Original Article
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Obesity

Sociodemographic, Behavioral, and Biological Variables Related to Weight Loss in Native Hawaiians and Other Pacific Islanders

Joseph Keawe'aimoku Kaholokula[1], Claire K.M. Townsend[1,2], Arlene Ige[1,2], Ka'imi A. Sinclair[1], Marjorie K. Mau[1], Anne Leake[3], Donna-Marie Palakiko[4], Sheryl R. Yoshimura[5], Puni Kekauoha[6] and Claire Hughes[7]

Objective: Native Hawaiians and other Pacific Islanders (NHs/PIs) have a high obesity prevalence compared to other ethnic groups. We examined socio-demographic, behavioral, and biological factors related to ≥3% weight loss in 100 overweight/obese NHs/PIs who completed a lifestyle intervention.
Design and Methods: Data were from 56 Native Hawaiians, 22 Chuukese, and 22 Other Pacific Islanders who participated in a randomized controlled trial of the Partnership for Improving Lifestyle Intervention (PILI) 'Ohana Project. All completed a 3-month weight loss program (WLP) to initiate weight loss and were then randomized into either a 6-month family/community focused WLP called the PILI Lifestyle Program (PLP; $n = 49$) or a standard behavior WLP (SBP; $n = 51$). We collected baseline, 3- and 9-month follow-up data on socio-demographics, weight (kg), a 6-min. walk test, dietary fat, exercise frequency, and blood pressure.
Results and Conclusion: Based on ANCOVA or logistic fit, ethnicity, sex, initial weight loss, fat in diet at baseline, change in systolic blood pressure, and intervention type were significantly associated ($P \leq .05$) with ≥3% weight loss at 9-month follow-up. A logistic regression model indicated that Chuukese (OR = 6.04; CI = 1.14–32.17) and participants who had more weight loss in the first 3-months (OR = 1.47; CI = 1.22–1.86) and who were in the PLP (OR = 4.50; CI = 1.50–15.14) were more likely to achieve ≥3% weight loss [model; χ^2 (7, $N = 100$) = 45.50, $P < .0001$]. The same lifestyle intervention does not benefit all NHs/PIs equally, possibly due to differences in acculturation status and social support. The findings also point to the importance of initial weight loss to sustain motivation toward long-term weight loss maintenance.

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Introduction

Obesity is a major public health concern in the Unites States affecting 33.8% of the adult population (1), but the burden of obesity is even greater in certain ethnic groups. The prevalence of obesity among Native Hawaiians and other Pacific Islanders (NHs/PIs; e.g., Samoans and Chuukese) is 44-49% compared to 13.9% in Japanese-Americans and 20.6% in Whites (2–4). These obesity disparities are also reflected in the disproportionate number of NHs/PIs that have obesity-related diseases, such as diabetes and cardiovascular disease, compared to other ethnic groups in the United States (3). Although lifestyle interventions are shown to be effective in achieving meaningful weight loss and reducing the risk for diabetes, they are often less effective for ethnic minority groups when compared to non-Hispanic whites (5). Identifying the sociodemographic, behavioral, and biological factors that affect weight loss in overweight and obese individuals from high-risk ethnic minority groups, such as NHs/PIs, can lead to more effective strategies to reduce obesity and obesity-related disparities.

Studies have found that certain sociodemographic, behavioral, and biological factors are associated with intentional weight loss in overweight and obese individuals who participate in lifestyle weight loss interventions. Findings from the Diabetes Prevention Program (DPP) Research Group (5) found that African American participants,

[1] Department of Native Hawaiian Health, Center for Native and Pacific Health Disparities Research, John A. Burns School of Medicine, University of Hawai'i at Manoa, Honolulu, Hawai'i, USA. Correspondence: Joseph Keawe'aimoku Kaholokula (kaholoku@hawaii.edu) [2] Office of Public Health Sciences, John A. Burns School of Medicine, University of Hawai'i at Manoa, Honolulu, Hawai'i, USA [3] Queen's Medical Center, Inpatient Diabetes Team, Honolulu, Hawai'i, USA [4] Ke Ola Mamo, Native Hawaiian Health Care System, O'ahu, Hawai'i, USA [5] Kokua Kalihi Valley Comprehensive Family Services, Honolulu, Hawai'i, USA [6] Kula no na Po'e Hawai'i, Papakolea, Hawai'i, USA [7] Hawai'i Maoli, Association of Hawaiian Civic Clubs, Kapolei, Hawai'i, USA

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compared to Whites, Native Americans, Asians, and Hispanics, and participants who did not meet their exercise goals (i.e., less physical activity) and who engaged in less self-monitoring of fat intake were significantly less likely to achieve the ≥7% weight loss goal over a 24-week period. A study by Hall et al. (6) with older women of White, Black, and Hispanic ancestry found that a decrease in fat intake was directly associated with a decrease in body weight even when no particular attempt was made to reduce calories.

The Weight Loss Maintenance Trial Research Group (7) examined predictors of weight change in over 1,600 overweight and obese adults. They found that individuals who had a heavier weight at entry, who were of a non-African American race (vs. African Americans), who attended more of the intervention sessions (vs. less), who engaged in more moderate physical activity (vs. less), and who engaged in more dietary self-monitoring had significantly more weight loss over a 6-month period. Using a community-based participatory research (CBPR) approach in a pilot randomized control trial (RCT), Parikh et al. (8) also found that greater weight loss early in an obesity intervention can lead to continued long-term weight loss in a sample of mostly Hispanic females. They found that a majority of weight loss (an average of 4% of initial weight) occurred in the first 6 months of the 12-month intervention program when compared to a delayed intervention control group.

The high prevalence of obesity in Native Hawaiian and other Pacific Islanders is a directive to better address the epidemic in these populations. Research suggests that ethnic minority populations tend to lose less weight and are more likely to regain their weight than Whites given the same obesity intervention (9). This lack of comparable outcomes indicates that the one-size-fits-all approach to obesity treatment is not universally effective. Thus, identifying sociodemographic, behavioral, and biological factors that influence intentional weight loss in distinct ethnic minority groups, such as NHs/PIs, can lead to the development of more effective weight loss interventions for these populations.

The lifestyle interventions of the PILI 'Ohana Program (POP)[1] focused on modifiable factors associated with obesity, which include sedentary lifestyle, high fat and calorie intake, and stress management, in NHs/PIs. Using a CBPR approach, the POP community-academic partnership conducted a pilot RCT to compare the effectiveness of two 9-month lifestyle interventions for NHs/PIs who were given a modest goal of losing ≥3% of their baseline body weight. A description of the POP and the results from the RCT has been previously published (10–12). We report here our examination of the sociodemographic, behavioral, and biological factors related to success at achieving ≥3% weight loss in overweight and obese Native Hawaiians, Chuukese, and other Pacific Islanders who completed the 9-month POP lifestyle interventions. Of interest, were the sociodemographic factors of Pacific Islander subgroups, age, sex, education level, and marital status; the behavioral factors of initial weight loss, physical functioning, dietary fat intake, exercise frequency, and number of intervention lessons received; and the biological factors of baseline weight and blood pressure. Our study extends previous research on predictors of success in lifestyle interventions by focusing on NHs/PIs, an ethnic/racial group most at risk for obesity-related diseases.

[1]PILI is the acronym for Partnership for Improving Lifestyle Intervention and it is the Hawaiian word for ''together'' or ''joined''. 'Ohana is the Hawaiian word for family. The name, PILI 'Ohana, reflects the values of our CBPR project.

TABLE 1 Participants' baseline socio-demographic, behavioral, and biological characteristics

Variable	*N* = 100
Age (y)	50.4 ± 14.7
Sex	
Female	82 (82)
Ethnicity	
Native Hawaiian	56 (56)
Chuukese	22 (22)
Other Pacific Islander	22 (22)
Education	
Less than high school	23 (23)
High school diploma/GED	21 (21)
Some college/tech	29 (29)
College degree	26 (26)
Marital status	
Never	27 (27)
Currently	45 (45)
Disrupted	28 (28)
Exercise fatigue level	2.62 ± 2.91
6-min walk test (feet)	648.24 ± 139.76
Exercise frequency	3.24 ± 1.12
Fat in diet[a]	2.80 ± 0.40
Starting weight (kg)	106.03 ± 31.44
Systolic blood pressure (mm Hg)	136.08 ± 25.68
Diastolic blood pressure (mm Hg)	83.01 ± 13.51

Data shown as M ± SD or *n* (%).
[a]Dietary fat score of 2.5 or greater indicates greater than 30% of calories from fat.

Methods and Procedures

Participants

Data for this study comes from 100 Pacific Islander adults (18 years of age and older) who completed one of two POP 9-month weight loss maintenance interventions (11). As part of the POP lifestyle interventions, all 100 participants completed a 3-month weight loss program (WLP) to initiate weight loss and were then randomized into either a 6-month family and community focused weight loss maintenance program, called the PILI Lifestyle Program (PLP; $n = 49$), or a standard behavioral weight loss maintenance program (SBP; $n = 51$). Preweight loss baseline characteristics and 3-month weight loss outcomes can be found in Mau et al. (10) and between-intervention comparison of the 6-month weight loss maintenance outcomes can be found in Kaholokula et al (11). Table 1 presents the baseline characteristics of the 100 completers analyzed for this study.

Included in this study are a total of 56 Native Hawaiians, 22 Chuukese, and 22 Other Pacific Islanders (Table 1). The ''Other Pacific Islanders'' category is an aggregation of two Filipinos, one Tahitian, 13 Samoans, and six participants whose specific Pacific Islander ethnicity was not reported. Mean age was 50.4 years (standard

deviation = 14.7) and were predominately female (82%). All met the following criteria for participation in the intervention study: (a) Pacific Islander ancestry, (b) ≥18 years or older, (c) overweight/obese defined as body mass index (BMI) ≥25 or ≥23 for Filipinos only (13), (d) willing/able to perform 150 min of brisk walking per week (or equivalent) and a dietary regimen to induce weight loss of 1-2 lbs/week, and (e) identify at least one family member or friend to provide support throughout the program.

Assessment measures

Consistent with our CBPR approach, assessments were performed by trained community investigators using standardized protocols for data collection on demographics, clinical measures, physical functioning, and self-reported dietary and physical activity behaviors. Data were collected at baseline and at 3- and 9-month follow-up. We briefly review the assessment measures here but a more detailed description of the assessment process and the measures has been previously reported (10,11). The institutional review boards of the University of Hawai'i at Manoa and the Native Hawaiian Health Care Systems approved this study. Informed consent was obtained from all participants prior to their involvement.

Clinical Measures. All clinical measures were taken twice and computed as the average of two recorded values. Blood pressure was obtained using an automatic blood pressure device (HEM-907XL IntelliSense). Body weight (kg) and height (cm) were measured using an electronic scale (Tanita BWB800AS) and a stadiometer (Seca 222), respectively. BMI was computed as body weight in kilograms divided by height in meters squared.

Sociodemographics. Date of birth, sex, marital status, education level, and self-reported Pacific Islander ancestry were collected. The ethnic/racial category of NHs/PIs in the United States includes people with origins in the original inhabitants of Polynesian (e.g., Native Hawaiians, Samoans, and Tahitian), Micronesian (e.g., Chuukese), or Melanesian (e.g., Fijian) islands (3). Filipinos (often arbitrarily classified as ''Asian'') were included in this study given their similar risk profile as Pacific Islanders for obesity and related diseases in Hawai'i (14).

Physical Functioning and Fatigue Measure. Physical functioning was assessed using a 6-min walk test that measures the distance (in feet) a person is able to walk in 6 min (15). Participants were asked to walk as quickly as possible (without running) for 6 min using a fixed lap distance of either 60 or 100 ft. Participants were allowed to rest if needed but asked to resume walking as soon as they were able. Immediately following the walk test, degree of fatigue was measured using a Borg scale by asking participants to rate how difficult the 6-min walk test was for them using a scale ranging from 0 (not difficult at all) to 10 (very, very difficult) (16).

Exercise Frequency. Exercise frequency during the past month was assessed using a three-item physical activity questionnaire (17). It consists of three items: one item to assess moderate activity level (e.g., bowling, golf, light sports, light physical exercise), one item to assess vigorous activity level (e.g., jogging, running, swimming, aerobics,), and one item to assess change in activity level. For this study, only the first two items were used to calculate exercise frequency. Frequency for moderate and vigorous activities were rated on a scale from 1 (>4 times per week, more active) to 5 (rarely or never, less active). Participants' responses to each item were summed and divided by two to yield their exercise frequency score, which ranged from 1 to 5, with lower scores indicating greater exercise frequency.

Fat in Diet Measure. A 39-item modified version of the Eating Habits Questionnaire was used to estimate the amount of fat in participants' diet over the last month (10,18). Using a Yes/No response format, it first assesses types of foods consumed in the following categories: (1) red meat, fish, chicken, and pasta (six items), (2) milk and cheese products (three items), (3) fruits, vegetables, and salads (six items), (4) bread, rolls, muffins, and cereals (one item), and (5) food preparation (two items). For Yes responses, the frequency in using various preparation methods (e.g., frying vs. baking or broiling) were asked, using a four-point scale ranging from 1 (Always) to 4 (Never). The responses were grouped and scored into four fat consumption categories: (1) modify meat, (2) avoid fat, (3) modification/substitution, and (4) replace with vegetables. The summary score for fat consumption was obtained by adding the mean of each of the fat categories and dividing that by four. A dietary fat score of 2.5 or greater indicates greater than 30% of calories from fat in diet.

Study design

Our study design was guided by a CBPR approach in which the community and academic partners of the PILI 'Ohana worked collaboratively (10,12). Participant recruitment, implementation of the intervention, and all assessments were conducted in the respective participating communities by trained community recruiters, peer educators, and assessors.

Lifestyle interventions

The 100 Pacific Islanders included in this study were those who completed one of two 9-month lifestyle interventions. Both 9-month pilot interventions included two phases: in the first phase, all participants were first offered a 3-month weight loss intervention adapted from the DPP's Lifestyle Intervention (DPP-LI) (10). In the second phase, participants were randomized to either to a 6-month family and community focused weight loss maintenance program (the PLP), or to a 6-month standard behavioral weight loss maintenance program (SBP) (11).

The DPP-LI adaptation and the PLP were informed by community assessments to identify salient issues of obesity affecting NHs/PIs as described in detail by Mau et al. (10). Briefly, focus groups, informant interviews, and surveys with 320 Pacific Islanders and ''windshield tours'' of Pacific Islander communities were conducted. Several key sociocultural and socioeconomic factors emerged from the community assessments and were incorporated into the intervention. The value of 'Ohana (extended family and community) in daily living and decision making was incorporated throughout the intervention with the inclusion of family/friends and community resources in helping participants adopt realistic, sustainable, and culturally-meaningful healthy lifestyle behaviors. Our community investigators, who were Pacific Islanders themselves, assisted in this process to ensure cultural relevance and applicability. They also expanded the DPP-LI curriculum by adding two sessions. One session was designed to address the high cost of eating healthy in Hawai'i by focusing on economic factors that could impede weight

loss. Another session incorporated was ''Talking with the Doctor'' to help participants become actively engaged in their healthcare.

The adapted 3-month WLP consisted of eight lessons lasting 1-1 1/2 h and was delivered to small groups (6-10 people per group) over 12 weeks. Participants were taught and practiced empirically supported behavioral weight loss strategies regarding eating, exercise, and managing stress/negative emotions based on individual action planning (10,19). The PLP was composed of six additional lessons, each lasting about 1-1 1/2 h in length, delivered monthly to small groups. These lessons built on the 3-month WLP in which participants continued to practice the weight loss strategies previously taught, but also involved family and/or friends in their healthy lifestyle plan through various activities. They also identified community resources available to assist them with weight loss maintenance. The SBP was composed of six, monthly phone-calls delivered individually. Each call lasted 15-30 min in length. Reminders of the weight loss strategies taught during the 3-month program were also mailed to SBP participants. The phone calls were designed to provide participants with additional support from a community peer educator and to assist them in maintaining their healthy lifestyle plan formulated during the 3-month program.

Throughout the 3-month WLP and the 6-month weight loss maintenance programs, a weight loss goal of ≥3% weight loss was encouraged. For the purpose of this study, we categorized participants into two groups: (1) those who achieved ≥3% loss of their initial weight and (2) those who did not achieve this goal (i.e., <3% of their initial weight).

Data reduction and statistical analysis

The categorical variables of sex (1 = male; 2 = female), educational attainment (1 = no high school diploma or its equivalent; 2 = high school diploma or its equivalent; 3 = some college, technical, or vocational training; or 4 = college graduate), and marital status (1 = never married; 2 = currently married; or 3 = disrupted marital status) were dummy coded for multivariate analyses. The disrupted marital status is comprised of separated/divorced and widowed participants. The sociodemographic variables examined were ethnicity, age, sex, educational attainment, and marital status; the behavioral variables were initial weight loss in kg (baseline weight minus 3-month follow-up weight) and the baseline values and change (denoted by the subscript Δ) in values (baseline value minus 9-month follow-up value) of fat in diet, exercise frequency level, perceived exercise fatigue, and 6-min walk test; the biological variables were baseline weight (kg), systolic blood pressure (mm Hg), and diastolic blood pressure (mm Hg).

Statistical analyses were conducted using JMP Statistical Software (version 7.0) with an alpha level set at 0.05 (20). For bivariate analyses, logistic fit (χ^2) analysis was used to evaluate the association between weight loss group (≥3 vs. <3%) and categorical variables and analysis of covariance for weight loss group and continuous variables. Because the interventions differed in nature and varied in magnitude of weight loss, all bivariate analyses were done controlling for the effects of intervention group (dummy coded: 1 = PLP; 2 = SBP). When examining initial weight loss (kg), systolic and diastolic blood pressure$_\Delta$, fat in diet$_\Delta$, exercise frequency level$_\Delta$, perceived exercise fatigue$_\Delta$, and 6-min walk test$_\Delta$, their baseline values were also controlled for in the bivariate analyses. The variables found statistically significant in bivariate analysis were entered into a multiple logistic regression model to examine their independent associations with ≥3% weight loss (vs. <3%).

TABLE 2 Socio-demographic variables associated with weight loss (≥3 vs. <3%) at end of 9-month intervention study[a]

Variable	Weight loss ≥3%	Weight loss <3%	Effect test[a]
Age (y)	51.61 ± 13.2	49.63 ± 15.7	F (2,99) = 0.6233, P = 0.4317
Sex			
Male	4 (22.2)	14 (77.8)	χ^2 (1, N=100) = 5.631, P = 0.0176
Female	37 (45.1)	45 (54.9)	
Ethnicity			
Native Hawaiian	20 (35.7)	36 (64.3)	χ^2 (2, N=100) = 8.400, P = 0.0150
Chuukese	14 (63.6)	8 (36.4)	
Other Pacific Islander	7 (31.8)	15 (68.2)	
Education			
<High school	13 (56.5)	10 (43.5)	χ^2 (3, N=99) = 4.632, P = 0.2007
High school diploma/GED	8 (38.1)	13 (61.9)	
Some college/Tech	12 (41.4)	17 (58.6)	
College degree	8 (30.8)	18 (69.2)	
Marital status			
Never	9 (33)	18 (67)	χ^2 (2, N=100) = 1.000, P = 0.6064
Currently	21 (47)	24 (53)	
Disrupted	11 (39)	17 (61)	

Data shown as M ± SD or *n* (%).
[a]All bivariate comparisons (ANCOVA or nominal logistic fit) are adjusted for intervention group.

Results

Participants' weight loss

At the end of the 9-month pilot RCT, 51% of participants in PLP met the ≥3% weight loss goal compared to 31.4% of those in SBP, which was a statistically significant difference [χ^2 (1, N = 100) = 4.02 P = 0.045]. In combined category (PLP and SBP participants), 41% of them achieved ≥3% weight loss. Mean weight loss for participants who completed PLP was 2.54 kg (SD = 7.01) and 0.45 kg (SD = 9.79) for those who completed SBP, but this difference was not statistically significant [F (1, 99) =1.49, P = 0.224]. Overall, a modest mean weight loss of 1.48 kg (SD = 8.57) was achieved at the end of the 9-month study.

Sociodemographic variables associated with weight loss

Of the four sociodemographic variables examined, sex and ethnicity were significantly associated with weight loss of ≥3%, after adjusting for intervention group (Table 2). Females (45.1 vs. 22.2% of males) and Chuukese participants (63.6 vs. 35.7% of Native

TABLE 3 Behavioral variables associated with weight loss (≥ 3% vs. < 3%) at end of 9-month intervention study[a]

Variable	Weight loss ≥3%	Weight loss <3%	Effect test[a]
Initial weight loss[b] (kg)	3.60 ± 3.36	0.44 ± 2.76	$F(1,99) = 26.949$, $P < 0.0001$
Exercise fatigue level$_b$	2.95 ± 3.13	2.40 ± 2.75	$F(1,97) = 0.4684$, $P = 0.4954$
Exercise fatigue level$_\Delta$	0.49 ± 3.52	0.06 ± 3.33	$F(1,94) = 0.0058$, $P = 0.9396$
6-min walk test$_b$ (ft)	643.08 ± 145.70	651.81 ± 136.69	$F(1,98) = 0.0435$, $P = 0.8352$
6-min walk test$_\Delta$ (ft)	45.26 ± 99.51	37.64 ± 117.15	$F(1,95) = 0.0082$, $P = 0.9279$
Exercise frequency$_b$	3.26 ± 1.07	3.23 ± 1.16	$F(1,98) = 0.0694$, $P = 0.7928$
Exercise frequency$_\Delta$	0.56 ± 1.49	0.21 ± 1.20	$F(1,98) = 1.337$, $P = 0.2436$
Fat in diet$_b$[c]	2.72 ± 0.41	2.88 ± 0.39	$F(1,99) = 3.799$, $P = 0.0542$
Fat in diet$_\Delta$	0.16 ± 0.41	0.26 ± 0.34	$F(1,99) = .4637$, $P = 0.4975$
Lessons completed[d]	11.43 ± 2.35	11.68 ± 2.39	$F(1,96) = .0847$, $P = 0.7717$

Data shown as M ± SD; subscript $_b$ indicates baseline values and $_\Delta$indicates change in value from baseline to 9-month follow-up.
[a]All bivariate comparisons (ANCOVA or logistic fit) are adjusted by intervention group; for change in exercise fatigue level, 6 minute walk test, and exercise intensity values, their baseline values were also adjusted for in the bivariate analysis.
[b]Weight loss in first 3-months of the 9-month intervention.
[c]Dietary fat score of 2.5 or greater indicates greater than 30% of calories from fat.
[d]Total of 14 lessons in both interventions.

Hawaiians and 31.8% of other Pacific Islanders) had a significantly greater proportion who achieved ≥3% weight loss at the end of the 9-month intervention period.

Behavioral variables associated with weight loss

Of the ten behavioral variables examined, initial weight loss (baseline to 3-month follow-up weight loss) and fat in diet reported at baseline was significantly associated with ≥3% weight loss, adjusting for intervention group (Table 3). Participants who had an average of 3.6 kg of weight loss (vs. 0.4 kg) in the first 3 months of the intervention and who had less fat in their diet at the start of the intervention were significantly more likely to reach the ≥3% weight loss goal at the end of the 9-month intervention period. Other than fat in diet, none of the other baseline behavioral variables were associated with weight loss. Between baseline and 9-month follow-up, changes in perceived exercise fatigue level, self-reported dietary fat intake, self-reported exercise intensity, and distance walked in 6 min were not significantly associated with ≥3% weight loss. However, changes in the desired direction were greater in these variables for participants who achieved the ≥3% weight loss goal compared to those who did not.

Biological variables associated with weight loss

Of the six biological variables examined, only systolic blood pressure was significantly associated with weight loss of ≥3%, adjusting for intervention group (Table 4). Participants who had greater reductions in systolic blood pressure$_\Delta$ (change of 12.7 vs. 2.7 mm Hg on average) were significantly more likely to achieve ≥3% weight loss at the end of the 9-month intervention period.

Multivariate analysis of sociodemographic, behavioral, and biological variables associated with weight loss

Only the variables found to have a significant bivariate association with weight loss were entered into a logistic regression model along with intervention group (Table 5). The variables entered were

TABLE 4 Biological variables associated with weight loss (≥ 3% vs. < 3%) at end of 9-month intervention study[a]

Variable	Weight loss ≥3%	Weight loss <3%	Effect test[a]
Starting weight[b] (kg)	104.79 ± 33.82	106.88 ± 29.94	$F(1,99) = .3535$, $P = 0.5535$
Systolic blood pressure$_b$ (mm Hg)	139.51 ± 30.62	133.69 ± 21.55	$F(1,99) = 2.0233$, $P = 0.1581$
Systolic blood pressure$_\Delta$ (mm Hg)	12.68 ± 24.02	2.67 ± 17.45	$F(1,99) = 4.5042$, $P = 0.0364$
Diastolic blood pressure$_b$ (mm Hg)	83.51 ± 12.78	82.65 ± 14.09	$F(1,99) = .2612$, $P = 0.6104$
Diastolic blood pressure$_\Delta$ (mm Hg)	6.74 ± 12.11	2.82 ± 11.08	$F(1,99) = 3.3213$, $P = 0.0715$

Data shown as M ± SD; subscript $_b$ indicates baseline values and $_\Delta$ indicates change in value from baseline to 9-month follow-up.
[a]All bivariate comparisons (ANCOVA) are adjusted by intervention group; for change in blood pressure values, their baseline values were also adjusted for in the bivariate analysis.
[b]Weight at the start of the 9-month intervention (baseline).

TABLE 5 Multiple logistic regression of socio-demographic, behavioral, and biological variables on ≥3% weight loss (vs. <3%) at end of 9-month intervention study

	≥3% Weight loss		
Variables	Odds ratio	95% Confidence intervals	*P* value
Ethnicity (vs. other PIs)			0.0252[a]
Native Hawaiians	1.06	0.27–4.18	0.1332
Chuukese	6.04	1.14–32.17	0.0116
Sex (men vs. women)	0.29	0.05–1.35	0.1296
Initial weight loss (per 1 kg)	1.47	1.22–1.86	0.0002
Fat in diet$_b$ (per unit)	0.36	0.09–1.44	0.1658
SBP$_\Delta$ (per 1 mm Hg)	1.02	0.99–1.04	0.1323
PLP (vs. SBP)	4.50	1.50–15.14	0.0100

Subscript $_b$ indicates baseline values and $_\Delta$ indicates change in value from baseline to 9-month follow-up; Model: χ^2 (7, N = 100) = 45.5017, $P < 0.0001$.
PIs = Pacific Islanders; PLP = PILI Lifestyle Program; SBP = systolic blood pressure; SBP = standard behavioral program.
[a]Overall *P* value for ethnicity.

ethnicity, sex, initial weight loss, fat in diet at baseline, systolic blood pressure$_\Delta$, and intervention group. Of these variables, ethnicity, initial weight loss, and intervention group remained significantly associated with losing ≥3% of baseline weight at 9-month follow-up. Chuukese participants were six times more likely to achieve ≥3% kg weight loss compared to Native Hawaiian and other Pacific Island participants. Participants who had more weight loss in the first 3-months of the intervention and who were in the PLP intervention group were also more likely to lose ≥3% weight at the end of the 9-month intervention period.

Discussion

We examined a selected set of sociodemographic, behavioral, and biological variables to better understand intentional weight loss in a sample of overweight and obese Native Hawaiians, Chuukese, and other Pacific Islanders who completed one of two 9-month lifestyle interventions (10,11). This is the first study to examine such factors associated with intentional weight loss in Pacific Islanders who underwent a formal lifestyle intervention. Our sample of Pacific Islanders included people of Polynesian, Micronesian, and Filipino descent. Because weight loss is challenging for many Pacific Islanders, partly due to socioeconomic and acculturative stressors (e.g., language barriers, substandard living conditions, and employment barriers) that hinder their weight loss efforts (3,9,21,22), a modest weight loss of ≥3% was selected as the weight loss goal by the academic and community investigators of the PILI 'Ohana Project for the pilot intervention study from which data for this sample was obtained (11).

Initially, we found that ethnicity, sex, amount of fat in diet at baseline, initial weight loss, and changes in systolic blood pressure over the course of the 9-month lifestyle interventions were significantly associated with weight loss. However, after partitioning out their shared variance, only ethnicity, initial weight loss, and intervention group had a significant and independent association with weight loss over a 9-month period. That is, Chuukese participants (vs. NHs/PIs) and participants, regardless of their ethnicity, who had more weight loss within in the first 3 months of the intervention (i.e., the initial weight loss phase) were more likely to reach the ≥3% weigh loss goal. Participants of the PLP were 4.5 times more likely to reach the weight goal of ≥3% weight loss than those of the standard behavioral program.

As in our study, greater weight loss early in an intervention has been found associated with long-term weight loss in other populations (5). It may be that losing more weight early on spurs or maintains an individual's motivation to lose weight. It may also be that individuals who benefit from a weight loss intervention will do so early on because of other factors, such as initial motivation, self-efficacy, and/or social support. The finding that improvement in systolic blood pressure is associated with weight loss is also well established in the literature (23,24). Although it is likely that the participants' weight loss led to improved systolic blood pressure, improved systolic blood pressure could also be the result of increase in physical activity (23) and/or reductions in psychosocial stressors (25) that thereby increases a person's ability to lose excess weight. Although we found no significant association between increases in physical activity and physical functioning with meeting weight loss goal, we did find that those who had met the weight loss goal did increase their physical activity and improve their physical functioning more so than those who did not meet goal.

The weight loss goal (≥3%) and mean weight loss (2.5 kg ± 7.0 for PLP) in our study is considerably smaller than that of the lifestyle intervention of the original DPP study (goal ≥7%; mean weigh loss = 4.5 kg ± 7.6) (5). The original DPP-LI was delivered by highly trained health professionals, and the lessons and activities were intensive (i.e., strict daily caloric intake and expenditure). Although such lifestyle interventions lead to large initial weight loss, the intensive lifestyle changes required are difficult to maintain over a long-period of time. Comparing our study to the original DPP, 49% of DPP-LI participants met the 7% weight loss goal, whereas 51% of our PLP participants met the 3% weight loss goal. Many of the adaptations of the DPP into real-world settings, especially those adapted for community settings and delivered by lay community educators, are often less intensive in nature. Our intervention was purposefully less intensive to ensure that participants could adopt the lifestyle behaviors promoted and maintain them over a lifetime. In a recent meta-analysis of 28 studies that adapted the DPP-LI into real-world settings (26), it was found that those using lay community educators achieved an average of 3% weight loss. It appears that our adapted DPP-LI and PLP leads to comparable weight loss when compared to similar studies in other ethnic and community-based populations.

A novel finding of our study was the large ethnic differences in weight loss across Pacific Islanders. A majority of Chuukese participants (63.6%) were able to meet the weight loss goal of the interventions compared to less than half of Native Hawaiians (35.7%) and participants from other Pacific Islander groups (31.8%). Native Hawaiians are the indigenous people of Hawai'i, whereas Chuukese are immigrants to Hawai'i from the island state of Chuuk, one of four states that comprise the Federated States of Micronesia. The other Pacific Islanders are also primarily immigrants from American

Samoa and the Philippines. Because Pacific Islanders across the board are more economically challenged and more likely to live in obesogenic environments when compared to other ethnic groups in Hawai'i (10), it is unclear from our data to why Chuukese participants responded to the behavioral lifestyle interventions markedly better than other Pacific Islanders.

There are several possible explanations for why Chuukese responded better to the interventions. The lessons were delivered to them in both English and in their native language by a bilingual Chuukese health worker to ensure comprehension. Although the intervention materials were in the English language, receiving the didactic aspects of the intervention in their native language may have made the lessons more salient and relevant to their cultural context. The Chuukese is a tight-knit community that relies heavily on each other for economic and emotional support because of the economic and acculturative stressors they face as a new and emerging immigrant group in Hawai'i (27). The behavioral changes promoted in the interventions may have been easily adopted because others in the group were also making and supporting the same behavior changes. There could have been information sharing by Chuukese participants across the two interventions; thereby, improving the outcomes of the SBP. The information and strategies may have been more novel to Chuukese, making them more receptive to behavior changes encouraged in the interventions. Studies find that failed weight loss attempts in the past can inhibit future attempts (28), which may have been a factor affecting the other Pacific Islander participants. More research is needed to examine the differential benefits behavioral-based lifestyle interventions have on various Pacific Islander populations.

Because we used a CBPR approach and implemented the interventions in various community settings, the available community resources to support the participants' healthy lifestyle goals were incorporated into the interventions. Although all participants received the same standardized lessons and activities, many of the outside resources available to them differed across the communities. In the community serving most of the Chuukese participants, they had greater access to fresh fruits and vegetables through a large community garden and were exposed to intensive healthy cooking classes to supplement the intervention activities. The community where a quarter of the Native Hawaiian participants were recruited had free access to an exercise program led by a certified exercise instructor that included low impact aerobics and weight-bearing exercises. These different community resources (e.g., cooking vs. exercise classes) may have had differential effects on the weight loss efforts of the participants. It is likely that the success of Chuukese in meeting the weight loss goal of 3% or more may have to do with their exposure to the activities made available to them in their community setting or a combination of factors we mentioned earlier. We are unable to examine these possibilities in this study given the available data. One hypothesis worth testing is whether Pacific Islanders are more amenable to making dietary changes than exercise changes, given the greater exposure of Chuukese participants to additional nutrition-related activities versus Native Hawaiians' greater exposure to additional exercise activities in our study.

Several methodological issues with our study should be noted. We used brief self-report measures of physical activity frequency and dietary fat intake, which may have poorly estimated the participants' actual behaviors in these areas. Because it was a pilot study focusing more on the effects of the intervention on weight loss, and because community health promoters were conducting the assessments, we used brief and easy-to-administer measures of physical activity and eating behaviors. We also had a relatively small sample size and, thus, we may not have had enough statistical power to detect differences for variables with small effect sizes. We obviously had enough statistical power to detect differences for those with larger effect sizes.

Our findings have important implications for developing more effective weight loss interventions for NHs/PIs. The findings suggest that the DPP-LI can be translated successfully to Pacific Islander communities, and that its effects are enhanced by involving and engaging family and community supports and resources into the intervention. However, our findings also indicate that a behavioral lifestyle intervention targeting weight loss may not be equally effective across different Pacific Islander groups, possibly due to differences in acculturation status (e.g., native vs. immigrant) or other sociocultural factors (e.g., discrimination, family size). Different weight loss intervention foci and strategies should be explored that account for differences in acculturation-related and sociocultural factors affecting obesity control; for the relative influence of, and motivation to, making healthy dietary changes versus increasing physical activity; and for the mode of intervention delivery across distinct Pacific Islander groups. Finally, our findings also indicate that greater weight loss early on in a formal lifestyle intervention is a strong correlate of long-term weight loss. Lifestyle interventions with Pacific Islanders may want to have more intense efforts at the beginning to better facilitate long-term weight loss. Our findings and their implications are relevant to other ethnic minority populations in the United States that share similar sociocultural and socioeconomic characteristics as NHs/PIs.

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