommendations from the Kushi Institute's *Way to Health* menu planning guidelines (36). These guidelines are provided to participants of the Kushi Institute's Healing Retreats and are a recognized standard for individuals following a MBD. In the guidelines, a week of sample menus is provided for each season of the year. To account for the seasonal variation that occurs in the MBD, each season's menu was entered and analyzed separately to provide seasonal nutrient profiles and the seasonal nutrient profiles were combined to provide an overall nutrient profile. Each menu gave suggested foods for breakfast, lunch, dinner, and an afternoon snack. *Way to Health* (36) also provided recipes, but serving sizes and guidelines for scaling to meet the higher caloric needs of men compared to women were not specified. Serving sizes per meal were estimated based on the combining of standard portion sizes used in the macrobiotic community and portion sizes recommended in other cancer-focused diets (based on personal communication from Alex Jack and Julia Ferre to Jane Teas) including *Nature's Cancer Fighting Foods* (p. 222) (37). Therefore, each meal item used the following portion sizes: 1 cup of a cooked whole grain, 1–2 cups of vegetables, ¼ cup of salad or pickles, 1 sheet of seaweed, ½ cup of fruit, 1 cup of sweet vegetable drink or tea, 2 tablespoons of fat (i.e., oil, dressing), and ½ cup of beans or bean product (i.e., tofu, tempeh).

The Nutrition Data System for Research (NDSR Version 2009)), licensed from the Nutrition Coordinating Center (NCC) at the University of Minnesota, was used for the analysis of the MBD (38). Recipes and suggested foods derived from the *Way to Health* menus were entered directly into NDSR as seven days of intake for four seasons. When a suggested food or recipe ingredient was not available, a request to NCC was put in for the food to be added. When NCC could not add a food due to a lack of information, a food of nutrient equivalence was substituted. Substitutions required research into the food's nutrient content and consensus within the study team. A total of 18 substitutions were made (8 in spring, 3 in summer, 5 in fall, and 2 in winter). During analysis, the 7 days of data for each season were averaged to provide an estimate of the diet's daily nutrient composition within season. The seasonal averages were then combined to create an overall daily nutrient estimate. Data analysis consisted of descriptive statistics for 28 nutrients plus total calories and percentage of calories from fat, protein, and carbohydrate. Means and SDs were computed of each of these nutritional parameters. The same profile of over 28 nutrients was also created using dietary data from the 2009–2010 National Health and Nutrition Examination Survey (NHANES) *What We Eat in America* to represent the average American diet. For the NHANES nutrient profiles, data from the age groups 30–39 and 40–49 were averaged (39).

The MBD seasonal and overall profiles were compared to NHANES daily nutrient values for men and women. These NHANES profiles and the MBD overall nutrient profile also were compared to recommended dietary allowance (RDA) data for adults 31–50 year olds (40). Of the over 28 nutrients in the profiles, 17 had an RDA that could be compared across the profiles. A dietary inflammatory index (DII) score also was calculated for the seasonal and overall MBD nutrient profiles as well as for the NHANES profiles for men and women.

Development and validation of the DII has occurred over the past 5 yr by researchers at the University of South Carolina. The DII is a tool that can categorize individuals' diets on a continuum from maximally anti-inflammatory to maximally pro-inflammatory (41–43). A higher, positive DII score indicates a more pro-inflammatory diet and a lower, negative score indicates a more anti-inflammatory diet. Nearly 2,000 articles on the effect of 45 food parameters (including whole foods, nutrients, and bioactive compounds) on 6 inflammatory markers [i.e., C-reactive protein, interleukin (IL)-1β, IL-4, IL-6, IL-10, and tumor necrosis factor-α] were read and scored to determine the inflammatory effect score (42). The DII was standardized to its current range using dietary intake provided by 11 datasets from around the world (42). A complete description of its development is available elsewhere (42,43). Briefly, the 11 datasets were compiled into a "global database" from which a mean and SD were calculated for each of the 45 food parameters identified from the literature (42). The diets of individuals were expressed relative to the global mean as a *z* score, calculated by subtracting the global mean from the person's intake and dividing by the standard deviation. To minimize the effect of "right skewing," *z* scores were converted to a percentile score. To obtain a DII score for an individual, the centered percentile score for each food constituent consumed is multiplied by its respective inflammatory effect score and the food constituent-specific DII scores summed. Construct validity of the DII was established using high-sensitivity C-reactive protein (hs-CRP) samples from the Seasonal Variation of Blood Cholesterol Study (41). A 1-point increase in DII score was associated with an increased odds of elevated hs-CRP when both 24-h recall data (odds ratio (OR) = 1.08; 95% confidence interval (CI): 1.01, 1.16) and 7-day dietary records (OR = 1.10; 95% CI: 1.02, 1.19) were used to calculate DII scores. Tests for trends across DII tertiles found significant increasing trends for hs-CRP with both dietary data sources ($P < 0.0001$) (41). Thus far, the DII has been found to be associated with inflammatory cytokines including C-reactive protein and IL-6 (41, 44, 45), the glucose intolerance component of metabolic syndrome (44), increased odds of asthma and reduced forced expiratory volume (FEV_1) (45), shiftwork (44), and colorectal cancer among women (46).

RESULTS

Table 1 compared energy-adjusted nutrient profiles and the DII score of the MBD with those from NHANES for men and women. Nutrient intakes for the MBD are shown for each of the four [Julian] seasons of the year as well as for the overall diet. Seasonal variation was seen. Spring had the highest overall calories; however, the nutrient levels in the fall were higher for percent of calories from fat as well as nutrients such as polyunsaturated fatty acids, folate, β-carotene, phosphorus, iron, sodium, and potassium.

When comparing the overall MBD to NHANES, large differences in energy-adjusted nutrient intakes were seen. The MBD was associated with a lower percentage of energy from fat (14% compared to 33% NHANES-men and women) and a higher percentage from carbohydrates (71% compared to 47% NHANES-men and 51% NHANES-women). The amount of saturated fatty acids in the MBD was much lower than in NHANES (2.9 g compared to 12 g NHANES-men and women). Total sugar in the MBD was half that seen in NHANES (20.6 g compared to 52 g NHANES-men, 57.6 g NHANES-women), whereas total dietary fiber was 4–5 times higher (34.7 g compared to 7.3 g NHANES-men, 8.7 g NHANES-women).

Equally large differences were seen in many micronutrients. With the exception of lycopene, carotenoid concentrations for the MBD were higher than in NHANES, as much as 9 to 10 times higher for α-carotene (2363 mcg compared to 170 mcg NHANES-men, 232 mcg NHANES-women) and β-carotene (9508 mcg compared to 837 mcg NHANES-men, 1204mcg NHANES-women). Many of the B vitamins also were found at higher concentrations in the MBD, with the exception of B12 (1 mcg compared to 2.5 mcg NHANES-men, 2.6 mcg NHANES-women) and vitamin D (1.3 mcg compared to 2.1 mcg NHANES-men, 2.5 mcg NHANES-women). In looking at DII scores across seasons for the MBD, the lowest DII score was seen for fall (−2.59) followed by spring (−2.30), winter (−1.48) and summer (−0.98). The DII scores calculated from NHANES data were lower (more anti-inflammatory) for men compared to women by half (0.64 and 1.36, respectively); however, the overall MBD was more anti-inflammatory (−1.88) than either NHANES profile.

When nonenergy adjusted nutrient values were compared to the RDAs, both the MBD and NHANES generally met or exceeded recommendations for nutrients (Table 2). For some nutrients, such as dietary fiber, the MBD exceeded the RDAs (50 g compared to 38 g RDA-men, 25 g RDA-women), whereas the NHANES data indicated dietary fiber intake in the average American diet was lower than recommended (20 g NHANES-men, 16 g NHANES-women). With iron, the MBD (18 g) and NHANES (19 g) exceeded the 8 mg/day RDA for men. The MBD met the 18 mg/day recommendation for women, whereas intakes in NHANES for women (14 mg) were lower than recommended. For other nutrients, such as phosphorus and sodium, both the MBD and NHANES exceeded recommendations. Intakes of vitamins D and B12, calcium, and potassium were all lower in the MBD than recommended. NHANES for men and women indicated vitamin D intake was lower than the 15 mg RDA at 5.8 mcg and 4.5 mcg, respectively; while the MBD was even lower, at 1.8 mcg. With vitamin B12, NHANES indicated men and women (6.8 mcg and 4.7 mcg, respectively) both consumed more than the recommended amounts (2.4 mcg), whereas the MBD was lower than recommended (1.4 mcg). Calcium in the MBD was almost half the recommended amount (598 mg compared to 1000 mg), whereas NHANES for men (1207 mg) was slightly above and women's intake (917mg) slightly below recommendations. The MBD and NHANES both showed lower levels of potassium (3056 mg macrobiotic, 3356 mg NHANES-men, 2406 mg NHANES-women) than recommended (4700 mg).

DISCUSSION

It is important to examine the nutrient adequacy and potential nutritional mechanisms of complementary and alternative diet recommendations. Concerns have been voiced about possible harmful effects of adhering to a MBD (22, 24–27). Comparisons with NHANES data and current national recommendations indicate the MBD has a more anti-inflammatory nutritional profile than the average American diet; however, key nutrients such as vitamin D, vitamin B12, and calcium tend to be low in the diet as it is currently recommended. This study provides evidence that a MBD aimed at health promotion and disease prevention has the potential

TABLE 1
Comparison of energy-adjusted nutrients[a] in a macrobiotic diet plan with intake in a nationally representative sample

	Macrobiotic diet[b]						
Nutrient	Spring	Summer	Fall	Winter	Overall	NHANES data: Men[c]	NHANES Data – Women[c]
Energy (kcal/day)	1719	1227	1496	1332	1444	2733	1813
% from fat	12.1	12.8	17.1	15.6	14.4	33.1	33.0
% from carbohydrate	73.7	70.4	67.7	70.6	70.6	47.4	50.7
% from protein	14.2	16.8	14.8	13.8	14.9	15.7	15.3
Total SFA (g)	2.5	2.7	3.4	3.2	2.9	12.0	12.0
Total PUFA (g)	6.6	6.8	9.8	7.8	7.8	7.8	8.4
Total omega-3 FA (g)	0.6	0.6	0.8	0.7	0.7	0.7	0.8
Total omega-6 FA (g)	6.0	6.3	9.0	7.2	7.1	7.0	7.5
PUFA 18:2 (linoleic acid) (g)	6.0	6.3	8.9	7.2	7.1	6.9	7.4
PUFA 20:4 (arachidonic acid)(g)	0	0	0	0	0	0.1	0.1
Omega-3:Omega-6	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total sugars (g)	20.4	21.9	18.5	21.9	20.6	52.0	57.6
Total dietary fiber (g)	34.1	34.1	37.1	33.3	34.7	7.3	8.7
Vitamin D (calciferol) (mcg)	0.9	1.5	1.3	1.4	1.3	2.1	2.5
Folate (mcg) DFE	293	273	512	334	355	249	266
Thiamin (vitamin B1) (mg)	1.0	0.9	1.1	1.0	1.0	0.8	0.8
Riboflavin (vitamin B2) (mg)	0.7	0.7	1.2	0.9	0.9	1.0	1.0
Niacin (vitamin B3) (mg)	11.6	11.2	13	11.4	11.8	12.6	11.5
Vitamin B6 (mg)	1.3	1.4	1.6	1.4	1.4	1.0	1.0
Vitamin B12 (cobalamin) (mcg)	0.7	1.5	1.3	0.4	1.0	2.5	2.6
Vitamin C (mg)	77.6	72.9	82.8	73.3	77.0	35.7	43.5
Beta-carotene (provitamin A) (mcg)	9197	9289	10747	8718	9508	837	1204
Alpha-carotene (provitamin A) (mcg)	2427	2588	2341	2099	2363	170	232
Beta-Cryptoxanthin (provitamin A) (mcg)	46.5	126.2	15.5	5.6	46.0	34.2	47.7
Lutein + zeaxanthin (mcg)	8299	4710	6985	5437	6535	552	842
Lycopene (mcg)	1.9	1510.2	1.3	1.6	322.2	2812	2588
Calcium (mg)	429	438	416	371	414	442	506
Phosphorus (mg)	897	912	1027	936	943	654	673
Iron (mg)	12.4	11.3	14.7	12.0	12.7	6.9	7.5
Zinc (mg)	7.5	6.9	7.9	7.4	7.5	5.7	5.5
Sodium (mg)	2693	3169	4619	2574	3266	1669	1672
Potassium (mg)	1965	2061	2437	2002	2116	1228	1327
DII score	−2.30	−0.98	−2.59	−1.48	−1.88	0.64	1.36

NHANES = National Health and Nutrition Examination Survey; SFA = saturated fat; PUFA = polyunsaturated fat; FA = fatty acid; DFE = dietary folate equivalents; DII = dietary inflammatory index.
[a]All nutrients energy adjusted to represent amount per 1000 kcal except for % calories from fat, carbohydrate, and protein.
[b]Based on the Kushi Institute's *Way to Health*
[c]Data from the 2009–2010 NHANES *What We Eat in America*; average of age groups 30–39 and 40–49.

to provide a healthy nutrition profile with many nutrient concentrations sufficient to compensate for low caloric intake.

Reports on the cancer preventive abilities of the MBD may be due in part to its anti-inflammatory profile. Compared to the average American diet, this study found a large difference in DII scores (−1.88 vs. 1.00), indicating relatively strong anti-inflammatory properties of the MBD. Based on previous global intake estimates, the MBD score corresponds to roughly the 25th percentile of the DII and the typical American diet to just under the 75th percentile (42). When the DII was calculated for 1 day of a simulated macrobiotic, fast food, and Mediterranean diet, similar findings were seen with the MBD strongly anti-inflammatory and the fast food diet strongly pro-inflammatory (47). Research on cancer prevention has highlighted the importance of reducing inflammation, especially through consumption of foods with strong anti-inflammatory properties (48–50).

TABLE 2
Comparison of nutrient composition of a macrobiotic diet plan with intake in a nationally representative sample and recommended dietary allowances

Nutrient	Macrobiotic–Overall[a]	NHANES: Men[b]	NHANES: Women[b]	RDA: Men	RDA: Women
Total carbohydrate (g)	255	324	230	130	130
Total protein (g)	54	107	69	56	46
Total dietary fiber (g)	50	20	16	38[c]	25[c]
Vitamin D (calciferol) (mcg)	1.8	5.8	4.5	15	15
Folate (mcg) DFE	512	681	483	400	400
Thiamin (vitamin B1) (mg)	1.5	2.1	1.4	1.2	1.1
Riboflavin (vitamin B2) (mg)	1.3	2.7	1.9	1.3	1.1
Niacin (vitamin B3) (mg)	17	34	21	16	14
Vitamin B6 (mg)	2.1	2.8	1.7	1.3	1.3
Vitamin B12 (cobalamin) (mcg)	1.4	6.8	4.7	2.4	2.4
Vitamin C (mg)	111	97	79	90	75
Calcium (mg)	598	1207	917	1000	1000
Phosphorus (mg)	1361	1787	1221	700	700
Iron (mg)	18	19	14	8	18
Zinc (mg)	11	15	10	11	8
Sodium (mg)	4716	4561	3032	1500[c]	1500[c]
Potassium (mg)	3056	3356	2406	4700[c]	4700[c]

NHANES = National Health and Nutrition Examination Survey; RDA = Recommended Dietary Allowances; DFE = dietary folate equivalents.
[a]Based on the Kushi Institute's *Way to Health*.
[b]Data from the 2009–2010 National Health and Nutrition Examination Survey (NHANES) *What We Eat in America*; average of age groups 30–39 and 40–49.
[c]Adequate Intake value.

Previous studies and current recommendations (51) suggest high vegetable (52) and whole grain (53, 54) intake is anti-carcinogenic. Overall, the MBD stresses that 40–60% of daily calories should be from vegetables and whole grains, with animal products consumed only in small amounts monthly (18). Based on recommendations in the 2010 Dietary Guidelines, the MBD had fewer calories from fat (14%) than recommended (27.5%), whereas the average American diet had more (33%) (39). In addition, the saturated fat content of the MBD was much lower than the average American diet. The Dietary Guidelines also suggest that 55% of calories should come from carbohydrates (55). The average American diet had a lower percentage (49%), whereas the MBD plan was much higher (71%). Based on the high dietary fiber and low total sugar amounts seen in the MBD nutrient profile, carbohydrate sources appear to be primarily complex carbohydrates. This nutrient profile aligns with the MBD's focus on vegetables and whole grains and contributes greatly to the MBD's anti-inflammatory score.

In addition to its anti-inflammatory nutrient profile, the MBD was very low in calories, but still maintained sufficient concentrations for most nutrients, due to its high nutrient density. Lower caloric intake may aid in the reduction of body weight over time in individuals consuming a MBD similar to the one modeled in the study. Overweight and obesity have been shown to be positively associated with higher levels of chronic inflammation (56). A recent article reported a positive protective effect of the MBD on outcomes related to diabetes mellitus (57). Participants eating a MBD saw a favorable change in body weight and lipid values, reduced oxidative stress, and improved insulin secretion. After 6 mo of the macrobiotic intervention, significant reductions were seen in body weight (9.0%), total cholesterol (16.4%), LDL cholesterol (22.7%), and triglycerides (37.0%); and an increase was seen in HDL (97.8%) (57). Findings from our study add to this literature indicating the MBD, when consumed as recommended, has the potential to aid in disease prevention and control, in part through its potential to be low in calories while high in nutrient density, an important consideration of any dietary recommendation, given the emphasis placed on reducing caloric intake in order to lose weight by various disease-prevention recommendations (58).

Despite the anti-inflammatory profile of the MDB, there were some nutrient excesses and deficiencies that pose concerns. Although most carotenoids were high with the MDB, lycopene was especially low, except in summer where it was still lower than the amounts seen with NHANES. The MBD recommendations include avoidance of the nightshade family, which includes tomatoes, a prime source of lycopene (59). Research indicates lycopene may be anti-carcinogenic, especially in relation to prostate cancer (60). In addition to low lycopene, the MBD plan also was low in vitamin D, vitamin B12, and calcium. The avoidance of meat and dairy in the

MBD most likely contribute to the low levels of these nutrients. While vitamin D and calcium have the potential to be low in the average American diet, they were even lower in the MBD. Recent research has highlighted the potential cancer prevention benefits of vitamin D, with diet shown as an important source (61). The low-calcium, high-fiber content of the MBD also may have negative health impacts given the potential for a high-fiber diet to reduce the absorption of calcium as well as iron, magnesium, and zinc (62). This lower calcium intake and absorption have the potential to decrease bone mineral density, impair normal muscular function, and negatively impact cardiovascular health (63, 64). In addition to low vitamin D and calcium, the MBD showed low levels of vitamin B12. Vitamin B12 plays an important role in nerve health, red blood cell formation, and DNA synthesis, and has been noted before as a potential area for deficiency with the MBD (65). Deficiency of vitamin B12 also can be masked by high levels of folate (65, 66), which were seen in the MBD. The emergence of "gourmet macrobiotic" cuisine and recommendations that highlight the emotional and spiritual balance with food versus rigorous dietary restrictions may provide more balance and higher levels of the key nutrients found to be deficient in MBD aimed at disease prevention and control (30–32, 67). In addition, liberalizing the diet to include foods such as cold-water fish may actually increase the anti-inflammatory potential of the diet through increases in omega-3 fatty acids.

Also of potential concern in the MBD are high phosphorus and sodium intakes. In general, these nutrients are found primarily in highly processed cereal and grain products (68), whereas in the MBD the high level of intake may be due to the consumption of pickled foods, sea vegetables, high-sodium seasonings, and whole grains. The low-calcium, high-phosphorus content of the MBD has the potential to negatively influence bone and cardiovascular health (68). In both the MBD and the American diet, potassium was below the RDA for men and women while sodium exceeded the RDAs. Research on the anti-inflammatory properties of foods indicates seasonings such as turmeric, garlic, and other herbs and spices are highly anti-inflammatory (69–73). Use of these seasonings as substitutions for the high-sodium and phosphorus containing seasonings found in the MBD is a way to not only achieve more healthful ratios between these nutrients, but also to further improve the anti-inflammatory properties of the diet.

Although the findings from this study provide important information on the nutrient profile of the MBD and point to components of the diet that are anti-inflammatory and potentially cancer preventative, there are limitations to the interpretation of these results. The MBD we analyzed was created using dietary recommendations and the literature, not actual diets. However, understanding the implications of adhering to the recommendations is a crucially important first step that must come before large-scale interventions with people, in part to understand if inadequacy is due to the dietary prescription or nonadherence to the recommendation. We compared this model of the MBD to that of data from NHANES and established RDAs. The use of ideals (i.e., MBD plan, RDAs) provides an understanding of the potential for the MBD to meet recommendations while providing disease prevention benefits. However, our findings must be interpreted cautiously as they do not include the range in intake that would come from actual consumption data nor do our comparisons take into account modified needs that may come with advanced disease or intensive treatments.

The *Way to Health* and other literature consulted in the creation of the MBD provided guidelines that did not differ for men compared to women. Dietary recommendations vary by sex for some nutrients, but not for most, and we found few instances where the MBD met the needs of one sex and not the other, or greatly exceeded the needs of one sex (i.e. reached upper tolerable limits) and not the other. Future studies should examine differences that occur in the application of MBD recommendations among men compared to women.

This study found the nutrient profile from a MBD aimed at disease prevention and control was anti-inflammatory and contributed to increased intake of many health-protective nutrients when compared to the average American diet and dietary recommendations. Next steps in this research include applying the DII to data derived from individuals consuming both a MBD for disease prevention and control as well as more liberal interpretations to examine if our current findings can be replicated or improved upon in real-world scenarios. In addition, future studies should assess dietary intake as well as biomarkers for inflammation to further understand the link between anti-inflammatory diets and disease prevention.

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DISCLOSURES

Dr. James R. Hébert owns controlling interest and Dr. Nitin Shivappa is an employee of Connecting Health Innovations LLC (CHI), a company planning to license the right to the dietary inflammatory index (DII) from the University of South Carolina in order to develop computer and smart phone applications for patient counseling and dietary interventions in clinical settings.

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