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Factors affecting adherence to a raw vegan diet

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Abstract

The purpose of this study was to evaluate adherence and identify predictors of adherence to a raw vegan diet (i.e., uncooked plant foods) following a stay at a raw vegan institute. In this cohort study of guests at a raw vegan institute, subjects completed written questionnaires upon arrival and 12 weeks later. Of 107 eligible guests, 84 participated. Mean age was 54 years, 23 were male, and 73 white. Fifty-one completed the 12-week follow-up. Eight (16%) reported their diet to be 80% raw vegan at baseline and 14 (28%) at follow-up. Based on a raw vegan dietary adherence score (range 0–42) created for this study, mean adherence (SD) increased from 15.1 (5.4) to 17.0 (5.8) over 12 weeks ($p=0.03$). Baseline predictors of adherence included: education ($\beta=0.95$), severity of disease ($\beta=0.98$), and self-efficacy to adhere ($\beta=0.72$). Future interventions that evaluate this diet should address self-efficacy, an important, potentially remediable predictor of adherence.

Keywords

vegetarian diet; vegan; raw; patient compliance; self-efficacy

INTRODUCTION

Studies have identified a variety of factors associated with dietary change.(1, 2) According to one heuristic framework, the “Adherence Model,” dietary adherence is affected by numerous variables, including self-efficacy, perceived control over one’s health, perceived severity of the illness, social support, readiness to change, past adherence, and sociodemographic factors.(3) Although considerable information about predictors of relatively modest dietary changes is available (1, 2), little is known about the factors associated with more extreme dietary changes.

Raw vegan food (uncooked food prepared without any animal products, dairy, or eggs) has become increasingly popular recently. In the ancient world, the Pythagoreans advocated a raw food diet. Germans who settled in Southern California at the turn of the 19th century brought the raw vegan diet to the United States, and in the 1960s, Ann Wigmore, co-founder

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of the Hippocrates Health Institute, further popularized it.(4) Advocates maintain that the diet benefits both healthy individuals and those with chronic disease.

There is some evidence that raw food is healthier than cooked food. Cooking food destroys nutrients and enzymes, alters the structure and, thus, digestibility of food, and creates byproducts that may be harmful. For example, cooking vegetables decreases water-soluble and heat sensitive nutrients, such as carotenoids.(5) The insoluble fiber in vegetables, which helps decrease fecal transit time and increase binding and excretion of carcinogens (6), decreases as a result of cooking.(7) In foods rich in reducing sugars (e.g., glucose and fructose) and amino acids, peptides, or proteins, heat initiates the Maillard reaction, which destroys many essential amino acids, causes proteins to cross-link with reducing sugars, makes the food harder to digest (8), and forms proinflammatory advanced glycation endproducts.(9) Heating pure proteins, peptides, or amino acids also forms compounds that are often mutagenic.(10) Some observational studies suggest that raw food is healthier than cooked food (11, 12), and a few anecdotal reports describe alteration of chronic disease among patients on a raw vegan diet (13), but the diet has rarely been studied in clinical trials.

Cooking certain types of foods does have some benefits. Heating vegetables decreases the amount of carotenoids, however, it also increases the bioavailability of certain carotenoids and kills harmful microbes.(14, 15) In addition, legumes and some tubers contain enzyme inhibitors that reduce the effectiveness of certain pancreatic enzymes, but are inactivated by cooking. (However, soaking, germinating, or fermenting legumes can also inactivate enzyme inhibitors.) Cooking may help decrease the level of pesticides in or on vegetables, (16) although eating organic produce is another way to avoid pesticides.(17)

We chose to study the raw vegan diet because it appears to have a number of health benefits, is increasingly popular, and has not been well studied. The purpose of this study was to identify predictors of adherence to a raw vegan dietary program among guests at a raw vegan institute. The diet provided and promoted at this institute consists of uncooked organic vegetable dishes and wheatgrass and other vegetable juices (see Box). We chose to study this type of diet because it has been described as beneficial in some anecdotal reports (13) and because each of its components is reported to have health benefits.(18-20)

METHODS

In this cohort study, guests at the Hippocrates Health Institute (HHI) in West Palm Beach, FL (US), were recruited between August and December 2004. Guests usually stay one to three weeks at HHI, which provides all their meals as well as daily lectures, exercise classes, meditation sessions, and spa treatments. The diet consists of wheatgrass juice twice daily, vegetable juice three times per day, and salads with sprouts and nut- or avocado-based side dishes for lunch and dinner. The institute offers cooked vegan side dishes twice per week and encourages guests to consume only vegetable juices one day per week.

Guests were recruited to participate in this study upon arrival. All guests who were 18 years of age, were intending to stay at least seven days, could read English, felt well enough to complete the questionnaire, and were without dementia, were eligible to participate in the study. Those who completed the study were sent a raw vegan cookbook. During the period of recruitment, 107 of the 119 guests at HHI were eligible for this study. Of those eligible, 84 (79%) completed the baseline questionnaire and 51 (48%) also completed the 12-week follow-up questionnaire. Written informed consent was obtained from those who agreed to participate. The study was approved by the Institutional Review Board at Columbia University.

Subjects were asked to complete a written questionnaire upon arrival to HHI and again approximately 10-12 weeks later. The possible predictors of adherence measured in the baseline questionnaire included sociodemographic factors, previous use of complementary or alternative therapies (CAM), frequency of exercise, length of stay at HHI, comorbid conditions (Charlson Comorbidity Scale(21)), interest in adhering to the diet (“On a scale of 0 to 10, with 10 being very interested, how interested are you in following a raw food diet after you leave HHI?”), social support (support from family and/or friends for coming to HHI, having friends and/or family who follow a raw vegan diet, and MOS Social Support Survey(22)), self-efficacy for adhering to the diet (“On a scale of 0 to 10, with 10 being very confident, assuming you decided to follow a raw food diet, how confident are you that you could succeed after you leave HHI?”), faith in the HHI program (“On a scale of 0 to 10, with 10 being complete faith, how much faith do you have in the HHI program as a way to improve your health?”), quality of life (MOS Short Form-36 (23)), general well-being and level of pain (0-100 visual analog scales), anxiety and depression, (Hospital Anxiety and Depression Scale (24)), perceived stress (Perceived Stress Scale (25)), and locus of control (Multidimensional Health Locus of Control Form (26)).

The follow-up questionnaire contained two open-ended questions about facilitators and barriers to adherence: 1) “What has made it easier to stick to the Hippocrates program?” 2) “What has made it harder to stick to the Hippocrates program?”

To quantify adherence, we developed a raw vegan diet score (range 0-42 points; appendix), based on HHI’s dietary recommendations. Using a scale of 0-4, points are added for the percent of the diet that is raw, percent vegan, frequency of fasting, and frequency of consumption of candy and desserts, processed grains, wheatgrass juice, other vegetable juice, salad at lunch, and salad at dinner. Additional points are added on a 0-2 scale for frequency of fasting, and intake of caffeine and alcohol. To differentiate adherers from non-adherers, we asked the following question at baseline and follow-up: “Whether or not you have been trying to follow a raw food diet, about what percentage of your diet, by weight, is raw *and* vegan (no dairy, eggs or meat)?” Responses 80% were considered adherent.

Statistical analyses

We used chi square and ANOVA to assess differences in baseline characteristics between adherent, non-adherent, and non-responder groups. The Scheffe test was used to adjust for multiple comparison testing among these three groups. Change in weight between the adherent and non-adherent groups was assessed using a t-test. We used multiple linear regression techniques to identify predictors of adherence. Specifically, we first assessed the impact of each predictor on adherence without adjusting for other predictors. Those predictors that contributed significantly to describing adherence at the 0.20 level of significance were put into a multivariate model, and only those with p-values < 0.20 were retained. These candidate predictors were included in the subsequent model, and those with p-values < 0.05 were retained in the final model. SAS (version 9.1, 2003, SAS, Inc, Cary, NC) was used for all quantitative analyses.

Qualitative analysis techniques were used to identify other factors that affected adherence to the raw vegan diet. One author (LBL) coded the data. Common concepts were combined into categories, and then further combined into broader categories.

RESULTS

Subjects were predominantly female, Caucasian, with incomes >\$50,000 per year, and users of CAM (Table 1). The most common diseases included cancer (n=20), depressive

symptoms (n=13), diabetes (n=10), thyroid disease (n=10), and cardiovascular disease (n=8). Only 14 subjects reported having no medical problems.

Of those who completed the follow-up questionnaire, the number of subjects who were adherent increased significantly, from 8 (16%) at baseline to 14 (28%) at follow-up ($p=0.02$). Those who adhered to the raw vegan diet at follow-up were significantly more likely to be following this diet at baseline and to have a higher comorbidity score, higher self-efficacy for adhering to the diet, worse physical quality of life, more depressive symptoms, and a cancer diagnosis. Of note, responses to this question (percent of diet raw and vegan) correlated strongly with the raw vegan diet score, both at baseline and follow-up ($r=0.80$).

Among those with complete follow-up data, the mean raw vegan diet score increased from 15.1 at baseline to 17.0 at follow-up ($p=0.03$) (Table 2). The frequency of fasting, and consumption of wheatgrass juice, vegetable juice, and salads also increased significantly. Consumption of sweets, processed grains, and caffeine decreased. Mean weight decreased 6.5 pounds, but weight loss was not associated with adherence to the raw diet. In analyses of the entire cohort, assuming no change from baseline for those without follow-up data, the results were similar.

In univariate linear regression analysis of candidate predictor variables and the raw vegan diet score, the score was positively associated with the number of people in the household, following a diet that was 80% raw and vegan at baseline, length of stay at HHI, comorbidity score, and self-efficacy for following the diet. Adherence was inversely associated with the number of close friends and relatives.

In the final multivariate model, adherence at follow up was most strongly positively associated with following a raw vegan diet at baseline (Table 3). It was also positively associated with education, severity of comorbid disease, and self-efficacy for adhering to the diet; and negatively associated with number of close friends and relatives, and physical quality of life. Together, these seven variables explained 78% of the variance in adherence to the raw diet.

Qualitative analysis of the open-ended questions revealed five major factors that affected subjects' ability to adhere to the raw vegan diet: 1) sufficient means (e.g., time, energy, money, knowledge, and kitchen equipment); 2) social support (e.g., supportive friends and family, knowing others who eat the same way, and meeting others who have done well on the program); 3) a supportive environment, (e.g., being able to buy food nearby, having raw restaurants nearby, living in a warm climate, and not being surrounded by tempting foods); and 4) faith in the program, described by two subjects as, "Knowing it was right." The only factor that was cited as a barrier, but not a facilitator, was emotional state; experiencing emotional stressors made it more difficult to adhere.

DISCUSSION

Twelve weeks after a one to three week stay at a raw vegan institute, study subjects had increased their adherence to each of the components of the raw vegan diet recommended by HHI. However, only 14 reported at least 80% adherence to the raw vegan diet. In addition to already following the diet, the variables that best predicted adherence to the diet were more education, greater comorbid disease, greater self-efficacy for adherence, fewer close friends and relatives, and worse physical quality of life. The open-ended questions in the follow-up questionnaire offered insight into other factors important to understanding adherence. Subjects noted the negative effect of close friends and family (who were generally not following the raw vegan diet), and also described the raw vegan diet as labor intensive.

Being surrounded and tempted by other foods decreased adherence; however, having faith in it improved adherence, and feeling better on it provided positive reinforcement.

Subjects with more years of education were more likely to adhere to the diet. Some studies have found education to be associated with patient adherence to behaviors such as cardiac rehabilitation (27) and antihypertensive medication (28), and a few have also shown education to be associated with dietary change.(29, 30) Although the link between education and adherence is not well understood, people with higher education are more likely to use CAM in general.(31)

Level of comorbidity, another strong predictor of adherence, is directly related to one year mortality (21), and therefore may be a marker for how sick one perceives oneself to be. Perceived severity of illness can be a motivating factor for behavior change, according to the “Adherence Model” and other health belief models.(3, 32) Such motivation may also help to explain the inverse association of adherence with physical quality of life.

The confidence subjects had in their ability to follow the raw vegan diet was another strong predictor of adherence. This concept, known as self-efficacy (33), has consistently been shown to be important in changing behavior.(34-36) It may be the most relevant predictor variable in the multivariate model because it can be affected by a health care provider or researcher more easily than the other significant factors.

Although social support often is associated with successfully making behavioral changes (36), number of close friends and relatives was inversely related to dietary adherence in this study. A large support network may not help a person adhere to a raw vegan diet since the diet is quite different from most people’s eating patterns. In the qualitative responses, living with others who did not follow the diet and socializing in restaurants were frequently cited as barriers to following the diet.

Locus of control is a type of coping style that, according to some health belief models, can also moderate how a person responds to illness.(32) It was not a significant predictor in this study, perhaps because all subjects had already chosen to go to HHI and had high internal loci of control (results not shown).

Positive predictor variables that were significant, or borderline significant, in the univariate analysis, but not in the multivariate analysis, included income, length of stay at HHI, having friends and/or family on the diet, and interest in following the diet. These variables would be logical predictors of adherence and may not have reached statistical significance because of the relatively small sample size.

The small sample size and the self-selected nature of the cohort of individuals who chose to attend a raw vegan institute limit the generalizability of the findings. In addition, all measures of adherence were self-reported, and none was validated because no validated instruments for measuring adherence to a raw diet are available. Given the nature of the diet and of self-report, it is unlikely that average adherence in the study cohort was actually greater than reported. Also, the use of self-report probably did not bias the analysis of predictors of adherence.

This study provides evidence that some people, especially those with severe disease diagnoses, can adopt and adhere to the extreme dietary change from a largely western to a raw vegan diet; but even in this self-selected population, only a small proportion were able to adhere strictly. Adherence to an extreme diet, such as a raw vegan diet, may be achieved when attention is paid to improving self-efficacy, and by offering logistical support and positive social support. A clinical trial to test the effects of this dietary change should

include methods for increasing self-efficacy, assistance with food purchasing and preparation, positive social support, and guidance for adhering to the diet in social settings.

Examples of raw vegan foods

Vegetables	Mushrooms
Fruits	Flowers
Nuts, nut butters, coconuts	Cold pressed oils
Seeds/seed butters (e.g., tahini paste)	Sea vegetables
Sprouts grains (e.g., wheatberries)	Algae
Sprouted seeds (e.g., alfalfa, broccoli)	Fermented vegetables
Sprouted legumes (e.g., lentils, mung beans)	Dehydrated foods (heated to a temperature below 118°F)
Fatty fruits (e.g., avocados, olives)	
Fresh juices (fruit or vegetable)	

Sample menu at HHI:

Breakfast:

Vegetable juice, wheatgrass juice

Fruit

Snack:

Vegetable juice

Lunch:

Large vegetable and sprout salad with tahini dressing

Half avocado and dehydrated flaxseed crackers

Snack:

Vegetable juice, wheatgrass juice

Apple

Dinner:

Large vegetable and sprout salad with lemon/olive oil dressing

"Pasta" made from coconut and zucchini, with mushroom and red pepper sauce

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Components of the raw vegan diet score

%raw 0 if <20% 1 if 20-<40% 2 if 40-<60% 3 if 60-<80% 4 80%	candy/ dessert 0 if 1x/day 1 if 5-6x/wk 2 if 3-4x/wk 3 if 1-2x/wk 4 if 2x/month	wheatgrass juice 0 if none 1 if 1-2x/wk 2 if 3-4x/wk 3 if 5-6x/wk 4 if 7x/wk
%vegan 0 if <20% 1 if 20-<40% 2 if 40-<60% 3 if 60-<80% 4 80%	processed grains 0 if 1x/day 1 if 5-6x/wk 2 if 3-4x/wk 3 if 1-2x/wk 4 if 2x/month	vegetable juice 0 if none 1 if 1-2x/wk 2 if 3-4x/wk 3 if 5-6x/wk 4 if 7x/wk

%organic 0 if <20% 0.5 if 20-<40% 1 if 40-<60% 1.5 if 60-<80% 2 80%	caffeine (cups) 0 if > 3/day 0.5 if 2.5-3/day 1 if 1.5-2/day 1.5 if 0.5-1/day 2 if none	salad @ lunch 0 if none 1 if 1-2x/wk 2 if 3-4x/wk 3 if 5-6x/wk 4 if 7x/wk
fasting 0 if never 1 if few x/yr 2 if 1x/month 3 if 2x/month 4 if 1x/wk	alcohol (drinks) 0 if >12/wk 0.5 if >8-12/wk 1 if >4-8/wk 1.5 if >0-4/wk 2 if none	salad @ dinner 0 if none 1 if 1-2x/wk 2 if 3-4x/wk 3 if 5-6x/wk 4 if 7x/wk

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Table 1

Baseline characteristics of subjects^a

	Responders		Non-responders		Total	p-value
	Adherent ^b (N=14)	Non-adherent (N=37)		(N=33)		
Demographics						
Age, mean (SD), yrs.	49.8 (13.5)	54.6 (15.8)		54.4 (14.1)	53.8 (14.8)	0.56
Male	3 (21.4)	10 (27.0)		10 (30.3)	23 (27.4)	0.82
Married	7 (50.0)	18 (48.7)		15 (45.5)	40 (47.6)	0.95
White	12 (85.7)	33 (89.2)		28 (84.9)	73 (86.9)	0.18
Employed	9 (64.3)	23 (62.2)		15 (45.5)	40 (47.6)	0.29
Income > \$50,000 ^c	11 (78.6)	23 (62.2)		21 (63.6)	55 (65.5)	0.52
Years of education, mean (SD)	15.3 (2.6)	15.0 (2.5)		15.0 (2.4)	15.0 (2.5)	0.91
Health behaviors						
Used CAM in past yr.	12 (85.7)	31 (83.8)		25 (75.8)	68 (81.0)	0.61
Exercise, mean times/wk. (SD)	6.3 (4.1)	4.8 (3.9)		3.7 (2.9)	4.6 (3.7)	0.08
Following raw diet (80%)	5 (35.7)	3 (8.1)		3 (9.1)	11 (13.1)	0.02
Length of stay, mean (SD), wks. ^d	2.5 (0.9)	2.0 (0.9)		2.3 (1.4)	2.2 (1.1)	0.23
Comorbidity score, mean (SD) ^e	2.6 (2.3)	0.8 (1.6)		1.7 (2.6)	1.5 (2.2)	0.03

^aData are presented as No. (%) unless otherwise indicated.^bBased on a response of 80% to the 12-week follow-up question, "Whether or not you have been trying to follow a raw food diet, about what percent of your diet, by weight, is raw *and* vegan (no dairy, eggs or meat)?"^cOne value missing from 'Adherent,' 4 values missing from 'Non-adherent,' 2 values missing from 'Non-responders.'^dOne missing value from 'Non-responder' group.^eA score 4 is considered severe comorbidity.

Table 2

Adherence to the raw vegan diet

Diet	Baseline ^a mean (SD)	Follow-up mean (SD)	p-value
Raw diet score	15.1 (5.4)	17.0 (5.8)	0.03
Percent of diet raw vegan	43.3 (28.8)	50.4 (31.6)	0.10
Percent of diet vegan	77.4 (29.3)	83.8 (20.8) ^b	0.26
Percent of diet organic	42.0 (33.5)	46.1 (33.6)	0.38
Fasting (times/month)	0.4 (1.0)	1.1 (1.4)	0.01
Consumption of (times/wk.):			
Candy/dessert	3.3 (4.0)	2.1 (2.8)	0.01
Processed grains	4.4 (4.2)	3.3 (3.4)	0.06
Alcohol	4.2 (15.4)	1.6 (3.0)	0.17
Wheatgrass juice	1.4 (2.4) ^b	3.1 (4.2)	0.01
Vegetable juice	3.0 (4.7)	5.9 (6.6) ^b	0.003
Raw salad for lunch	3.4 (2.3)	4.2 (2.4) ^b	0.04
Raw salad for dinner	2.9 (2.1)	3.8 (2.6) ^b	0.02
Caffeinated beverage (no./day)	0.7 (0.9)	0.5 (0.7)	0.05

^aIncludes those with complete follow-up data only.

^bOne missing value.

Table 3

Associations between adherence to the raw vegan program and baseline predictors using multivariate analysis

Variable	Coefficient β	Standard error	<i>p</i> -value
Years of education	0.95	0.18	<0.0001
Raw (80%) at baseline	8.25	1.36	<0.0001
Comorbidity	0.98	0.24	0.0002
Number of close friends	-0.22	0.08	0.01
Number of close relatives	-0.26	0.13	0.05
Self-efficacy to adhere	0.72	0.23	0.003
Physical component (SF-36)	-0.14	0.05	0.005