Physical Activity, Nutrition, and Obesity among Pacific Islander Youth and Young Adults in Southern California: An Exploratory Study

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Abstract

This exploratory study aimed to assess obesity, physical activity, and nutrition among Pacific Islander youth and young adults in Southern California. A total of 129 Tongan, Samoan, and Marshallese participated in the study, including relatively similar proportions of males and females and age groups. We calculated Body Mass Index (BMI), dietary intake by a food frequency questionnaire (FFQ), and 7-day physical activity levels with accelerometers. Overall, 84% of Tongan, 76% of Samoan, and 24% of Marshallese participants were overweight or obese, with mean BMI of 31.2 and 34.3 kg/m^2 (for Tongan males and females), 32.3 and 33.4 kg/m^2 (Samoan males and females), and 25.3 and 22.1 kg/m^2 (Marshallese males and females). We found moderate- and vigorous-intensity physical activity (MVPA) fell below current guidelines at 38 min/day, with over 87% engaging in light-intensity PA and large sedentary times. Daily percent of energy from saturated fat, fiber/1,000 kcal and dairy intake were higher in Tongans compared to Samoans and Marshallese. Despite promising outcomes from this study, high prevalence of overweight, low physical activity levels, and high caloric intake put Pacific Islander youth and young adults at risk for a variety of health concerns and future efforts should focus on further research as well as community-wide prevention and amelioration efforts.

Keywords

physical activity, nutrition, Pacific Islanders, community-based participatory research, health disparities, obesity

Introduction

Obesity continues to be an increasingly important risk factor for populations worldwide, yet relatively little is known about obesity prevalence to inform prevention in ethnically diverse populations, including Pacific Islanders (PIs). In 2010, there were over 1.2 million PIs (alone or in combination with one or more races) in the United States (U.S.), encompassing a wide diversity of over 20 distinct ethnic groups, each with their own culture, language, traditions, and political and migration history.[1] Compared to nearly all other ethnic groups, PIs suffer from higher prevalence of leading obesity-related health problems, including Type II diabetes,[2,3] hypertension,[4,5] and cancer.[6] For instance, a study of 80 PI adolescents found that 86% of overweight youth had at least one component of metabolic syndrome, compared to 11% of healthy-weight participants.[7] High waist circumference (> 90th percentile) and low levels of high-density lipoproteins (≤ 10th percentile) were the two most common components of metabolic syndrome in the sample. As with other groups, obese U.S. PI youth are also substantially more likely to be diagnosed with Type-II diabetes than their normal-weight peers.[8]

Obese youth are more likely to become obese adults, and rates are of considerable concern for PIs. Worldwide among youth less than 20 years of age, overweight and obesity prevalence in the Federated States of Micronesia (29.7% among boys and 61.4% among girls), Samoa (42.2% and 50.0%, respectively), and Tonga (34.5% and 52.6%) were higher than in the U.S. (28.8% and 29.7%).[10] Data from the Hawai‘i School Health Survey (2015) found that 15.3% of adolescents were overweight (BMI between 85th to 94th percentile) and 12.9% were obese (BMI equal to or greater than 95th percentile), with higher proportions of overweight or obese youth who were Native Hawaiian (33.5%) and other Pacific Islander (59.3%).[9] Existing health data on PI youth in Southern California are variable. One study reported 20% of PI children as overweight in Los Angeles,[11] while another study reported disaggregated overweight prevalence of 48.6% for Samoans, 27.8% for Tahitians, 22.1% for Native Hawaiians, 17.2% for Guamanians, and 31.3% for other PIs.[12]

PI cultures often view obesity as a mark of high social status,[13] and PI youth may be more likely than other ethnicities to view obesity as more culturally acceptable and even desirable. Thus, community-based, culturally appropriate research should take into consideration the norms and traditions of this diverse ethnic group.[14] Furthermore, to inform the development of intervention strategies, assessment of obesity should include measures of physical activity (PA) and nutrition,[15] as these are two of the most important modifiable risk factors for disease. This exploratory study aimed to use a community-based participatory research (CBPR) approach to estimate overweight/obesity prevalence, PA levels, and dietary intake among PI youth and young adults in Southern California.

Methods

Study Design and Team

This cross-sectional, CBPR study involved a collaborative partnership between one university and two community-based organizations. The study team included university researchers with backgrounds in behavioral science, nutritional epidemiology and kinesiology, and community leaders from the Marshallese, Samoan, Tongan communities with extensive experience in adolescent programs and/or health education. Following CBPR approaches developed in previous studies, we employed CBPR principles throughout the study period, including equal partnership of community and university researchers and shared participation in all aspects of the research design, implementation, and evaluation.[16] Quarterly CBPR meetings among the research team and community leaders occurred throughout the entire two-year study period for: planning (six months), youth recruitment (6 months), two waves of data collection (6 months), data analyses and community report-back (6 months). Community leaders and designated community members (including youth) received training on all aspects of data collection including a training manual on assessment procedures and role playing. Community and university members co-facilitated all data collection activities, with the exception of the dietary assessment spearheaded by university researchers. Please see a previous publication for a full description of the CBPR planning, recruitment and other strategies used in this study.[17] The study was approved by the California State University, Fullerton, Institutional Review Board.

Participants

Eligible participants were youth and young adults (13-24 years old) from three ethnicities (Tongan, Samoan, Marshallese) residing in Southern California. During a six-month period, we recruited participants from churches in Los Angeles, Orange and San Diego counties. Churches play a pivotal role in promoting PI culture and community in the continental U.S., taking the place of traditional PI villages (and pastors of village chiefs) from the islands.[18] Community leaders outreached to youth and young adults through multiple churches (three Tongan, three Marshallese, and five Samoan) to maximize diversity with regards to geographic location and denomination (eg, Methodist, Catholic, and the Church of Latter Day Saints). Participants received a $50 gift card for each of two waves of data collection.

Procedures

Data collection occurred either at the church or a convenient community setting (eg, local community center) and in groups of 6-20 participants of the same ethnic group. Before assessment, we provided youth with parental consent forms and scheduled them to participate in two visits scheduled seven days apart. During the first visit, participants returned with signed parental consent forms, received instructions on all study procedures, signed youth assent forms and completed a demographic questionnaire. They rotated in small groups to each of three stations where they completed height and weight measures, the Food Frequency Questionnaire (FFQ), and received detailed instructions on proper wear of the accelerometers. During the second visit, participants returned the accelerometers and participated in a short debriefing interview to share their feedback on the assessments (data not reported). The remainder of this paper presents findings from the demographic, height/weight, FFQ and accelerometer data.

Measures

Physical Measures

We measured height and weight individually at each site. Height was measured to the nearest 0.1 cm using a Seca 214 portable stadiometer (Hanover, MD), and weight was measured to the nearest 0.1 kg using a stand-up Ohaus ES200L bench scale (Pine Brook, NJ). The scale was calibrated before each session. These procedures followed the guidelines provided by the National Health and Nutrition Examination Survey.[19] BMI was calculated as total body weight in kilograms divided by height in meters squared (kg/m^2). BMI values were compared to CDC calculations for children and teens (for only participants age less than 21 years old) to determine overweight (≥ 85th percentile to less than the 95th percentile for age and gender) or obesity (≥ 95th percentile) status.[20] Extreme obesity was calculated at BMI values > 99th percentile.

Physical Activity

We assessed physical activity levels with the ActiGraph GT1M (ActiGraph, Pensacola, FL), a uniaxial accelerometer that measures and records vertical accelerations ranging in magnitude from 0.05 to 2 g.[21] The GT1M model has been shown to produce similar results to the older 7164 model,[22] and is widely used in PA research. There is extensive evidence establishing the Actigraph as a valid and reliable instrument for assessing adolescent PA measures.[23] Validity of the Actigraph for adolescents has been reported against various criterion measures, including indirect calorimetry ($r = 0.86$)[24] and direct observation ($r = 0.50$).[25] Previous studies have reported intra-instrument reliability ranging from ICC = 0.31 for 1 day of monitoring, to ICC = 0.87 for 7 days of monitoring.[24,25]

Participants received instructions to wear accelerometers during the waking hours for seven consecutive days. Since the accelerometers were not waterproof, the monitors had to be removed during water-based activities (eg, showering, swimming). The ActiGraph recorded activity in 10-second intervals, and we reviewed accelerometer data for valid wear times using MeterPlus v4.0 software (MeterPlus, La Jolla, CA). For this paper, data were reintegrated into 60-second intervals and presented as activity counts. A valid recorded hour was defined as having at least 30 consecutive minutes of activity counts, and a valid recorded day consisted of at least 8 valid hours of counts. Participants with at least 4 valid days of accelerometer data were included in the PA analyses. We converted activity counts to daily duration (min/day) of sedentary (activity count <101), light- (activity count 101-1951), moderate- (activity count 1952-5724), and hard/very hard-intensity (activity count 5725-10000) activity categories.[26] We calculated average minutes per day in each category by summing daily minutes of each activity category across valid days and dividing by the number of valid days. Total daily moderate-to-vigorous physical activity (MVPA) was calculated by summing the daily totals for moderate and hard/very hard activity categories.

Dietary Assessment

We utilized the FFQ that was developed and validated by the Epidemiology Program of the University of Hawai'i Cancer Research Center. The 150-question FFQ was administered to Native Hawaiian and multi-ethnic adults, and found relatively good agreement when compared against 24-hour recall.[27] The food composition database was derived from the U.S. Department of Agriculture, and was supplemented and updated with data from local recipes consumed by the various ethnic groups in Hawai'i. At the first visit, participants completed the FFQ based on their "usual" dietary pattern over the previous seven days. The "usual time frame" to report participant's intake in most studies is over the last year. However, a previous report suggested that most children (8 – 13 years) better recall dietary data over the last week.[28] We also showed photographs of serving sizes and plastic food models to help participants visualize and estimate food portions.

Data Analyses

All analyses were conducted using the Statistical Package for Social Sciences (SPSS) for Windows v16.0 (IBM, Chicago, Il) and Statistical Analysis Software (SAS) v9.1 (SAS, Cary, NC). To determine categories of normal weight, overweight, obesity or extreme obesity, participants aged less than 21 years of age were classified according to CDC criteria of BMI values equaling or exceeding the 85th, 95th, or 99th percentile for age and gender.[20] Dietary data were log transformed in order to convert the data from a skewed distribution to an approximated Gaussian distribution. We calculated means and frequencies for daily micronutrients, food group intake, and PA levels, and performed independent *t*-tests to test for gender differences in PA levels and dietary intake within each ethnic group. Analysis of variance (ANOVA) identified differences in PA and dietary intake between ethnic groups. Bonferroni post-hoc tests were run for analyses involving more than two groups. Power calculations using G*Power (Softpedia, Dusseldorf, Germany) determined a total sample size of $N = 84$ necessary to detect differences of moderate effect sizes at $r = .30$ with $P < .05$ and 80% power.

Results

A total of 129 Tongan, Samoan and Marshallese were recruited into the study, with the following completion numbers: 118 provided basic demographic data; 111 provided usable accelerometer data with 81% (n = 86) meeting the minimum criteria (at least 4 valid days with a minimum of 8 hours per day) for inclusion in PA analyses; and 129 were measured for height, weight, and provided dietary assessments. For the dietary data, we removed outliers based on recommendations from previous research.[34] We excluded the top and bottom 10% of the log transformed energy distribution, then a robust SD (RSD) was calculated. We also excluded energy intakes outside the range (mean ± 3 RSD). Subsequently, four outliers were identified and removed, resulting in analysis of 125 FFQs.

Demographic characteristics and BMI percentages by ethnic group are shown in Table 1, with Marshallese participants presenting much lower prevalence of overweight and extreme obesity compared to Tongans or Samoans. Overall, 84% of Tongan, 76% of Samoan, and 24% of Marshallese youth were overweight (85th-94th percentile) or obese (95th percentile or greater). Average BMIs for Tongan males and females were 31.2 kg/m^2 and 34.3 kg/m^2 (respectively); 48% of males and 50% of females were extremely obese. Average BMIs for Samoan males and females were 32.3 kg/m^2 and 33.4 kg/m^2; 50% and 36% were extremely obese. Lastly, average BMIs for Marshallese males and females were 25.3 kg/m^2 and 22.1 kg/m^2; 20% of males and 0% of females were extremely obese. See Table 2 for BMI by gender and ethnicity.

Accelerometer data found total MVPA at 37.5 ± 27.2 min/day for the entire sample (Table 3). Over 87% of daily activity was classified as light-intensity (266.5 ± 71.0 min/day) and time spent sedentary was 508.1 ± 120.5 min/day. Males had significantly higher levels of moderate-intensity PA compared to females (45.4 ± 25.9 min/day vs 24.7 ± 18.9 min/day; $P < .001$).

Accelerometer data (Table 4) indicated no between-group differences for total daily MVPA, although light-intensity activity was significantly higher in Samoans (308.7 ± 67.5 min/day) compared to Tongans (256.4 ± 68.1 min/day; $P < .01$) and Marshallese (233.9 ± 57.3 min/day; $P < .001$). Tongans and Marshallese also had higher minutes of non-wear time compared to Samoans ($P < .01$). Compared to Samoan females, Samoan males demonstrated significantly higher minutes of moderate-intensity PA (44.9 ± 29.4 min/day vs 14.1 ± 7.0 min/day; $P < .01$). Marshallese males accumulated significantly higher levels of light-intensity (255.2 ± 66.3 min/day vs 208.7 ± 31.3 min/day; $P < .05$), moderate-intensity (57.1 ± 26.8 min/day vs 23.9 ± 14.0 min/day; $P < .01$), and total MVPA (58.6 ± 28.2 min/day vs 25.5 ± 14.9 min/day; $P < .01$), compared to Marshallese females.

Marshallese males reported significantly higher ($P < .05$) consumption of fiber/1,000 kcal (10 ± 4 vs 8 ± 3), vegetables (10 ± 10 vs 5 ± 5 servings), and dairy (4 ± 3 vs 2 ± 1 servings) compared to Marshallese females (Table 5). Tongan males consumed a significantly higher percent of energy from protein compared with Tongan females (16 ± 3, 14 ± 3, respectively; $P < .05$). Between the three ethnic groups, Tongans (7865 ± 5872 calories) had significantly higher energy consumption compared to Marshallese (5503 ± 4620 calories), while both Tongans (35 ± 7%) and Samoans (35 ± 6%) had significantly higher consumption of energy from saturated fat compared to Marshallese (33 ± 7%, $P < .05$). Tongans (5 ± 4 servings) also had a significantly higher consumption of daily dairy servings compared to Marshallese (3 ± 3 servings, $P < .05$), and Tongans (9 ± 3) had significantly higher fiber/1,000 kcal intake compared to Samoans (8 ± 3, $P < .05$).

Table 1. Demographic Characteristics and Body Mass Index Profile by Ethnicity (n=118)

	Tongan (n=52)	Samoan (n=38)	Marshallese (n=28)
Gender			
Male	25 (48%)	22 (58%)	15 (54%)
Female	27 (52%)	16 (42%)	13 (46%)
Age Group			
13-14	16 (31%)	11 (29%)	7 (25%)
15-16	22 (42%)	10 (26%)	10 (36%)
17-20	14 (27%)	15 (40%)	11 (39%)
21+	0	2 (5%)	0
Parental Education Attainment			
Father completed college degree	3 (7%)	5 (13%)	3 (17%)
Mother completed college degree	3 (6%)	4 (11%)	1 (5%)
BMI (n=126)*			
Normal weight [Total (males/females)]	16% (23%/11%)	24% (17%/27%)	76% (60%/93%)
Overweight and obese [Total (males/females)]	84% (77%/89%)	76% (82%/73%)	24% (40%/ 7%)
85th-94th percentile [Total (males/females)]	13% (11%/14%)	10% (5%/18%)	14% (20%/ 7%)
95th-98th percentile [Total (males/females)]	22% (18%/25%)	22% (27%/19%)	0% (0%/ 0%)
> 99th percentile [Total (males/females)]	49% (48%/50%)	44% (50%/36%)	10% (20%/ 0%)

*To adhere to CDC growth chart categories, only participants under age 21 were included (eliminating 7 participants)

Table 2. Height, Weight, and Body Mass Index Profile (Mean and Standard Deviation) by Ethnic and Age Groups (n=116)			
	Tongan	**Samoan**	**Marshallese**
Males			
	n = 25	n = 22	n = 15
Ages 13-14			
Height (cm)	175.9 ± 4.9	170.7 ± 8.5	152.5 ± 8.6
Weight (kg)	86.1 ± 18.6	94.4 ± 31.4	45.3 ± 6.8
BMI	29.8 ± 6.3	31.9 ± 9.3	19.5 ± 2.2
Ages 15-16			
Height (cm)	180.8 ± 4.4	177.3 ± 5.1	171.1 ± 6.0
Weight (kg)	108.1 ± 26.0	102.1 ± 32.4	81.0 ± 19.6
BMI	31.7 ± 7.9	34.5 ± 14.5	27.5 ± 5.7
Ages 17-20			
Height (cm)	185.4 ± 7.2	170.2 ± 25.7	170.5 ± 4.8
Weight (kg)	110.4 ± 22.4	111.4 ± 30.4	79.9 ± 22.5
BMI	28.6 ± 4.0	38.2 ± 1.3	27.4 ± 7.3
Total Males			
Height (cm)	108.3 ± 6.2	175.7 ± 7.1	165.9 ± 10.2
Weight (kg)	101.6 ± 24.6	100.1 ± 25.7	80.0 ± 23.8
BMI	31.2 ± 7.4	32.3 ± 7.9	25.3 ± 6.6
Females			
	n = 27	n = 14	n = 13
Ages 13-14			
Height (cm)	170.2 ± 4.4	163.2 ± 6.2	156.4 ± 6.9
Weight (kg)	92.0 ± 22.7	79.4 ± 18.2	50.9 ± 7.5
BMI	32.5 ± 7.4	30.4 ± 6.8	20.7 ± 1.2
Ages 15-16			
Height (cm)	168.7 ± 4.6	166.5 ± 4.0	155.4 ± 7.3
Weight (kg)	99.0 ± 28.6	111.4 ± 36.2	53.7 ± 6.6
BMI	33.9 ± 10.2	43.1 ± 1.0	22.2 ± 1.5
Ages 17-20			
Height (cm)	169.9 ± 5.6	162.3 ± 8.4	156.2 ± 8.6
Weight (kg)	105.1 ± 32.6	84.1 ± 33.7	55.8 ± 7.5
BMI	36.3 ± 10.6	39.2 ± 14.5	22.9 ± 2.9
Total Females			
Height (cm)	169.5 ± 4.7	163.8 ± 6.6	155.9 ± 7.0
Weight (kg)	98.7 ± 27.7	90.6 ± 31.7	53.7 ± 6.7
BMI	34.3 ± 9.4	33.4 ± 10.6	22.1 ± 2.0

Table 3. Comparison of Accelerometer Data in Minutes Per Day (Mean and Standard Deviation) by Gender (n=86)

Physical Activity Variable	Total (n=86)	Males (n=44)	Females (n=42)
Valid wear days	6.1 ± 1.3	6.0 ± 1.2	6.1 ± 1.4
Valid hours per day	13.9 ± 2.1	14.0 ± 2.1	13.8 ± 2.0
Sedentary	508.1 ± 120.5	487.8 ± 95.2	529.3 ± 140.4
Light	266.5 ± 71.0	283.4 ± 68.2	248.2 ± 70.4*
Moderate	35.3 ± 24.9	45.4 ± 25.9	24.7 ± 18.9**
Hard	2.1 ± 5.3	2.0 ± 3.9	2.1 ± 6.4
Very hard	0.2 ± 0.4	0.2 ± 0.4	0.2 ± 0.4
Total MVPA	37.5 ± 27.2	47.6 ± 27.3	27.0 ± 22.9**

*P < .05, **P <.001 compared to males. MVPA = moderate-to-vigorous physical activity.

Table 4. Comparison of Accelerometer Data in Minutes/Day (Mean and Standard Deviation) by Ethnicity (n=86)

	Tongan			Samoan			Marshallese		
Physical Activity Variable	Total n = 35	Males n = 17	Females n =18	Total n = 27	Males n = 14	Females n = 13	Total n = 24	Males n = 13	Females n = 11
Valid wear days	5.8 ± 1.1*	5.7 ± 1.2	5.9 ± 1.1	6.7 ± 1.3	6.6 ± 1.3	6.7 ± 1.5	5.7 ± 1.3*	5.8 ± 0.8	5.6 ± 1.7
Valid hours per day	13.5 ± 1.9***	13.3 ± 1.9	13.4 ± 2.0	15.3 ± 2.1	15.5 ± 2.1	15.0 ± 2.1	13.1 ± 1.4***	13.2 ± 1.6	13.1 ± 1.3
Sedentary	491.9 ± 142.7	464.6 ± 104.9	517.7 ± 170.0	542.0 ± 123.4	521.4 ± 94.9	564.1 ± 149.0	493.4 ± 66.6	481.9 ± 77.1	507.0 ± 52.0
Light	256.4 ± 68.1**	272.1 ± 62.0	249.5 ± 144.1	308.7 ± 67.5	323.2 ± 62.5	292.8 ± 71.6	233.9 ± 57.3***	255.2 ± 66.3	208.7 ± 31.3*
Moderate	34.8 ± 21.4	37.0 ± 19.3	32.7 ± 23.5	30.1 ± 26.4	44.9 ± 29.4	14.1 ± 7.0**	41.9 ± 27.3	57.1 ± 26.8	23.9 ± 14.0**
Hard	2.8 ± 7.5	3.0 ± 5.8	2.7 ± 9.0	1.6 ± 3.6	1.3 ± 2.1	2.0 ± 4.8	1.4 ± 1.5	1.4 ± 1.5	1.4 ± 1.6
Very Hard	0.1 ± 0.3	0.2 ± 0.4	0.1 ± 0.1	0.3 ± 0.6	0.2 ± 0.6	0.4 ± 0.6	0.2 ± 0.3	0.1 ± 0.2	0.2 ± 0.5
Total MVPA	37.7 ± 26.2	40.1 ± 21.9	35.5 ± 30.2	32.0 ± 27.3	46.4 ± 30.9	16.5 ± 9.1**	43.4 ± 28.2	58.6 ± 28.2	25.5 ± 14.9**

*P < .05; **P < .01; ***P < .001 compared to male and Samoan participants. MVPA = moderate-to-vigorous physical activity.

Table 5. Comparison of Daily Macronutrient and Food Group Intakes (Mmean and Standard Deviation) (n=125)

	Tongan			Samoan			Marshallese		
Dietary Variable	Total (n = 56)	Males (n = 27)	Females (n = 29)	Total (n = 37)	Males (n = 21)	Females (n = 16)	Total (n =32)	Males (n = 18)	Females (n = 14)
Energy (kcal)	7865 ± 5872	7345 ± 5298	8348 ± 6415	7440 ± 7085	6952 ± 5163	8080 ± 9174	5503 ± 4620	6452 ± 5490	4284 ± 2940
Fiber/1,000kcal	9 ± 3	9 ± 2	10 ± 3	8 ± 3	7 ± 4	8 ± 3	9 ± 4	10 ± 4	8 ± 3*
% energy from fat	35 ± 7	35 ± 7	34 ± 8	35 ± 6	34 ± 7	35 ± 5	33 ± 7	33 ± 8	33 ± 6
% energy from saturated fat	12 ± 2	12 ± 2	12 ± 3	12 ± 2	12 ± 3	12 ± 2	10 ± 2	11 ± 2	10 ± 2
% energy from protein	15 ± 3	16 ± 3	14 ± 3*	14 ± 2	15 ± 2	14 ± 2	17 ± 3	16 ± 2	17 ± 3
Vegetable (servings)	10 ± 9	10 ± 9	10 ± 10	8 ± 9	7 ± 7	10 ± 11	7 ± 8	10 ± 10	5 ± 5*
Fruit (servings)	12 ± 15	11 ± 14	13 ± 16	5 ± 8	6 ± 9	4 ± 4	7 ± 8	8 ± 10	5 ± 4
Total grain (servings)	24 ± 18	22 ± 17	26 ± 19	24 ± 23	23 ± 15	25 ± 30	19 ± 15	21 ± 19	16 ± 9
Whole grain (servings)	5 ± 4	4 ± 4	5 ± 5	4 ± 6	3 ± 3	4 ± 8	2 ± 3	3 ± 4	2 ± 2
Dairy (servings)	5 ± 4	5 ± 4	5 ± 4	4 ± 4	4 ± 3	4 ± 5	3 ± 3	4 ± 3	2 ± 1*
Meat (ounces)	17 ± 14	19 ± 14	16 ± 14	18 ± 22	17 ± 18	20 ± 27	17 ± 16	18 ± 17	15 ± 13

*P < .05 compared to males

Discussion

This study aimed to use CBPR to estimate levels of obesity, PA, and dietary intake among PI youth and young adults. In this study, Marshallese participants had substantially lower prevalence of overweight (25%) than Tongan (84%) or Samoan (76%) participants, with prevalence estimates for these latter ethnicities much higher than has previously been reported.[11,29,30] In particular, we found higher prevalence of extreme obesity in the Tongan and Samoan samples than previously described international data (49% and 44%, respectively).[10] Current BMI cutoffs for Pacific Islander adults and youth may overestimate obesity based upon past studies finding higher lean mass compared to Europeans.[31,32] Furthermore, U.S. based Tongan and Samoan youth may be at urgently elevated risk for a variety of future medical complications, and extreme obesity may need to be addressed with more intensive treatment approaches.

CDC physical activity guidelines for youth include 60 minutes or more of activity a day.[33] The findings from this study support the literature that adolescent males are typically more active than females. Low levels of physical activity and high levels of sedentary behavior have been reported for Tongan youth overseas,[34] and findings from the present study highlight similarities for all PI groups. The overwhelming proportion (87%) of daily activity (4-5 hours/day) registered at the low end of the intensity spectrum; approximately 8-9 hours per day were recorded as sedentary. Recent studies report that high levels of sedentary behavior are associated with adverse health effects, even in individuals meeting physical activity recommendations.[35] Modest increases from light- to moderate-intensity PA could help youth reap health benefits associated with sufficient MVPA levels.

U.S. Department of Agriculture dietary guidelines recommend adequate energy intake to support growth and maintain a healthy body weight, and that calories from fat be limited to 35% of total calories.[36] Our study highlighted potentially important ethnic-specific differences between Tongan, Samoan, and Marshallese participants regarding energy, percent energy from fat, fiber and dairy intake, similar to previous calls for understanding ethnic-specific subgroup differences.[37] For instance, we found Tongan participants had higher consumption of energy and other energy-dense food groups compared to the other two groups, underscoring the importance of studies exploring the unique influences in this population.[38] Other studies have assessed dietary intake in PI adults with differing results, however our study focused on youth and thus dietary consumption via FFQ in the respective population may only lend to comparisons of dietary/nutrient intake within and between groups for our study population.[39]

Limitations

There are several limitations that should be considered when interpreting the study results. First, despite attempts to identify and recruit diverse PI participants, generalizability to the larger youth population is difficult due to our non-probability, community- and church-based sampling.[17] Second, although we found high proportions of overweight and obesity in our sample, this may be an overestimation as specific BMI cutoffs for Pacific Islander youth and adults have not been established, and past research strongly suggests increased BMI thresholds due to higher lean mass compared to Europeans.[31,32] Third, there are several limitations associated with accelerometers. We were unable to estimate many common activities (eg, water-based activities, or activities at extreme ends of the intensity spectrum), although we hope the information in this paper still contributes to the limited literature available for this population. Although we instructed participants to wear the monitors above the right hip, many male youth wore pants much lower than waist level due to current fashion trends.[17] Newer technology that places accelerometers worn around the wrist (eg, Fitbits) could well address such limitations in the future.[40] Lastly, FFQs are considered less burdensome compared with other dietary data assessment methodology. However, FFQs generally provide data on usual intakes rather than exact point estimates of macronutrient and food groups, and therefore dietary/nutrient intake data are more appropriately interpreted via comparisons and/or rankings within group and/or between groups of the respective study population. Also, over-reporting may result in extremely high energy intakes, and therefore energy adjustment of dietary variables, as well as comparison between groups provides for a more appropriate representation of the data. Future studies should build upon this study by considering use of other robust dietary assessment methodology, such as 24-hour dietary recall or food records, and/or development of a self-reported, validated dietary assessment tool for PI adolescents.

Implications and Recommendations

Following the community report-back to share findings from the study,[17] several of the community leaders created the first-ever Native Hawaiian and Pacific Islander youth fitness day in April 2011 that has subsequently been hosted annually at the University of California, Los Angeles, by PI student and other leaders as well as community organizations. Many of these same leaders also participated in the creation of the Pacific Islander Let's Move! physical activity program for primary prevention among PIs of all ages, inspired by then first-lady Michelle Obama and launched through churches and other community organizations throughout southern California.[41] Despite these outcomes, we recommend further research particularly on appropriate BMI cutoffs for PI youth. In addition, health promotion programs aimed at decreasing caloric intake and sedentary behavior, and increasing time spent in MVPA, appear warranted for PI youth given the high levels of overweight and obesity observed in this study. Although we investigated individual-level nutrition and physical activity, public health prevention research also points to the importance of social and environmental intervention factors. Hawley and McGarvey (2015) describe a number of promising multi-level efforts across the Pacific including banning imports of fatty meats and taxing sugar-sweetened beverages,[5] although youth may present a particularly challenging age group for intervention.[42,43] Lastly, future research should not only confirm our local findings with other PI populations and in other areas of the U.S., but also explore the larger cultural, community and policy influences on obesity prevention, persistence, and amelioration.

Conflict of Interest

None of the authors identify a conflict of interest.

Disclosure

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