Mediators of Lifestyle Behavior Change in Native Hawaiians

Initial findings from the Native Hawaiian Diabetes Intervention Program

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OBJECTIVE — To examine the association of stage of change with diet and exercise behaviors in response to a lifestyle intervention for Native Hawaiians (NHs).

RESEARCH DESIGN AND METHODS — A family ('ohana) support lifestyle intervention was compared with a standard intervention in NHs with or at risk for diabetes in two rural communities in Hawaii (n = 147). Stage of change, as a hypothesized mediator of behavior change, and dietary and exercise behaviors were measured at baseline and at 1 year postintervention.

RESULTS — Stage of change was significantly associated with positive dietary and exercise behaviors. NHs receiving the 'ohana support (OS) intervention were more likely to advance from pre-action to action/maintenance for fat intake and physical activity than the group who received the standard intervention. Participants in the OS group who advanced from pre-action to action/maintenance showed more improvement in fat intake and physical activity than those in the standard group.

CONCLUSIONS — These initial findings suggest that stage of change is an important factor in mediating lifestyle behavior changes in persons with or at risk for diabetes and merits further study among minority populations at high risk for diabetes.

Diabetes Care 24:1770–1775, 2001

Native Hawaiians (NHs), the indigenous people of Hawaii, have the second highest rate of type 2 diabetes in the U.S. and have an increased risk for new cases of diabetes due to high rates of obesity, impaired glucose tolerance, and insulin resistance syndrome (1–4). Diet and exercise habits play a major role in the management and prevention of diabetes, and not surprisingly, a variety of interventions have been developed to address these adverse lifestyle behaviors (5–8). Unfortunately, few intervention programs have evaluated the process of changing lifestyle behaviors in individuals with diabetes, and furthermore, successful lifestyle behavior changes have not been consistently reported by all programs. Even less is known about how these processes may unfold in unique high-risk populations such as NHs. Understanding the process of behavior change may provide insight into the variable rates of success found and may also aid in the development of more effective methods for improving lifestyle behaviors in individuals with diabetes.

The process of changing behaviors is complex, and several theories have been proposed to predict and/or explain observed lifestyle behaviors (9–11). The Transtheoretical Model and Stages of Change has been successfully used to predict diet and physical activity behaviors (12–22). Unfortunately, few studies have included individuals with chronic diseases or a significant number of ethnic minorities. Therefore, the Native Hawaiian Diabetes Intervention Program (NHDIP) sought to evaluate the Stages of Change model as a potential mediator in changing lifestyle behaviors in NHs with or at risk for diabetes.

The NHDIP was a 4-year research project in which the main objective was to determine whether a lifestyle intervention implemented with a family ('ohana) support (OS) person would improve lifestyle behaviors compared with standard intervention (SI). We hypothesized that the implementation of a "helping relationship" in the OS group, via the OS person, would enhance movement along the stages of change and thus mediate improvement in lifestyle (diet and exercise) behaviors (9). A culturally responsive lifestyle intervention was developed and then implemented by peer educators in two rural NH communities (23). The primary purpose of this analysis was to evaluate *1*) whether participants receiving the OS lifestyle intervention showed greater improvements in diet and exercise behaviors and stages of change compared with the SI group and *2*) whether forward movement in stages of change was associated with improvement of healthful diet and exercise behaviors.

RESEARCH DESIGN AND METHODS

— The overall study design was a nonrandomized, concurrent intervention with assignment of OS to the West Kauai community and SI to the North Kohala community. A quasi-

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Received for publication 19 October 2000 and accepted in revised form 19 June 2001.

Abbreviations: MET, metabolic equivalent; NH, native Hawaiian; NHDIP, native Hawaiian Diabetes Intervention Program; OR, odds ratio; OS, 'ohana support; SI, standard intervention; SOC, Stage of Change.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

experimental design with ecologic assignment of the intervention was chosen for two major reasons: *1*) the concept of randomization was not culturally acceptable in these NH communities; and *2*) individual treatment assignment would have been highly susceptible to cross-contamination, considering the use of a lifestyle intervention arm. Of the 250 eligible NHs invited to participate, 147 (59%) agreed to enroll in the study (OS group, $n = 72$; SI group, $n = 75$) (1,24). Eligible participants that enrolled in the program were not significantly different from those who did not volunteer for the study in terms of glucose intolerance, presence of diabetes, mean weight, and NH blood quantum. Eligibility criteria for the study included: *1*) resident of the study communities; *2*) NH ancestry (self-reported); *3*) age ≥30 years and nonpregnant; and *4*) presence of diabetes (previous diagnosis or positive result on 2-h oral glucose tolerance test) or high risk for diabetes (presence of impaired glucose tolerance or two or more components of insulin resistance syndrome) (25). Insulin resistance syndrome components included hypertension (blood pressure ≥140/90 mmHg), dyslipidemia (total cholesterol ≥200 mg/dl, triglycerides ≥200 mg/dl, or HDL cholesterol ≤35 mg/dl), central adiposity (waist-to-hip ratio ≥0.9 in men and ≥0.8 in women), and obesity (BMI ≥27.5 kg/m^2).

In addition, all participants in the OS group were asked to identify one OS person who would attend all program activities and examinations with them. This OS person was required to be aged ≥18 years, live in the study community area, and be a family member, neighbor, or coworker of the participant. All participants (including OS persons) were required to receive medical clearance by a physician before participation in the program and gave written informed consent.

Table 1—*Baseline characteristics of participants with or at risk for diabetes: the Native Hawaiian Diabetes Intervention Program* ($n = 47$)

Background factors	OS group (W. Kauai)	SI group (N. Kohala)	*P*
n	72	75	—
Women (%)	69	68	—
With diabetes (%)	41	29	0.12
With ≥50% Hawaiian blood quantum (%)	68	46	0.02
Age (years)	47.9 ± 10.6	51.3 ± 11.9	0.06
BMI (kg/m^2)	34.5 ± 7.6	32.3 ± 5.9	0.05
Diet and exercise behaviors			
Total daily calories (kcal/day)	2,323 ± 1,159	2,273 ± 1,140	0.79
Daily fat intake (g/day)	81 ± 51	76 ± 42	0.51
Calories from fat	30.3 ± 7.6%	30.0 ± 7.0%	0.56
Daily fiber intake (g/day)	19 ± 11	23 ± 14	0.05
Total physical activity (MET h/week)	86 ± 95	111 ± 136	0.21
Leisure physical activity (MET h/week)	44 ± 65	47 ± 48	0.75
Stage of change			
Pre-action stage of change for dietary fat (%)	31	25	0.60
Pre-action stage of change for dietary fiber (%)	29	32	0.84
Pre-action stage of change for exercise (%)	89	68	0.01

Data are or means ± SD.

Lifestyle intervention

Both intervention groups (OS and SI) received a culturally competent program for a total of 6 months (23). However, the OS group differed from the SI group in two major areas. First, participants in the OS group were enrolled with a designated OS person. Second, participants in the OS group were given practical instructions on "how to" ask their OS person to help them overcome challenges in making lifestyle behavior changes (see Appendix). Community peer educators at both sites were trained regarding program implementation by the core research staff through didactic and role-playing teaching methods. Peer educators were then personally evaluated on site and/or videotaped during a teaching session after the program was launched, followed by verbal feedback and discussion with the core team every month to ensure standardization.

Measures of dietary and physical activity behaviors and mediating factors

A 3- to 4-h research examination was performed at study entry (Exam 1) and 6 months after the intervention program ended at Exam 3 (~1 year after the baseline exam). All research examinations were performed on site by trained community research staff who performed clinical measurements and interviewed participants on all research questionnaires. All questionnaires used in this study were selected because of demonstrated acceptable reliability and validity, as indicated below.

Dietary behaviors were measured using a semiquantitative food-frequency questionnaire, previously validated in a NH population, to assess usual dietary intake during the past month (26,27). The 166-item questionnaire was administered by an interviewer using visual aids to help respondents estimate portion sizes accurately. Dietary behaviors were assessed by nutrient intake of total calories (kcal/day), daily fat (g/day), and daily fiber (g/day).

Physical activity behaviors were assessed using the Modified Activity Questionnaire, an instrument previously validated and adapted to an NH population (28–30). Estimates of energy expenditure were calculated for total and leisure physical activity and expressed in metabolic equivalent (MET) hours per week.

Mediating factors of dietary and physical activity behaviors were assessed using previously validated instruments based on the Stage of Change (SOC) construct (12,13,19,31). Dietary SOC was calculated for fat and fiber intake using a 19-item questionnaire previously validated in the Working Well Trial (12–14). Exercise SOC was assessed using a four-item subscale adapted from the Dieting Readiness Test questionnaire (31).

Statistical analyses

Bivariate analyses at Exam 1 were performed using χ^2, Student's *t* tests, or nonparametric tests where appropriate. For analyses on the patterns of dietary SOC, the number of stages were reduced from five to two and defined as pre-action and action/maintenance. This modification was made for practical reasons (i.e., small numbers, simplicity and interpretability) and to allow for comparison with other published literature (14). For analyses us-

ing exercise SOC, a priori scores were summed for each person and collapsed into a dichotomous variable defined as pre-action and action/maintenance to facilitate and simplify analyses and interpretation (31). All analyses evaluating intervention effects (before and after changes) were performed using only participants with complete data for both Exams 1 and 3 (OS, $n = 70$; SI, $n = 62$). Of the individuals not examined at Exam 3 ($n = 15$), one had moved out of the community, one had died, four had a major illness or surgery that precluded their continuation in the study, and nine refused follow-up examination. Baseline stages of change for these 15 individuals showed that 19 and 31% were in the pre-action stage of change for dietary fat and fiber, respectively, whereas 63% were in the pre-action stage of change for exercise.

The two main outcomes analyzed in this study were: *1*) achieving or maintaining the action/maintenance stage of change at follow-up and *2*) the mean dietary intake and physical activity expenditure for individuals in the action/maintenance stage at follow-up. Odds ratios (ORs) and 95% CIs for each diet and physical activity domain were calculated to evaluate the odds of being in the action/maintenance stage of change in the OS group compared with the SI group. Ordinary least-squares regression analysis was performed to compare the mean values at follow-up in each behavioral domain (diet and physical activity behaviors) between intervention arms adjusted for the baseline behavior values. The number of participants for each behavioral domain analyzed varied according to the number of individuals noted to be in the action/maintenance stage at follow-up for each intervention group. All findings were considered statistically significant if the P value was <0.05. Statistical analyses were performed using SAS software (version 6.12; SAS Institute, Cary, NC) and SPSS software (version 10; SPSS, Chicago, IL).

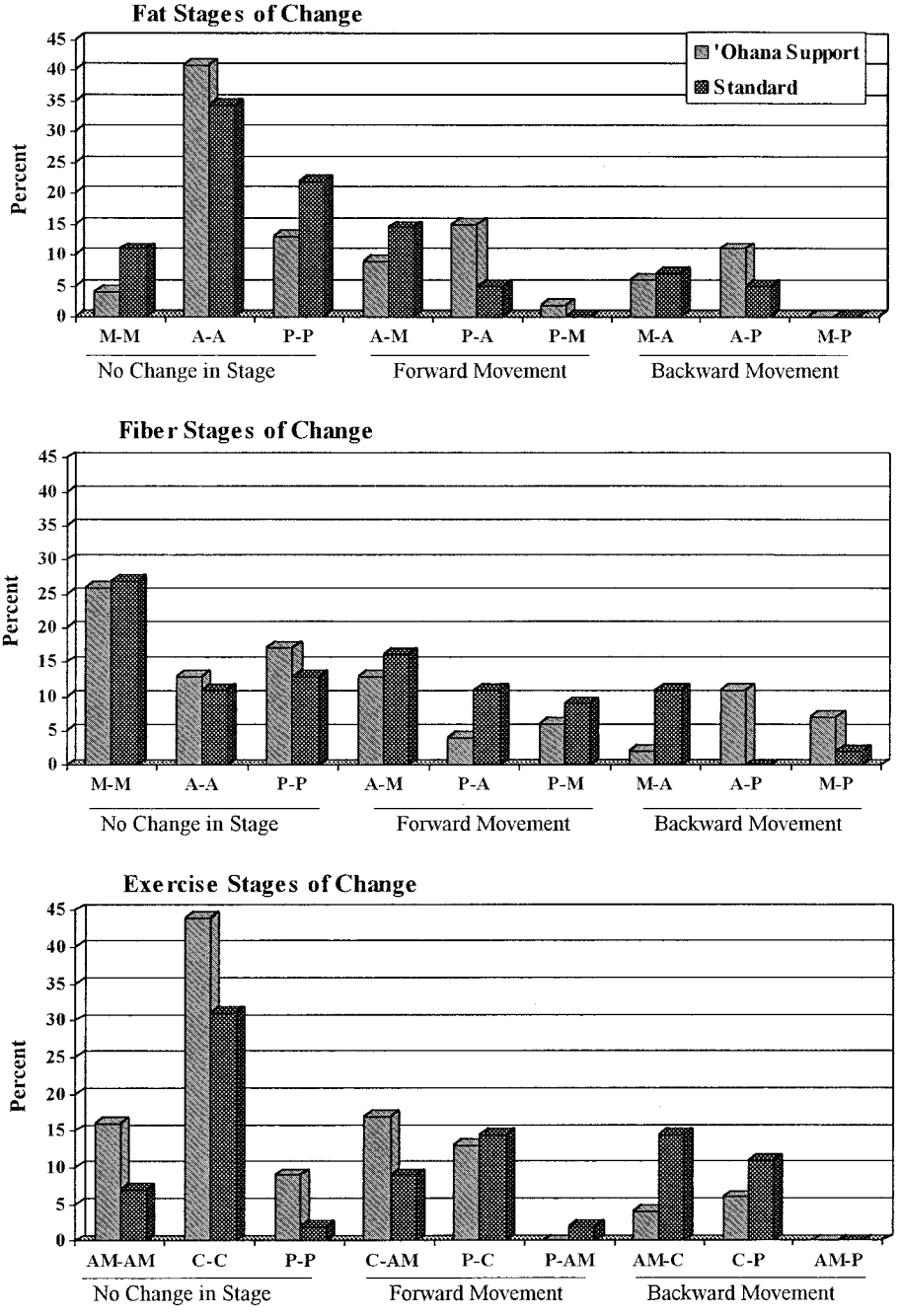

Figure 1—*Change in stages of dietary and exercise change for lower fat, higher fiber, and increased exercise: the Native Hawaiian Diabetes Intervention Program* (n = *132). A, action; AM, action/maintenance; C, contemplation; M, maintenance; P, pre-action.*

RESULTS — Baseline characteristics of the OS and SI groups are shown in Table 1. In general, the groups were not significantly different, except for percentage with 50% Hawaiian blood quantum (68% in OS vs. 46% in SI, $P = 0.02$) and percentage in the pre-action stage of change for exercise (89% in OS vs. 68% in SI, $P = 0.01$).

Dietary intake at baseline showed relatively high caloric intake (i.e., >2,200 kcal/day), although the percent of calories from fat was not excessive (~30% of daily calories from fat). Both groups also reported moderate to high intake of dietary fiber, which approached or met national recommendations of 20–35 g/day. Both groups showed wide variability in levels of physical activity (total and leisure); the distribution of participants was skewed toward sedentary activity levels (mode of leisure activity hours/week = 1.8 h vs. recommended moderate activity levels = 3.5 h/week) (32).

Mean changes in diet and exercise behaviors from baseline to follow-up were not statistically significant for either intervention group and were broad in variability. The SI group showed improvements in mean total calories and daily fat com-

Table 2—*Odds of being in action/maintenance SOC for diet and exercise at follow-up for OS group (n = 69) versus SI group (n = 62)*

Domain and baseline stage of change	Follow-up stage of change: action/maintenance	95% CI
Fat		
Pre-action	2.88	0.76–10.99
Action/maintenance	1.07	0.47–2.40
Overall†	1.01	0.46–2.20
Fiber		
Pre-action	0.44	0.13–1.58
Action/maintenance	0.15*	0.03–0.74
Overall†	0.36*	0.16–0.83
Exercise		
Pre-action	1.45	0.50–4.22
Action/maintenance	0.97	0.17–5.60
Overall†	0.78	0.36–1.70

*$P < 0.05$; †"overall" refers to the OR of being in action/maintenance at follow-up, regardless of baseline SOC.

pared with the OS group (total calories: SI −94.54 vs. OS +21.24 kcal/day; daily fat: SI −4.70 vs. OS +0.46 g/day). However, the OS group showed improvements in mean daily fiber intake compared with the SI group (daily fiber: OS +1.69 vs. SI −0.90 g/day). Both groups reported mean decreases in leisure and total physical activity energy expenditure (leisure activity: OS −12.58 vs. SI −4.66 MET h/week; total physical activity: OS −6.23 vs. SI −25.00 MET h/week).

Association of stage of change with dietary and physical activity behaviors

Individuals with the healthiest dietary fat and exercise patterns were more likely to be in the action/maintenance stage of change than participants with the least healthiest diet/exercise behaviors at both exams (daily fat: Spearman's *r* at Exam 1 = −0.29 and at Exam 3 = −0.25; leisure physical activity: Spearman's *r* at Exam 1 = 0.41 and at Exam 3 = 0.26; all $P < 0.005$). A similar association was also found with daily fiber intake, although this correlation was only significant at Exam 3 (daily fiber: Spearman's *r* at Exam 1 = −0.16, $P = 0.06$ and at Exam 3 = −0.32, $P < 0.001$).

Patterns of change in diet and exercise stage of change by intervention group

Figure 1 shows that the most common pattern of diet and exercise SOC movement was no change in stage. For fat SOC, ~35–40% of the participants in both intervention groups remained in the action stage; similar distributions of forward and backward movement were observed in both groups. For fiber SOC, the most common pattern was to remain in the maintenance stage at follow-up (~25%). Although a higher percentage of participants in the SI group had forward movement in fiber SOC, no apparent differences were observed for backward movement between groups. For exercise SOC, most individuals were in the contemplation stage at both time points. However, a higher percentage of participants in the SI group moved backward from action/maintenance to contemplation in exercise SOC (SI 13% vs. OS 4%).

The odds of being in action/maintenance for the OS group versus the SI group for exercise activity, fat intake, and fiber intake are shown in Table 2. For fat SOC, the odds for the OS group to advance from pre-action at baseline to action/maintenance at follow-up was more than twofold higher (OR 2.88, 95% CI 0.76–10.99) compared with the SI group. Exercise SOC in the OS group also showed that the odds of advancing to action/maintenance from pre-action was 45% higher than in the SI group (OR 1.45, 95% CI 0.50–4.22). Little difference was observed for the participants in the OS group in action/maintenance at baseline to remain in this stage for fat or exercise SOC (fat SOC, OR 1.07; exercise SOC, OR 0.97). For fiber stage, OS group participants were less likely to advance to a later stage at follow-up, regardless of the stage at which they started at baseline: pre-action (baseline), OR 0.44, 95% CI 0.13–1.58; postaction (baseline), OR 0.15, 95% CI 0.03–0.74.

Changes in stage and changes in dietary intake and physical activity behaviors

The mean differences in dietary and physical activity behaviors between the OS and SI groups for participants in the action/maintenance stage at follow-up are shown in Table 3. Individuals in the OS group who advanced from pre-action to action/maintenance, on average, made more healthy changes, as assessed by reduced fat intake (−2.3 g/day), increased daily fiber intake (2.5 g/day), and increased physical activity (63.3 MET h/week), than the SI group. By contrast, individuals in the OS group who started in the action/maintenance stage at baseline, on average, made less healthier changes, such as increased fat intake (5.6 g/day) and reduced physical activity (−19.9 MET h/week), but increased their mean fiber intake compared with the SI group. Overall, individuals in the OS group who were in the action/maintenance stage at follow-up improved in all behavioral domains compared with the SI group (overall fat −0.92 g/day, overall fiber 3.5 g/day, and overall physical activity 20.1 MET h/week).

CONCLUSIONS— The analyses presented here show that SOC is significantly correlated with dietary intake (fat and fiber) and physical activity behaviors. In response to an intervention emphasizing social support, participants in the OS group in the pre-action stage were more likely to advance to action/maintenance for dietary fat and exercise but not for dietary fiber SOC compared with the SI group. This apparent discordance in the dietary fiber stage with the other stage domains is probably related to a number of factors, including small sample sizes, slightly older population in the SI group, and relatively high baseline intakes of dietary fiber with a high proportion in action/maintenance at baseline, thus creating a ceiling effect. Finally, individuals in the OS group who advanced from pre-action to action/maintenance at follow-up were found to have overall "healthier" dietary and exercise behaviors compared with the corresponding participants in the SI group.

The results of this study suggest that interventions of a similar design seem to

Table 3—*Mean differences between OS (n = 69) and SI (n = 62) groups in fat intake (g/day), fiber intake (g/day), and total physical activity (MET h/week) for participants in action/maintenance stage at follow-up*

Domain and baseline stage of change	Adjusted mean difference at follow-up for participants in action/maintenance*	95% CI
Fat		
Pre-action	−2.3	−40.9 to 36.2
Action/maintenance	5.6	−8.9 to 20.2
Overall†	−0.92	−15.2 to 13.4
Fiber		
Pre-action	2.5	−7.6 to 12.7
Action/maintenance	4.0	−0.50 to 8.5
Overall†	3.5	−0.37 to 7.4
Exercise		
Pre-action	63.3	−0.65 to 127.2
Action/maintenance	−19.9	−110.4 to 70.6
Overall†	20.1	−26.8 to 67.1

Data are *n*. *Adjusted mean difference indicates adjusted for baseline values for each domain behavior; †"Overall" refers to the differences in mean changes in participants in action/maintenance at follow-up, regardless of baseline SOC.

have the greatest impact on individuals in pre-action stages of change who advanced to action/maintenance, and these changes in stage corresponded to healthier changes in dietary fat intake and exercise energy expenditure in the OS group compared with the SI group. These results also suggest that the OS intervention was not particularly effective in maintaining individuals at the action/maintenance stage or at improving the corresponding lifestyle behaviors. Similar findings were also reported in another diabetes intervention, in which participants with the worst self-care behaviors benefited the most from a 5-day education program compared with the other groups (33). This study also confirms the positive role of social support in changing behaviors in minority populations, such as NHs, and suggests that tailoring a lifestyle intervention to a person's stage of change may enhance its effectiveness in changing diet and exercise behaviors.

Although promising, these results should be interpreted with some consideration of their limitations, such as the nonrandomized study design, relatively small sample sizes, and lack of a true control group. However, notwithstanding the limitations, we believe these results are of particular interest because encouraging individuals to change their lifestyle behaviors is often difficult and, therefore, understanding the process of improving lifestyle behaviors via mediators of behavior change may aid in the development of more effective and efficient interventions. Thus, we propose that future studies to evaluate the construct of SOC and other potential mediators of behavior are warranted and that such studies could be strengthened by enrolling a larger study population (including ethnic minority groups), limited to a single category of glucose intolerance (diabetes or at risk), with a randomized study design and a minimal intervention or "true" control group.

Acknowledgments— This research was supported in part by awards from the National Institutes of Health, the Research Centers in Minority Institutions Program of the National Center for Research Resources Grant RR-03061, and the National Institute for Diabetes, Digestive and Kidney Diseases Grant DK-48136.

We thank the na kanaka maoli (the native Hawaiians) and their 'ohana (families) of West Kauai and North Kohala for their participation in this study and the native Hawaiian health organizations of Papa Ola Lokahi, Ho' ola Lahui Hawaii, and Hui Malama Ola Na Oiwi for their support of this study. We also thank Dr. Richard Arakaki for advice and guidance; Dr. E. Francis Cook for reviewing the manuscript; To Kamana' opono Crabbe, Cynthia Kenui, Randi Chen, and Jay Maddock for assistance in data management and analysis; Cynthia Kenui, William Rezentes III, Sandy Chasnoff, Anna Farmer, and Elva Yoshihara for developing, reviewing, and editing the Ku-

APPENDIX

Comparison of lifestyle intervention protocol in West Kauai and North Kohala Communities: Native Hawaiian Diabetes Intervention Program, 1995–1998

West Kauai Community: OS lifestyle intervention	North Kohala Community: Standard lifestyle intervention
Family/social support	
Enrolled with OS Person	—
Program leaders	
Trained community peer educators	Trained community peer educators
Number of group sessions	
Group teaching sessions	Group teaching sessions
1. "Exercise can be Fun"	1. "Exercise can be Fun"
2. "Grinding the Akamai Way"	2. "Grinding the Akamai Way"
3. "Eating Hawaiian Style"	3. "Putting It All Together"
4. "Change is No Big Deal"	4. —
5. "Putting it all Together"	5. —
Follow-up contacts	
Face-to-face personal follow-up	Telephone follow-up
"Cutting Back on Sugar" handout	"Cutting Back on Sugar" mailed out
"Continuing the Journey" handout	
Exercise classes	
Offered to participant and OS person (6 months)	Offered to participant (6 months)
1. "Power Walking"	1. "Power Walking"
2. "Water Aerobics"	2. "Water Aerobics"
3. "Low-Impact Aerobics"	3. "Low-Impact Aerobics"

lia Ola Kino Maikai program materials; and Gail Sakagawa for secretarial and administrative assistance.

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