Uli'eo Koa program: incorporating a traditional Hawaiian dietary component

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Abstract

Traditional Hawaiian Diet (THD) programs were developed over the past 15 years as a culturally appropriate community intervention for improving the health status of Native Hawaiians. THD programs are generally three weeks in length and incorporate a diet regimen of foods traditional to the Hawaiian culture, coupled with an education component that emphasizes cultural beliefs and practices that support health and wellness. In accordance with traditional practice, THD meals consist mainly of vegetable foods, with controlled amounts of protein. THD programs have demonstrated high success in weight reduction of severely overweight individuals, as well as reductions of serum cholesterol, triglycerides, glucose, and blood pressure. THD programs, to date, have focused on the reduction of these risk factors. The Uli'eo Koa Program, Warrior Preparedness Program, is a pilot study that incorporated a traditional Hawaiian diet component to ascertain its effects on a group of moderately active, non-obese Native Hawaiian adults—specifically the diet's contribution to wellness and physical fitness. Other components of the Uli'eo Koa Program were a physical exercise regimen and a traditional healing component. The purpose of the dietary component of the Uli'eo Koa Program was to provide the nutritional support needed to sustain nutritional requirements for increased physical activity within this group. The year-long Uli'eo Koa Program consisted of three phases. In Phase I, exercise was conducted twice a day and three meals, including snacks, were provided for participants over a three-week period. During Phase II, structured exercise time and meals were decreased to three times a week and two times a week, respectively, for eight weeks. Participants were responsible for maintaining these regimens on their own outside of the structured activities. In Phase III (in progress at the time of this manuscript preparation), the remainder of the program year, participants were solely responsible for structuring their own physical and dietary behaviors. The nutrient composition of the meals followed a traditional Hawaiian diet, which was typically high in complex carbohydrates, low (< 10%) in total dietary fat and limited in protein (as compared to a standard American diet). Dietary assessments were conducted at the onset (baseline) of the program, using a 24-hour dietary recall methodology. When the post-dietary assessments, conducted at the end of Phase II, were compared to the baseline assessments, positive results were indicated by the reported increases in intakes of all major nutrients, including key vitamins and minerals required for exercise. A final dietary assessment will be conducted at the end of the program year (Phase III) to determine maintenance of positive dietary habits. Implications and future research are discussed.

Introduction

This paper will discuss the development and implementation of a Traditional Hawaiian Diet (THD) program and its incorporation as the dietary component of the Uli'eo Koa (warrior preparedness) Program. The Uli'eo Koa dietary component utilized dietary assessments at specified points in the program to measure changes over the 11-week period (Phases I and II) in the level of National Research Council (NRC) recommendations for dietary intakes[1] by participants.

The THD was one of four components (diet, exercise, *lomi lomi* and spirituality) of the Uli'eo Koa Program included to support the nutrient demands of an intense physical activity regimen, in addition to growth and repair of the body. The purpose of the program was to assure adequate intake of specific nutrients by participants who would be engaged in heightened physical activity. This pilot program aimed at demonstrating the efficacy and adequacy of the THD and the entire Uli'eo Koa Program in maintaining and increasing physical fitness levels of moderately active Native Hawaiian adults.

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Table 1. Composition of traditional Hawaiian diets

Nutrient composition	Examples
Carbohydrates (78%)	
Starchy Vegetables	Taro, sweet potato, breadfruit, yams
Leafy Greens	Taro leaves, sweet potato leaves
Other Vegetables	Fern, seaweed
Fruits	Berries, banana, mountain apple
Protein (12%)	Fish, shellfish, chicken
Fat (10%)	Coconut, chicken, fish, human milk

Background

The traditional diet of Hawaiians prior to the arrival of Westerners to Hawai'i in 1778 was largely plant-based (see Table 1), and consisted mainly of starchy and leafy green vegetables, a few fruits, moderate amounts of protein, and minimal fat[2]. In 1987, Blaisdell estimated the nutrient composition of the traditional Hawaiian diet was approximately 78% carbohydrates, 12% protein, and 10% fat.

Traditional Hawaiian Diet (THD) programs were developed in 1989 as a culturally appropriate community intervention model for improving the health status of Native Hawaiians[3]. The THD programs succeeded the 1987 Ho'oke 'Ai - Moloka'i Diet Study (MDS), an investigation scientifically designed to demonstrate the serum lipid lowering effects of the traditional Hawaiian diet[4]. The THD program integrates a diet of traditional Hawaiian foods and instructional components of cultural history and wellness in a three-week program. THD participants are provided three daily meals plus snacks. They eat ad libitum amounts of vegetables, some fruit, and five to six ounces of protein. The programs have been designed such that some of the meals (usually breakfast and dinner) are eaten in a group setting—i.e., congregate dining with education and "talk story" sessions that complement the evening meal.

The traditional Hawaiian diet, coupled with education sessions that emphasize Hawaiian cultural and wellness concepts, was first tested in the Moloka'i Diet Study (1985). The program proved to be highly successful in lowering serum lipids for obese and severely obese adults. However, weight loss was not a goal for the Moloka'i Diet Study, and in fact, the program added calories to the diet to maintain a stable body weight.

Successive THD programs over the next decade produced consistent improvements in blood pressure, serum cholesterol, triglycerides, and glucose levels[5] and weight loss. The Wai'anae Diet Program (WDP) was the first community-based THD intervention to demonstrate this success, with a specific focus on weight loss. An average weight loss of 17.1 pounds was achieved in the three-week WDP in 1989. Serum cholesterol decreased 14.1% and the ratio of high-density lipoprotein to low-density lipoprotein improved, reducing the risk of heart attack by an estimated 28%. Additional findings included (a) an average decrease in serum glucose levels from 161.9 mg/dl to 123.4 mg/dl; (b) an average reduction of triglycerides from 211.3 to 163 mg/dl; and (c) average decreases in the systolic and diastolic blood pressures of 9% and 11%, respectively.

Although different THD programs have documented their effects on weight, serum lipids, glucose, and blood pressure, there have been no reports on the effects a traditional diet may have in relation to an exercise or fitness component.

Methods

Participants

Twelve Native Hawaiian adult males and four adult females were recruited from an existing exercise group that met once a week. Participants ranged in age from 22-64 years old. All participants were moderately active prior to the program, and none were obese, defined as having a body mass index (BMI) ≥ 30 kg/m^2. Participation in the program was voluntary and all participants were active members of a Hawaiian group that practiced a traditional Hawaiian art of fighting.

Program description and procedures

Phase I. Phase I of the Uli'eo Koa Program consisted of three weeks of daily exercise and meals, and provided three daily meals and snacks. A Hawaiian-owned-and-operated catering company ('Ai Pono) that had extensive experience preparing and conducting THD programs throughout the state was contracted to provide meal service. Meals were prepared and brought to the meeting site twice a day. Breakfast and dinner were served buffet-style and protein and dessert foods were pre-portioned to specified weights. Lunch and snacks were pre-packed for participants to take to work daily. The breakfast was preceded by an hour of light physical workout and dinner meals were preceded by an hour of intense physical exercise. Various guests were invited to share informa-

Table 2. Nutrient composition of Uli'eo Koa meals compared to recommended nutrient composition of meals for athletes in training

Nutrient composition	Male		Female	
	Uli'eo Koa	Recommended	Uli'eo Koa	Recommended
Kilocalories	4,055 - 4,353	3,000 - 6,000	2,412 - 3,068	2,000-4,000
Carbohydrate	71 - 76%	44 - 65%	71 - 74%	46 - 60%
Protein	15 - 19%	12 - 17%	16 - 21%	13 - 16%
Fat	8 - 11%	20 - 40%	9 - 10%	26 - 38%

tion on Hawaiian health, wellness, language, and cultural concerns.

Phase II. During Phase II of the program, prepared meals for participants were reduced to two evening meals per week. Exercise as a group during this eight-week period was also less frequent. Participants met once during the day three times a week for intensive evening exercise. Dinner was provided after the exercise on two of the three evenings. Other than the scheduled group exercises, participants were responsible in Phase II for the level of exercise they desired to maintain. Many participants reported continuing their morning exercise, either alone or with a partner. During this second phase, participants were responsible on their own for all other meals. Daily meal analyses and nutrient intakes were discontinued during this phase.

Phase III. Phase III of the program began immediately after the initial eleven weeks, and the final program assessments will be conducted at the point that marks one year from the beginning of the study. One of the assessments to be completed will be another 24-hour dietary recall and will examine the maintenance of dietary habits and practices of the program.

Food substitutes. Due to the high cost and limited availability, it was not feasible to serve certain traditional Hawaiian foods at every meal. Brown rice and lean chicken were often served instead of poi, made from the taro corm, and fish in daily meals. For increased variety, other vegetables, such as Chinese cabbages, tomatoes, and broccoli, were often used in the place of taro leaves and sweet potato leaves. The substitutions enabled participants to adhere to the dietary regimen and to learn about appropriate food alternatives. Additionally, these substitutes provided variety to the menu.

Nutrient analysis. The objective of the dietary component was to measure the food consumed and to assure adequacy of nutrients for development of the desired physical capacities of Uli'eo Koa participants. Composition of the Uli'eo Koa dietary component differed from previous THDs in that larger portions and higher nutrient intakes of non-protein foods were allowed to provide the required nutrients for intense daily exercise.

Table 2 shows recommendations from an article in *Sports Medicine* for the total energy and nutrient intake for adult male and female athletes in training (see "Recommended" columns). For comparison purposes, Table 3 shows what Uli'eo Koa participants consumed while on the traditional Hawaiian diet. Note the differences in fat and carbohydrate compositions.

Table 3. Average percent of the National Research Council (NRC) dietary standards fulfilled

Selected major nutrients	Pre/Baseline	Post
Calories	97%	107%
Protein	141%	219%
Carbohydrate	89%	99%
Fiber	96%	140%
Fat	101%	103%
Saturated Fat	114%	83%
Monounsaturated Fat	102%	110%
Cholesterol	83%	82%
Vitamin A	175%	326%
Vitamin C	135%	517%
Vitamin E	73%	124%
Calcium	59%	120%
Iron	140%	204%
Sodium	128%	147%

To ensure that the meals met specific nutrient requirements, the nutrient content of all meals, snacks, and drinks was analyzed each day during Phase I. The cook provided the nutritionist with the daily menu to calculate the nutrients provided and to determine whether the cumulative nutritional value met nutrient requirements. Portion sizes and recipes were adjusted in consultation with the cook to assure that all nutrient requirements would be met. These calculations were made for males and females and by age groupings due to differing nutrient requirements. Each day participants received the day's menu listing recommended portion sizes for males and females. Participants were informed that the portions recommended were designed to accommodate their increased physical activity. Recipes were also made available to participants.

Nutritional analyses for all menu items were calculated daily using the Food Processor Nutrition Analysis and Fitness Software Version 7.0[6]*. The nutrient composition was determined for an average-sized portion of each menu item. Serving sizes and additional foods from the menu were recommended for participants to meet their specified calorie, protein, fat, and nutrient needs each day. Food portions and additions to meet nutrient levels were discussed with the cook each evening to facilitate menu adjustments for the following day. Meal nutrient analysis was not done in Phase II of the program.

Nutrient composition. The participants were given menus detailing the recommended intake for foods each evening. The participants did not always eat the amount of foods recommended; thus, individual and group counseling on meeting the NRC standards was provided. The unique food groups of the Uli'eo Koa diet appeared to have made a difference in achieving the nutrient levels typically recommended for male and female athletes in training (see Table 2).

The Uli'eo Koa meal compositions were designed to achieve higher total calories for male participants through increased portions of carbohydrates, protein, and fat. Although the male participants consumed larger portions of food than the females, the percentage of calories from carbohydrates, protein, and fats was approximately the same for both sexes. For example, males received between 71% to 76% of their calories from carbohydrates and females received 71% to 74% of their calories from carbohydrates (see Table 2).

24-hour dietary recall. The nutrient intake of each participant was assessed at baseline (Day 1) and following Phase II of the program, which was eleven weeks after the baseline assessment.

The nutritional assessments were based on a 24-hour dietary recall—a standard research methodology for determining usual food intakes. Each program participant was interviewed by a Registered Dietitian and a Public Health Nutritionist (who were Native Hawaiians). All foods and drinks consumed in the preceding 24-hour period were recorded along with information on usual dietary practices. Measuring cups and spoons were available as visual aids to assist participants in recalling accurate amounts of all foods and drinks consumed. Another 24-hour dietary recall is planned at the end of the study, which will occur one year from its start date.

Measures

The major nutrients selected for analysis in this report were: kilocalories; protein; carbohydrate; fat; saturated fat; monounsaturated fat; fiber; cholesterol; Vitamins A, C, E; calcium; iron; and sodium. These nutrients were selected because of their roles in energy metabolism and chronic disease prevention. Nutrient intake data were assessed using Food Processor Nutrition Analysis and Fitness Software Version 7.0[6], a software program designed to analyze all menus and recipes[6]. This information was compared to the NRC dietary standards intake for gender and age. For example, a person might have been consuming 181 grams of fat in a 24-hour period. Comparing the NRC dietary standards for that person's age and gender, the program would compute the fat consumed as 184% of NRC dietary standards.

Results

Table 3 lists the average percent NRC dietary standards fulfilled among participants before Phase I and after Phase II of the study.

Kilocalories. The average NRC dietary standards for kilocalories increased slightly in the post assessment compared to baseline assessment. One reason for this change is that individuals reported eating breakfast during the program compared to their previous practice of skipping breakfast—thus accounting for the increased nutrient intake.

Protein. Post-assessments showed a major increase in average protein intake among participants. Based on the 24-hour dietary recall information, an increase in milk consumption occurred among all participants. Milk contains high levels of high-quality protein.

Carbohydrate. The slight increase in total carbohydrate intake in the post-assessment can be attributed to increases in daily sweet potato, poi, taro, whole wheat

**Nutrient standards used in this program included National Research Council's Recommended Dietary Allowances, Estimated Safe and Adequate Amounts and Dietary Guidelines.*

bread, brown rice, cereals, and milk consumption reported by participants during the program. Milk contains appreciable amounts of carbohydrates. In addition, the frequency and consumption of milk increased throughout the program.

Fat, saturated fat and monounsaturated fat. There was only a negligible increase in dietary fat intake. An important factor to consider in regards to fat intake is the type of fat that was consumed. Saturated fat, which is one of the major nutrients responsible for raising low-density lipoprotein (LDL), noticeably decreased in the participants' diets. Monounsaturated fat and polyunsaturated fat (not shown on this table), which are responsible for increases in high-density lipoprotein (HDL), increased. These are desirable outcomes. The increase in total fat consumed was attributed to the increase of foods with monounsaturated fat rather than saturated fat, which may have lowered participants' serum lipid levels. Increased fiber intake and physical activity also may have played a role in reducing serum lipid levels.

Fiber. A considerable benefit of the Uli'eo Koa diet was the increased fiber intake, which has been shown to decrease serum cholesterol levels and ultimately reducing the risk of heart disease and certain cancers. Dietary fiber intake increased dramatically due to increased consumption of vegetables, fruits, whole grains, cereals and breads.

Cholesterol. The overall cholesterol levels never exceeded 100% of the NRC dietary standards. There was no noticeable change in dietary cholesterol between the baseline and post-assessment. Cholesterol is found only in animal products. The traditional Hawaiian diet provided large quantities of fish, very little chicken and other fowl, and no high-fat red meat. Uli'eo Koa served mostly fish, some chicken, and no high-fat red meat.

Vitamins A, C, E. Vitamins A and C intakes increased approximately two-fold and more than three-fold, respectively, in the post-assessment compared to baseline. This was attributable to the increase in reported consumption of fruits and vegetables. The increase observed in Vitamin E may be explained by the additional consumption of hot and cold breakfast cereals and whole wheat bread.

Calcium. The increased milk consumption among nearly all participants explains the dramatic rise in calcium intake. Adequate calcium intake was stressed on the diet program due to its role in muscle contraction and prevention of osteoporosis.

Iron. Fortification or enrichment of iron in foods, such as breads, cereals, and whole grains, in addition to iron naturally found in the protein foods, may explain the increases in iron intake among all participants at post-assessment. Increased iron intake among physically active individuals is essential for its crucial role in oxygen transfer and utilization.

Sodium. There was a reported 19% (NRC) increase in sodium between the pre- and post-assessments. This may be attributable to the increased consumption of high-sodium foods such as milk, breads, and cereals that have sodium-based preservatives. It is important to provide sufficient sodium in the diet to prevent electrolyte imbalance; however, excess among athletes is unnecessary and extremes are to be avoided.

Discussion

A reported 43% of all Native Hawaiian adults are obese—the highest prevalence of obesity among the five major ethnic groups in Hawai'i[7]. Obesity is a major risk factor for specific chronic diseases, such as cardiovascular disease, some cancers, and diabetes. Other risk factors, such as elevated serum cholesterol and trigylcerides, and hypertension have been associated with specific chronic diseases and can occur among both obese and non-obese individuals. Decreasing these types of risk factors associated with chronic diseases is important to deter the onset of these debilitating conditions.

The health status of the Native Hawaiians needs to be restored. A major step in preventing and delaying onset of chronic disease and early death attributed to chronic conditions is through the implementation of a culturally appropriate program of diet and physical activity. Efforts should be made to maintain and improve the health of Native Hawaiians who are not yet obese and are moderately active—thus the purpose of the present study.

The Uli'eo Koa Program, Warrior Preparedness Program, is the first to test the effects of traditional Hawaiian diet and exercise on the fitness capacities of individuals. Warriors (*koa*) of ancient Hawai'i exhibited great strength and endurance sustained by their traditional, predominantly plant-based diet. This runs contrary to a popular practice among some athletes today, albeit not recommended by Western science, which follow high protein, highly supplemented vitamin and mineral sports diets. Because adherence to the food components of the traditional Hawaiian diet played a vital role in the program, it was important to assure that the diet provided adequate nutrients for the participants and that consideration be given to financial and time constraints of the program.

Dietary intakes were assessed and compared to the NRC dietary standards specific to age and gender of each participant. Dietary assessments, based on a 24-hour recall for each participant on the Uli'eo Koa Program, showed improvements in overall dietary habits after Phase II compared to baseline. Overall, there were

reported increases in consumption of milk, vegetables, fruits, and whole grain foods in the post-assessment compared to baseline. In part, this was due to more participants (except one who was ill) consuming breakfast regularly compared to baseline, and to the replacement of less-nutritious foods previously eaten daily. Further, a number of participants went from eating no fruits or vegetables to 10 or more combined servings of fruits and vegetables per day. These dietary improvements helped increase nutrients to amounts that exceeded the NRC dietary standards. Particularly important were increases in all nutrients involved in chronic disease prevention.

Limitations of the study should be considered, however. This investigation utilized the 24-hour dietary recall technique, which may be susceptible to socially desirable responding. It should be noted that this method is routinely used in diet studies to determine typical food intake in individuals. In addition, the participants, through direct interview, did not hesitate to disclose their eating habits, including those practices that are known to be unhealthy, such as high alcohol intake. This face-to-face interview methodology is related to the customary Hawaiian practice of kūkākūkā, or "talk story." When there is trust in the relationship, "talking story" is a common method for sharing information. It was important that the nutrition experts conducting the dietary recall were both Native Hawaiian and familiar with Hawaiian foods and eating habits. Participants were forthcoming with information on alcohol intake (i.e., more than 10 drinks per day), number of meals eaten (i.e., sometimes only one), and amounts and types of snacks eaten (i.e., two to three snacks per day); the recalls were descriptive and informative. This was helpful in interpreting the reasons for increases and/or decreases in percentages of the NRC dietary standards fulfilled. For example, a major increase in protein consumption was due to the fact that the majority of the participants started drinking milk. Skim and 2% milk were offered for every meal and the importance of calcium, including its role in physical activity, was taught. Many participants went from drinking no milk to drinking one to two glasses for at least two meals per day.

Another limitation is that the daily physical activity output of each participant was not considered in the comparison of the NRC dietary standards' intakes between baseline and after the three-week intensive program. Therefore, the NRC dietary standards recommended for their age and gender may actually be underestimated.

Further, although detrimental health effects due to substantial increases in intake of certain nutrients should be considered, intake that reportedly exceeded NRC dietary standards for a specific nutrient may have been desirable considering the high level of physical exercise engaged in by participants. Future investigations should explore the issue of what is a significant NRC percent change (no inferential statistical procedures were performed for the present study), and what types of changes are beneficial versus perhaps detrimental. Inclusion of a control group would also increase confidence in the conclusions drawn in an effort to rule out other possible factors affecting nutritional change.

Despite these considerations, the present study demonstrated the potential positive effects of a semi-structured, culturally appropriate, diet-exercise program for Native Hawaiians across a wide range of nutritional outcomes. Implications for further study are warranted, including a more in-depth analysis of nutrients and their correlation to the physical component of the Uli'eo Koa program. Further analyses could be expanded to study food practices and choices, as well as the probability of adopting new foods and diet practices within the study timeframe.

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References

1. National Research Council. *Recommended Dietary Allowances, 10th edition.* National Academy Press, Washington DC; 1989.
2. Blaisdell RK. Ke Ho'oke 'Ai: The Moloka'i Diet. *Ka Wai Ola OHA, Hawai'i,* 1998; July: 26.
3. Hughes CK. Traditional Hawaiian diet programs: a culturally competent chronic disease intervention. *Pacific Health Dialog,* 1998; 5(2): 328-331.
4. Aluli NE. Prevalence of obesity in a Native Hawaiian population. *American Journal of Clinical Nutrition,* 1991; 53: 1556S-1560S.
5. Shintani TT, Hughes CK, Beckham S, *et al.* Obesity and cardiovascular risk intervention through ad libitum feeding of traditional Hawaiian diet. *American Journal of Clinical Nutrition,* 1991; 53: 1647S-1651S.
6. ESHA Research. *Food Processor Nutrition Analysis and Fitness Software Version 7.0.* ESHA Research, Inc., Salem, OR, USA.
7. Department of Health, State of Hawai'i. *Prevalence of Obesity By Gender, Age, and Race—Adult Populations in Hawai'i, HHS 1998.* Office of Health Status Monitoring, Hawai'i State Department of Health, Honolulu, Hawai'i, (December 7) 1999. URL: http://mano.icsd.hawaii.gov/doh/stats/surveys/table3_1.html. May 29, 2001. ■