THE HAWAII DIET:

AD LIBITUM HIGH CARBOHYDRATE, LOW FAT MULTI-CULTURAL DIET FOR THE REDUCTION OF CHRONIC DISEASE RISK FACTORS: OBESITY, HYPERTENSION, HYPERCHOLESTEROLEMIA, AND HYPERGLYCEMIA

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Abstract

Objective: *The purpose of this study was to determine the health effects of a high carbohydrate, low fat multi-cultural traditional diet, The Hawaii Diet, fed ad libitum to an adult population.*

Methods: *Twenty-two adults recruited from various cultural backgrounds in Hawaii were fed, without calorie or portion size restriction, the Hawaii Diet for 21 days. The Hawaii Diet, based on familiar traditional foods from different cultures, is high in complex carbohydrate (77% of calories), low in fat (12% of calories), and moderate in protein (11% of calories). Participants were encouraged to eat to satiety.*

Results: *There was a significant weight loss on The Hawaii Diet averaging 10.8 lbs (23.8 kg) ($P < .0001$). Blood pressure was decreased from an average of 136.0/82.7 mm Hg to 125.5/78.9 mm Hg yielding a significant decrease of 10.4 mm Hg for systolic ($P < .01$). Beginning diastolic levels were normal so decreases in these values were not significant. Average lipid values also decreased with total serum cholesterol being significantly reduced from 205.3 to 156.9 mg/dl ($P < .0001$); LDL from 125.9 to 94.9 mg/dl ($P < .001$); and HDL from 38.3 to 31.3 mg/dl ($P < .0005$). Triglycerides (238.7 to 152.2 mg/dl) and the Chol:HDL ratio (5.8 to 5.2) improved at marginally significant levels ($P < .08$). There was also a significant reduction in blood glucose levels from 112.2 to 91.5 mg/dL ($P < .01$).*

Conclusion*: The Hawaii Diet consisting of high carbohydrate, low fat ethnic meals appears to have a beneficial influence on weight loss and in decreasing systolic blood pressure, total cholesterol, LDL, and blood glucose values. Marginal improvement occurred for triglyceride levels. There was also a significant drop in HDL levels, however, the Chol:HDL was ratio did not increase. Further studies of longer duration with a control group should be conducted to test the effectiveness of The Hawaii Diet in maintaining these health benefits over a longer period of time.*

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Introduction

People in Hawaii live longer than those residing in any other state in the United States.[1,2] A major factor may be the multi-ethnic traditional diets that were brought to Hawaii by the wide range of ethnic groups that have become the basis of the multi-cultural population of Hawaii. The popular use of foods from traditional diets of multi-ethnic, cultural origin occurs to a greater degree in Hawaii than in other regions of the United States.

According to MacGregor, diet is by far the most important environmental factor determining longevity.[3] Traditional diets have historically been associated with low rates of chronic disease from the Pacific to the Mediterranean. Although there is a common use of traditional Asian, Polynesian, and European foods in Hawaii, the modern American diet has rapidly become the dietary mainstay. Along with this change is the gradual increase in all the risk factors of related to the health problems of Americans such as obesity, coronary heart disease, certain cancers, diabetes, and strokes.

In order to evaluate the healthfulness of a modern mix of traditional ethnic foods in Hawaii, individuals of various ethnic backgrounds were placed on a diet composed of the multi-ethnic foods of Hawaii. This diet, called The Hawaii Diet, is a part of a greater program known as the Hawaii Health Initiative which is a whole-person, whole-community intervention strategy to help improve the health of the people of Hawaii. This multi-cultural traditional diet (77% carbohydrates; 12 % fat; and 11% protein) consists of modern versions of traditional dishes from many cultures.

While there are a number of studies that have demonstrated the healthfulness of traditional diets of the Mediterranean and Asia,[4,5] there is some controversy as to whether high carbohydrate – low fat diets are beneficial. The concern stems from certain studies indicating that high carbohydrate diets may increase triglycerides and lower HDL levels.[6] Recent findings also suggest that high insulin levels may be a risk factor for coronary heart disease, and that these may increase due to high carbohydrate diets.[7] This concern is especially relevant in Hawaii where the traditional diets of the ancestors of most people in Hawaii are typically high in carbohydrate.

The purpose of this nutrition-based intervention study was to determine if ad-libitum feeding of high carbohydrate, low fat multi-ethnic meals known as The Hawaii Diet, reduced certain chronic disease risk factors. Measurable outcomes were determined by evaluating weight loss/gain, blood pressure, lipid profile (total cholesterol, LDL, HDL, triglycerides, and cholesterol:HDL ratio), and blood glucose values.

Methods

Study Population: Twenty two participants were selected from various sectors of the community to include the Governor, cabinet members, one legislator, members of one of the Hawaiian homesteads, and various political, business, and community leaders. All resided on the island of Oahu, with the exception of one subject from the Big Island. A screening interview was conducted of individuals from this pool of potential participants. They were selected from this population on the following basis:

1) Commitment to the program and its rules so as to ensure the success of the program.
2) Stability of health problems so as not to pose a danger to the individuals by a complete change in diet.
3) Potential for facilitating change in the community.
4) Ethnic diversity.

Ten men and 13 women whose ages averaged 49.9 years (range = 33 to 89 years of age) were selected for the study. The average weight of the participants was 237 lb (107.7 kg) with a range of 123.5 to 471 lbs (107.8 to 102.9 kg). Of these participants; 13 were of native Hawaiian ancestry, 7 were of Asian ancestry, 2 were or European ancestry, and 1 was of African ancestry. One subject dropped out due to a conflict in scheduling making 22 the final number of participants. Patients were screened to eliminate unstable health conditions such as congestive heart failure, renal insufficiency, unstable angina, and poorly controlled hypertension. Chronic medical conditions of the subjects included: 6 hypertensives on medication; 1 borderline hypertensive not on medication; 4 diabetics on medications with one of these taking insulin; 2 with glucose intolerance; 2 on estrogen replacement therapy; and 1 with thyroid insufficiency taking synthroid. None of the subjects were taking cholesterol lowering medication, but one was taking a fiber supplement, metamucil.

The Diet and Study Design: The Hawaii Diet was designed to demonstrate the effectiveness of a multi-ethnic diet in controlling chronic disease risk factors in a multi-ethnic population. The selection of food on the program consisted of foods from the various ethnic groups in Hawaii such as Japanese, Filipino, Portugese, Italian, Hawaiian, Chinese, Thai, and others. In keeping with the patterns of healthy diets of the Pacific (including Asia), the fat content was kept low (below 12 %) and the animal protein content was limited to approximately 8 ounces per week. The menu included staple foods such as brown rice, pasta, oatmeal, whole wheat bread, taro (a starch root), poi (mashed taro), sweet potato, and yams; assorted vegetables such as salad greens, squash, eggplant, tomato, broccoli, Chinese greens, and seaweed; fruit such as apples, oranges, pears, and papayas, and protein sources such as legumes, tofu, fish, and skinless chicken.

The study period was 21 days. Patients were informed of the protocol, the risks and the benefits of the program, and a consent form was signed. This informed consent form was approved by the Institutional Review Board of University of Hawaii. The participants were instructed to adhere strictly to the dietary regimen and were not allowed to eat any food or drink any beverages other than what was prescribed. All meals were prepared at a common meal site in Honolulu that was conveniently accessed by the participants.

Unlimited quantities of foods were made available except for fish and chicken. To approximate the multi-ethnic diets of the Pacific, estimated to contain approximately 12% fat, the menus were identical to a research project previously conducted in which the food intake was measured carefully and the macronutrients calculated precisely.[6]

The participants were required to come to the meal site twice a day for breakfast and dinner. In the mornings, blood pressures were taken and any individuals who had diabetes had their blood sugar tested. Lunch and snacks were distributed at this time. In the evening everyone met for a health education session over dinner.

The Hawaii Diet Program physician was present each day to evaluate and monitor medical conditions including blood pressures, blood sugars, medications and any other medical problems. Fasting blood panels including HDL and brief physical exams were done at the beginning and at the end of the program. Blood samples were analyzed at the largest licensed commercial laboratory in Hawaii. Weights were taken each day at the meal site on the same balance scale. All official blood pressures were taken by a trained physician or registered nurse. The statistical significance of the results of the program were analyzed using a paired, two-tailed "t" test with a 95% confidence interval for comparing the difference between the means.

Results

Weight loss: The average weight loss on The Hawaii Diet Program was 10.8 lbs (23.8 kg) (range: 2.3 kg to 15kg) or 6.4% of total weight within the three week period (Table 1) ($P < .0001$). BMI decreased from 35.6 to 34.09 for a total decrease of ($P < .0001$).

Blood pressure: Systolic, but not diastolic blood pressure fell significantly. The average systolic blood pressure decreased from 136.0/82.7 mm Hg to 125.5/78.9 mm Hg yielding a significant decrease of 10.4 mm Hg for systolic blood pressure ($P < .01$).

Serum Lipids: Average lipid values also decreased with total serum cholesterol being significantly reduced from 205.3 to 156.9 mg/dl ($P < .0001$); LDL from 125.9 to 94.9 mg/dl ($P < .001$) (n=19 because three of the participants had triglyceride levels that were too high to use for LDL calculation); and HDL from 38.3 to 31.3 mg/dl ($P < .0005$). Triglycerides (238.7 to 152.2 mg/dl) and the Chol:HDL ratio (5.8 to 5.2) were also reduced, but at levels that were marginally significant ($P < .08$).

Serum Glucose: There was also a significant reduction in blood glucose levels from 112.2 to 91.5 mg/dL ($P < .01$). The significance of the effect of the diet on serum glucose is difficult to assess because four of the subjects were diabetics on medications and two additional subjects were glucose intolerant. All who were on medication had their dosages reduced. Of those who were not on medication, all experienced a reduction in their fasting blood glucose measurements.

Discussion

In general, ecologic studies on the relationship between traditional diets and health indicate that there is an association between modernization of diet and the rising rates of obesity and other cardiovascular risk factors.[9,10] Obesity is often associated with the cardiovas-

Table 1.— Average change in health risk factors for a multi-ethnic population (n=22[a]) after 21 days on The Hawaii Diet.

Health Risk Factor		Before	After	Change	p*
Weight	lbs	237.2	226.3	-10.8	< .0001
	(kg)	107.8	102.9	-4.9	
BMI	(kg/m2)	35.6	34.0	-1.6	< .0001
Blood Pressure					
	Systolic	136.0	125.5	-10.4	< .01
	Diastolic	82.7	78.9	-3.8	< .07
Cholesterol	(mg/dl)	205.3	156.9	-48.5	<.0001
	(mmol/l)	5.3	4.1	-1.25	
HDL	(mg/dl)	38.3	31.3	-7.0	< .001
	(mmol/l)	1.00	0.8	-1.3	
LDL [a]	(mg/dl)	125.9	94.9	-31	< .001
	(mmol/l)	3.3	2.5	-0.8	
Chol/HDL ratio		5.8	5.2	-0.6	< .08
Triglycerides					
	(mg/dl)	238.7	152.2	-86.5	< .08
	(mmol/l)	2.7	1.7	-1.0	
Glucose	(mg/dl)	112.2	91.5	-20.6	< .01
	(mmol/l)	6.2	5.1	-1.1	

[a] n=19; 3 participants had triglyceride levels too high for LDL calculation.

cular risk factors of hypertension, high total blood cholesterol, high LDL, low HDL, and higher fasting insulin levels.[11] Other major conditions associated with obesity are some cancers, osteoarthritis, and gall bladder disease.[12,13] Obesity is a particularly problem for Hawaiians and Samoans,[14-17] however, unexplained differences in diet and physical activity, suggests that genetic factors play an important role in the high prevalence of obesity in Native Hawaiians.[18] Nevertheless, multifactorial risk factor reduction is the most substantial benefit in decreasing cardiovascular morbidity and mortality.[19]

Weight Loss: Studies have been conducted that show the value of a low fat diet in producing weight loss.[20] Specifically, weight loss has been reported on ad libitum feeding of individuals with a low energy density (LED) diet.[21] Our previous study utilizing the ad libitum feeding of very low fat (less than 10%), high carbohydrate (78%) pre-Western contact traditional diet yielded results that are consistent with these studies.[5] These studies suggest that a low fat, high carbohydrate, low energy density diet will produce steady and safe weight loss sustained over a long period of time. Other research states that neither a low (35%) or high (45%) carbohydrate diet at hypocaloric levels of 1200 Kcal/day had a greater advantage when measuring weight loss.[22] On the other hand, high energy density high fat foods have been suggested to facilitate the overconsumption of fat.[23]

The multi-cultural Hawaii Diet in this study is both low in fat content (less than 12%) and low in energy density (0.80 cal/gm). The average weight loss observed in this study (3.6 lbs/1.6 kg per week) was somewhat greater than that found in other studies using LED diets (Weinsier 0.68 kg/wk)[24] and ad libitum low fat diets to reduce weight (Lissner 0.45 kg/wk)[25] or other health risks (Buzzard, 0.23 kg/wk).[26]

These observations may be explained by the relatively high initial weight and BMI of the participants. The weight loss may also be explained by the lower fat content of this diet (12%) compared to that of other programs (15-23%). This hypothesis is based on studies that suggest that percent body fat retention is related to percent fat in the diet,[27,28] and that according to Pagliassotti et al., genetically obese-prone rats do not become obese when fed low-fat diets.[29] Carmichael and associates also reported that a lower fat intake serves as a predictor of initial and sustained weight loss in obese subjects consuming an otherwise ad libitum diet.[30] Another factor contributing to the greater weight loss in this program may be the high carbohydrate content in this diet that some studies suggest is directly proportional to the amount of weight loss. This hypothesis is based on the thermogenic effect of carbohydrate[31] and on evidence that shows that only a small percentage of carbohydrate is actually converted to body fat.[32,33]

These results and those of other recent studies, suggest that varying the mix of nutrients, in particular the amounts of fat and carbohydrate, may be an effective way of dealing with obesity without requiring calorie counting. This is supported by Astrup et al. who reported that after a major weight loss, an ad libitum low-fat diet program appears to be superior to caloric counting in maintaining weight loss two years later.[34] It appears that ingesting LED diets contributes to self-regulation of caloric intakes that decrease naturally as reported in previous studies with the traditional Hawaii diet which is naturally low in energy density.[5] Supporting the importance of energy intake is Ernst et al. who reported that, "A focus on fat intake alone without emphasis on energy balance is inadequate for achieving and maintaining recommended weight."[35]

Recently there has been some debate as to whether carbohydrates cause a rise in insulin and therefore helps to reduce obesity. This study suggests that a traditional high carbohydrate diet based on whole traditional foods that are low in energy density helps to control blood sugar, insulin, and obesity.

Hypertension: The significant decrease in systolic blood pressure in this study may have been related to the observed weight loss and/or decreased dietary sodium. Data involving 361 participants suggested that weight loss in the range of 4% to 8% of body weight was associated with a decrease in blood pressure in the range of 3 mm Hg systolic and diastolic.[36] The decrease in systolic, but not diastolic blood pressures observed in this study may have been influenced by the blood pressure values prior to The Hawaii Diet. Five subjects had high systolic blood pressure values compared to only one subject with high diastolic blood pressure before the study, and all 6 cases of hypertension normalized after being on the Hawaii diet for 3 weeks.

Serum Lipids: The decrease in serum cholesterol could be attributed to the low fat, low cholesterol content of the multi-ethnic foods

in the Hawaii Diet .[37,38] Induced weight loss may also play a part in lowering cholesterol although even massive weight loss does not necessarily induce a decrease in cholesterol.[39] There was a moderate decrease in LDL, and a slight significant decrease in HDL. Although the decrease in HDL is not desirable, the decrease in total cholesterol yielded a net decrease in cardiovascular risk through the slight decrease in Chol/HDL ratio. The reduction in triglycerides is consistent with high carbohydrate diet studies[32,33,40,41] and inconsistent with others that indicate that high a carbohydrate diet causes a rise in triglycerides.[42,43] The triglyceride levels and Chol/HDL ratio marginally reduced on this high carbohydrate diet (contrary to other high carbohydrate studies) were possibly due to the use of more whole carbohydrate foods such as whole grains and legumes instead of refined carbohydrate sources such as sugar and white bread.

The moderate reduction in serum lipids with this diet occurred over a relatively short period. This suggests that a longer period on this very low fat diet could result in even lower lipid levels and a greater decrease in cardiovascular risk than currently demonstrated. A recent diet study that yielded reduced cholesterol levels and radiographic evidence of reversal of atherosclerosis used a diet that was similarly very low in fat (10%) and suggests that The Hawaii Diet would have similar results.[44]

Blood Glucose: The decrease in fasting blood glucose was consistent with other programs using high complex carbohydrate, high fiber diets in the management of diabetes.[45,46] The higher fiber content of The Hawaii Diet, especially soluble fiber, may contribute to what Chandalia et al. observed as improving glycemic control, decreasing hyperinsulinemia, and lowering plasma lipid concentrations in patients with Type II diabetes.[47] The individual taking psyllium supplements saw a reduction of blood sugar from 219 mg/dl to 120 mg/dl indicating that diet had a great impact over and above his baseline fiber supplement use.

As stated above, interpretation of this data is difficult due to four diabetic subjects in the study on medication, along with two subjects diagnosed with glucose intolerance. Because all 6 participants who had high starting fasting serum glucose levels had significantly lower blood sugar levels at the end of three weeks on the diet, with an average reduction of 55 mg/dl, it appears that the overall reduction in blood sugar would be even greater if this study were conducted with participants who all had elevated beginning fasting blood sugar levels. In addition, because there is a close correlation between blood sugar levels and insulin levels,[48] it may be inferred that insulin levels were also reduced by this diet, further decreasing cardiovascular risk.

Conclusion

The high carbohydrate, low fat, low energy density, multi-ethnic Hawaii Diet administered *ad libitum* was demonstrated to induce a significant weight loss and a reduction in systolic hypertension, total cholesterol, LDL, and serum glucose. Triglycerides and Chol:HDL ratio were marginally reduced.

Because these improvements in health risk factors were obtained without calorie restriction or portion-size limitations (with the exception of animal protein), this has important implications in long-term adherence to such a diet. Further research is needed to assess the long term effectiveness of such a program. In addition, the paradoxical impact of this high carbohydrate, low fat diet on triglycerides and glucose suggests that further study of this approach is warranted with an emphasis on the source of the carbohydrates and the overall energy density of the diet.

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"DNR Orders..." references continued from p. 67

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