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Effects of a One-Week Intensive Wellness Camp on Dietary Behaviors among Southwest American Indian Youth

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Abstract

American Indians (AI) suffer the highest rates of diabetes in the United States (US); a chronic disease that is increasingly prevalent among AI children and is associated with increased risk of cancer. A summer camp was developed to improve disease risk-reducing behaviors, including diet, among AI youth in Arizona. The aim of this study was to examine the efficacy of a one-week intensive summer health camp conducted from 2016 to 2019 on change in dietary behaviors and compliance for Dietary Guidelines for Americans (DGA) among AI youth.

AI children aged 10 to 15 years from several Arizona tribes participated in one-week intensive residential camps. Participants engaged in a week of experiential learning focused on healthy eating and physical activity. Twenty-four hour dietary recalls were collected from AI youth by trained staff six weeks before and six weeks after camp. T-tests were conducted to analyze differences in mean intake pre-and post-camp. Diet recalls for 45 children (boys = 19, girls = 26) were included in the current analysis. Results showed a statistically significant reduction in median intake of total fat by 19.5% (P-value = 0.01), and saturated fat by 14.9% (P-value = 0.01). Further, a statistically significant decrease in median energy intake of 18.7% (P-value = 0.002), a 22.9% decrease in total fat (P-value = 0.01), and 22.3% reduction in saturated fat was observed among boys only. However, post-camp, a higher percentage of girls met guidelines for fruit intake (54% vs 26%), percent saturated fat (23% vs 16%), calcium (7% vs 0%) and whole grains (15% vs 0%), while a higher percentage of boys met guidelines for vegetables (63% vs 50%) and sodium (25% vs 23%). The AI health camp was effective at reducing energy intake (kcals/day), total fat (g/day) and saturated fat (g/day) among participants aged 10 to 15 years. The camp was observed to be more effective at decreasing energy, total fat, and saturated fat intake among boys.

Keywords
Health; diet; behaviors; native American; American Indian; youth

1. Introduction

American Indians experience a disproportionate burden of chronic disease in the United States (US), a reality largely influenced by higher risk for obesity. Obesity rates among youth in the US is a serious health concern with 19% of children and adolescents between the ages of two and 19 being affected [1]. American Indian (AI) and/or Alaska Native (AN) youth experience disproportionate rates of obesity with a prevalence of 30% [2]. As in adults, increasing rates of type 2 diabetes (T2D) in AI youth have paralleled rising obesity rates with reports estimating a T2D prevalence of 1.2 per 1000 in 2001 among AI youth aged 0 to 19 years [3]. Alarmingly, the Center for Diseases Control and Prevention predicts that one in two AI children born in the last two decades will develop T2D in their lifetime if current trends continue [4]. Obesity and diabetes early in life pose a significant threat in this population as they place youth at higher risk for chronic disease in adulthood [5, 6]. In the US National Longitudinal Study of Adolescent Health, compared with participants with normal weight in both adolescence and young adulthood, those with excess weight in both periods of time experienced a significantly greater risk of hypertension (OR = 3.72; 95% CI: 2.86-4.84) and diabetes mellitus (OR = 3.32; 95% CI: 2.11-5.21) [6]. However, the study also found that excess weight in adolescence but normal weight in young adulthood did not seem to be associated with increased risk of these cardiovascular risk factors in young adulthood highlighting the potential clinical utility of interventions among youth focused on establishing healthy lifestyle practices.

Multiple determinants of health, including social and environmental factors, have been associated with obesity and related chronic disease among the AI population [7, 8]. While limited data exists, research shows that food insecurity is highly prevalent among this population [7, 8].

According to Jernigan et al., approximately 25% of AI/AN in the US suffered food insecurity from 2000 to 2010 [8]. It has also been documented that scarcity of grocery stores and presence of food deserts in synergy with limited access to traditional food systems limit access to fresh and healthy foods [9-11]. Not surprisingly, only about 60% of AI high schoolers were found to consume a green salad once per week, which was found to be 10% less than non-Hispanic White high schoolers [12]. Furthermore, close to half of all residents in tribal areas have reported incomes below 200% of the federal poverty level [13]. Of note, approximately 28% of these residents lived walking distance from a grocery store as compared to 64% of low-income individuals nationwide [13].

The American Indian Youth Summer Wellness Camp (hereafter referred to as Wellness Camp), was developed in 1991 as a Tribal-University partnership and has been an ongoing effort to address health concerns observed among AI youth [14]. As a particular emphasis, this one-week health intensive camp aims at promoting healthy lifestyle behaviors including healthful eating practices among high-risk AI youth [15]. Previously published results from the 2016 Wellness Camp showed that only 15% and 35% of participants met the Dietary Guidelines for Americans (DGA) recommendations for fruit and vegetable before the camp respectively, and after the camp, there was a significant reduction in total fat intake [16]. The current manuscript seeks to provide an update on the effectiveness of the Wellness Camp on dietary behaviors, including energy intake and intake of specific nutrient and food groups, combining data for the years 2016 through 2019.

2. Materials and Methods

2.1 Youth Wellness Summer Camp

Description of the wellness summer camp has been summarized previously [15, 16]. Briefly, AI youth from different tribes across Arizona were invited to participate in an annual one-week intensive residential camp from the years 2016 to 2019 and AI youth were followed up for two months after their participation in the camp. This Wellness camp was created from a University-Tribal partnership and an interdisciplinary team that included a University of Arizona camp director, Tribal Diabetes Program Director, and tribal health personnel (a pediatrician, physician assistant, a registered nurse, two registered dietitians, exercise instructors, tribal coordinators, and other community health representatives). The wellness camp was developed in the context of cultural capital, meaning, within and in consideration of tribal norms, practices, languages, beliefs, and expectations. The wellness camp curriculum included education sessions that covered topics such as nutrition with an emphasis on healthy tribal foods, diet, and chronic disease prevention such as T2D, heart health and cancer, assessment of clinical factors including anthropometrics and health risk behaviors (diet, exercise, tobacco, alcohol use, etc.), and health messaging. The camp also experientially provided attendees with healthy meals and snacks during the duration of their stay in an effort to reinforce diet-related health curriculum (Supplemental Figure S1).

2.2 Study Population

Interested parents and AI youth aged 10 to 15 were invited by local tribal health programs to participate in the one-week intensive health camp. Individuals were invited based on presentation of risk factors for T2D, including family history of T2D, obesity, impaired glucose tolerance, hyperinsulinemia, metabolic syndrome, and gestational diabetes [15]. As compensation for their

participation in the camp, participants received school supplies, a basketball, hygiene products, and a camp t-shirt. This study was conducted in agreement with the ethical standards specified in the 1964 Declaration of Helsinki and its later amendments. Additionally, the study was reviewed and approved by The University of Arizona Human Subjects Protection Program (Institutional Review Board #1506946623). Parents and youth signed and received a copy of the informed consent at a scheduled meeting held by each tribe with the purpose of answering any questions or concerns regarding the camp program.

2.3 Diet Assessment

Dietary intake was assessed through 24-hour dietary recalls using the validated US Department of Agriculture multiple-pass method [17]. For each participant, three recalls were conducted on three non-sequential days including two-weekdays and one-weekend day, during a period of six-weeks before and six-weeks after the camp. Protocol-driven training in 24-hour recall administration was provided by Registered Dietitian Nutritionists (RDN) to tribal health personnel to collect in-person diet data from the youth with the assistance of a parent. Personnel conducting recalls used tools and strategies to improve quality of the recalls such as measuring cups and spoons, images to aid in serving size estimation, and visual prompts to recall forgotten ingredients and food items such as food toppings. A trained registered dietitian nutritionist from the Behavioral Measurements and Interventions Shared Resource at the University of Arizona Cancer Center entered and processed dietary recall data using the Nutrition Data System for Research (NDSR-2019).

2.4 Statistical Approach

From the total analytic sample, only participants who completed one or more diet recall before and after the camp were included in this analysis. For each participant, average nutrient intake values were computed as the mean of the dietary recalls. Given the small sample size and the distribution of the outcome variables, non-parametric tests were conducted to analyze differences in median consumption of energy (kcals/day), total fat (g/day), saturated fat (g/day), total fiber (g/day), added sugars (g/day), and servings of fruit and vegetables (servings/day) pre- and post-camp. The Chi-squared test was utilized to examine differences in the proportion of youth meeting DGA before and after the camp. A P-value <0.05 was considered statistically significant and all statistical computations were performed with STATA 15.1.

3. Results

3.1 Sample Characteristics

Demographic and clinical characteristics of the total camp attendees from 2016 through 2019 (N = 179) and for youth in the current study (N = 45) are presented separately in Table 1. The analytic sample was comprised of primarily girls (58%). Compared to boys, girls were slightly older, had lower mean body mass index (BMI) and mean waist circumference measurements, and had slightly higher mean hbA1c, although these differences were not statistically significant (Table 1).

Table 1 Baseline demographic and clinical characteristics of American Indian (AI) youth that participated in a one-week Youth Wellness Camp from 2016-2019 stratified by sex.

	Total Camp Sample 2016-2019 [a, b, c, d]			**Analytic Sample** [e, d]		
	Girls N = 101 (57%)	**Boys N = 78 (43%)**	**P-value**	**Girls N = 26 (58%)**	**Boys N = 19 (42%)**	**P-value**
DEMOGRAPHICS						
Age, years (mean ± SD)	11.9 ± 1.7 (range 8-17)	11.9 ± 1.5 (range 9-15)	0.95	11.4 ± 1.3 (range 9-15)	10.8 ± 1.3 (range 9-13)	0.17
School grade, n (%)			0.74			0.29
3rd	1 (1%)	1 (1%)		0 (0%)	1 (6%)	
4th	10 (10%)	4 (5%)		4 (15%)	2 (12%)	
5th	19 (19%)	15 (20%)		5 (19%)	7 (41%)	
6th	18 (18%)	17 (23%)		9 (35%)	4 (23%)	
7th	22 (22%)	16 (21%)		6 (23%)	2 (12%)	
8th	13 (13%	15 (20%)		0 (0%)	1 (6%)	
9th	9 (9%)	5 (7%)		0 (0%)	0 (0%)	
10th	6 (6%)	2 (3%)		2 (8%)	0 (0%)	
CLINICAL CHARACTERISTICS						
BMI, kg/m^2 (mean ± SD)	28.3 ± 6.8	28.4 ± 8.6	0.94	27.7 ± 7.1	28.0 ± 8.1	0.89
Waist circumference, cm (mean ± SD)	90.7 ± 16.3	94.6 ± 20.4	0.17	90.6 ± 14.1	92.8 ± 18.4	0.66
Body fat, %	38.3 ± 8.1	35.1 ± 15.2	0.11	37.6 ± 8.6	37.5 ± 13.2	0.97
Blood pressure, mmHg (mean ± SD)						
Systolic pressure	104.8 ± 10.6	109.5 ± 11.4	0.007	103.8 ± 11.6	109.3 ± 11.6	0.14
Diastolic pressure	71.3 ± 8.3	73.0 ± 9.3	0.22	70.5 ± 8.9	75.6 ± 8.2	0.07
% Hemoglobin A1c (mean ± SD)	5.7 ± 1.2	5.5 ± 0.7	0.24	5.8 ± 1.3	5.5 ± 0.4	0.11

3.2 Dietary Intake

Dietary intake values before and after the health camp are presented in Table 2. Overall, statistically significant reductions were observed for energy intake of 11.7% (235.4 kcals/day, P-value = 0.003), total fat by 19.5% (16.8 g/day, P-value 0.01), and saturated fat by 14.9% (4 g/day, P-value = 0.01). While not statistically significant, favorable changes were observed for fruit intake with a 6.4% increase (0.06 svg/day), and a reduction in added sugars by 19.1% (12.9 g/day) (Table 2).

Table 2 Effects of one-week American Indian (AI) Youth Wellness Camp on AI children's dietary intake (N = 45) before and after camp for the years 2016-2019.

	Total Sample (N = 45)			**Girls (N = 26)**			**Boys (N = 19)**		
Dietary Component	**Before Camp Median (Range)**	**After Camp Median (Range)**	**P-value**	**Before Camp Median (Range)**	**After Camp Median (Range)**	**P-value**	**Before Camp Median (Range)**	**After Camp Median (Range)**	**P-value**
Energy (kcal/day)	2006.8 (982.4-4050.2)	1771.4 (798.9-2744.7)	0.003	1821.8 (982.4-2967.4)	1740.4 (982.8-2575.2)	0.26	2177.7 (1117.7-4050.2)	1771.4 (799.0-2744.7)	0.002
Total Fat (g/day)	86.1 (38.6-161.3)	69.3 (31.2-118.1)	0.01	73.1 (38.6-126.7)	69.0 (34.9-103.4)	0.20	90.1 (45.1-161.3)	69.5 (31.2-118.1)	0.01
Saturated fat (g/day)	26.9 (10.6-47.0)	22.9 (9.4-43.7)	0.01	25.4 (10.6-39.5)	22.4 (10.5-37.2)	0.13	30.9 (16.4-47.0)	24.0 (9.4-43.7)	0.02
Total fiber (g/day)	15.7 (5.1-33.9)	13.2 (5.1-33.9)	0.06	14.7 (7.2-23.1)	13.4 (5.7-31.7)	0.83	16.6 (5.1-33.9)	12.8 (5.9-24.6)	0.04
Fruit (svg/day)	0.94 (0-3.4)	1.0 (0-5.3)	0.66	0.98 (0-3.4)	1.6 (0-3.8)	0.29	0.7 (0-3.3)	0.5 (0-5.3)	0.56
Vegetable (svg/day)	2.7 (0.6-6.2)	2.6 (0.4-9.9)	0.13	2.6 (0.4-4.9)	2.4 (0.4-4.9)	0.04	3.0 (0.6-4.9)	2.9 (0.8-9.9)	0.87
Added Sugars (g/day)	67.5 (5.9-221.9)	54.6 (6.4-161.7)	0.15	62.6 (5.9-138.7)	62.0 (13.8-161.7)	0.47	68.5 (25.9-221.9)	50.5 (6.4-139.8)	0.24

Dietary intakes stratified by sex before and after camp are also summarized in Table 2. For girls, a slight statistically significant reduction in vegetable intake of 7.7% (-0.2 servings, P-value 0.04) was observed. On the other hand, among boys, a reduction in energy intake of 18.7%, (406.3 kcals/day, P-value = 0.002), total fat by 22.9% (20.6 g/day, P-value = 0.01), saturated fat intake of 22.3% (6.9 g/day, P-value = 0.02), and a 22.9% reduction in fiber (3.8 g/day, P-value = 0.04) was observed. Additionally, favorable but not statistically significant changes were observed for added sugar intake with a 26.3% reduction or 18 g/day Table 2.

Further, we examined percent of youth meeting several components of the DGA before and after they attended the camp. Results are summarized in Table 3 below. While not statistically significant, the percent of youth meeting guidelines increased for fruit by 4%, saturated fat by 4%, sodium by 8%, and whole grains by 5%. Looking at results stratified by sex, although not statistically significant, the number of girls meeting recommendations increased for fruit by 16%, saturated fat by 8%, sodium by 4%, and whole grains by 15% before vs after attending the camp. Among boys, there was an increase in the proportion of boys meeting recommendations for sodium by 14% while the proportion of boys meeting other guidelines remained similar or decreased. While these were not statistically significant, the proportion of boys meeting both fruit and whole grain intake guidelines decreased by 11% and the percentage of boys meeting guidelines for vegetable intake and saturated fat intake remained the same. A statistically significant result was only observed for the percent of boys meeting calcium guidelines, which decreased from 42% to 0% (P-value = 0.001).

Table 3 Percent of youth meeting Dietary Guidelines for Americans (DGA) before vs after camp 2016-2019 stratified by sex.

Guideline/target	Total Sample (N = 45)			Girls (N = 26)			Boys (N = 19)		
	Before Camp n (%)	After Camp n (%)	P-value	Before Camp n (%)	After Camp n (%)	P-value	Before Camp n (%)	After Camp n (%)	P-value
Fruit >1.5 svgs	17 (38%)	19 (42%)	0.70	10 (38%)	14 (54%)	0.25	7 (37%)	5 (26%)	0.47
Vegetables >2.5 cups	26 (58%)	25 (56%)	0.84	14 (54%)	13 (50%)	0.77	12 (63%)	12 (63%)	1.00
Saturated Fat <10%	7 (16%)	9 (20%)	0.62	4 (15%)	6 (23%)	0.46	3 (16%)	3 (16%)	1.00
Sodium <2300 mg	7 (16%)	11 (24%)	0.34	5 (19%)	6 (23%)	0.72	2 (11%)	5 (25%)	0.26
Calcium >1300 mg	10 (22%)	2 (4%)	0.01	2 (7%)	2 (7%)	1.00	8 (42%)	0 (0%)	0.001
Whole Grains >3 oz	2 (4%)	4 (9%)	0.34	0 (0%)	4 (15%)	0.30	2 (11%)	0 (0%)	0.14

4. Discussion

Chronic disease disparities are prominent among the AI population, and more concerning, among the AI youth. In an effort to address these disparities, a one-week intensive wellness camp was

created from a University-Tribal partnership which focused on promoting healthy lifestyle behaviors including healthful eating practices among high-risk AI youth. Utilizing the 24-hour dietary recall data collected six weeks before and six weeks after the camp for the years 2016 through 2019, we sought to examine the effects of the camp on dietary behaviors and DGA compliance among boys and girls.

The nutrition-specific camp curriculum included six hours of classroom-type instruction, two hours per day for three days of camp, one hour in the morning and one hour in the afternoon. The nutrition classes were taught by registered dietitians and tribal-based diabetes program educators. The topics focused on food groups, reading food labels, portion size, and interactive sessions focused on meal planning, snack options, energy in and energy out, and visualization exercises on salt and added sugar for commonly eaten foods (based on completed recalls prior to camp). The registered dietitians took time at each meal to describe the foods served to further exemplify the food groups and how substitutions were made to optimize nutrients without compromising taste, for example, squash spaghetti for pasta spaghetti. In addition, healthy snacks were offered at break times and water was made available throughout the day, with water stations dedicated to fruit or vegetable infused water. Water was the only beverage served over the entire camp week. Furthermore, all meals were served with food items portioned according to recommendations, for example, half the plate made up of fruits and vegetables, and protein and grains were served at each meal. Our program focused both on nutrition education and actualization of the concepts taught.

Overall, there was a statistically significant reduction in energy intake (11.7%), total fat (19.5%) and saturated fat (14.9%) in the whole analytic sample. When stratified by sex, girls had a slight statistically significant reduction in vegetable intake of 7.7%, while among boys there was a reduction in energy intake of 18.7%, total fat by 22.9%, saturated fat of 22.3%, and a 22.9% reduction in fiber. Further, when comparing the proportion of youth meeting DGA guidelines after the camp, a higher proportion of girls met guidelines for fruit consumption (54% vs 26%), percent of saturated fat (23% vs 16%), calcium (7% vs 0%) and whole grains (15% vs 0%), while a higher proportion of boys met guidelines for vegetable intake (63% vs 50%) and sodium (25% vs 23%). The percentage of boys meeting the recommendations for calcium and whole grains was less than desirable at baseline (42% and 11%, respectively) and it did not improve after the health camp. While the health camp did not emphasize consumption of calcium-rich foods, it did include menu items focused on whole grains, such as whole grain pancakes. The dietary recall assessments were conducted three-days post camp and the consumption of calcium and whole grains on these select days could have been less than usual. Additionally, the camp did focus on energy in and energy out and that may have certainly contributed to overall less calorie consumption, including lower consumption of these food groups and nutrients. The boy's age and development stage are important considerations and during the upcoming camps the need for increased consumption of calcium and whole grains will be emphasized while also adding additional food sources in the menu. Overall, this work underscores the importance of the intervention and efforts to improve diet habits in this population to address chronic disease disparities.

Strengths and limitations of this study further inform on our findings. A significant limitation to our measurement of dietary intake was the fact that the post camp measure occurred, on average, several weeks after camp was completed. If the assessment had reflected the camp week specifically, marked differences in intake based on usual (pre-camp) versus the healthy camp menu

would have supported positive diet behavior change in the short-term. Further, the high rates of food insecurity and healthy food deserts in this population likely were major drivers of family food choices, making it challenging for youth to sustain the food choices offered during camp. While we had a robust curriculum that addressed several key dietary behaviors that support overall health, the complexity of addressing multiple behaviors may have challenged youth to sustain any camp-specific behavior change longer term, especially in the context of all the other health behaviors being addressed (e.g., activity, tobacco use, etc.).

Demographic and clinical characteristics of the analytic sample (N = 45) are similar to the characteristics of total sample 2016-2019 (n = 179) indicating that the analytic sample utilized in this study is fairly representative of the overall youth attending the camps during these years. A limitation of our study is that not all boys and girls who attended camp participated in the 24-hour dietary recalls and that was largely due to time and budget constraints. As the camp program rigor evolves, the impact of the nutrition education component, including the 24-hour dietary recalls, is also gaining support and understanding. In a University-Tribal partnership, the role of respecting and adhering to tribal sovereignty is a core tenet of a successful partnership. Since 1991, the camp program has expanded to include objective measures to assess impact, the most recent addition being the 24-hour dietary recalls described herein. As with any new measure, the process needs to be tested and the results seem to be beneficial. We are encouraged by the number of recalls completed to date and that the University-Tribal partnership sees the 24-hour recalls as a core component of our program moving forward.

5. Conclusions

The one-week AI youth intensive summer health camp conducted from 2016 to 2019 was effective at reducing total fat (g/day) and saturated fat (g/day) among participants aged 10 to 15 years. The camp was observed to be more effective at decreasing energy and total fat intake among boys. However, given the multilevel factors contributing to the health disparities observed among this population, including food deserts and overall access to quality foods, the presented health camp exemplifies a segment of the interventions needed in order to make a meaningful and equitable improvement in the health of the AI youth.

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Author Contributions

Conceptualization, Melissa Lopez-Pentecost, Cynthia A. Thomson, and Francine C. Gachupin; Data curation, Robin Hazelwood, Otellie Honanie, Jessica Quamahongnewa, Francine C. Gachupin; Formal analysis, Melissa Lopez-Pentecost; Investigation, Robin Hazelwood, Otellie Honanie, Jessica Quamahongnewa, Francine C. Gachupin; Writing – original draft, Melissa Lopez-Pentecost, Cynthia

A. Thomson, Francine Gachupin; Writing – review & editing, Melissa Lopez-Pentecost, Cynthia A. Thomson, Robin Hazelwood, Otellie Honanie, Jessica Quamahongnewa, Francine C. Gachupin.

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Competing Interests

The authors have declared that no competing interests exist.

Additional Materials

The following additional materials are uploaded at the page of this paper.

1. Figure S1: Sample menu including culturally relevant foods for the 2017 American Indian Youth Wellness Camp.

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