Sociodemographic Factors Influencing Island Food Consumption in the Pacific Islander Health Study

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ABSTRACT

This dissertation explores the relationships between island food consumption, sociodemographic variables, and cardiovascular risk using data from the Pacific Islander Health Study (PIHS). Chapter 1 explores the associations between self-reported level of island food consumption and key covariates. Island food consumption was modeled using Poisson regression and adjusted for demographic, socioeconomic, and cultural characteristics. Increased Pacific Island cultural affinity was the strongest predictor of increased island food consumption while being formerly married was associated with decreased island consumption. These results speak to cultural norms and lifestyle choices that influence dietary choice.

Chapter 2 examines how the associations between Pacific Island cultural affinity and island food consumption is moderated by demographic covariates. Following exploratory factor analysis, two separate factors emerged. The scale was split into two subscales measuring cultural activity participation and culturally relevant media consumption. No significant interactions were found between the activity subscale and any of the covariates, but significant interactions were found between the media subscale and ethnicity and birth country. Differences in media consumption – and therefore food advertising or food portrayal – by birth country may drive the moderation seen in these interactions.

Chapter 3 assesses the association between island food consumption and cardiovascular risk using linear regression. A 9-point cardiovascular risk score was constructed. After adjustment for four blocks of covariates island food consumption was not significantly associated with cardiovascular risk. In bivariate analyses, island food consumption was significantly associated with higher fruit and vegetable consumption, but not fast food or sugar sweetened beverage consumption. These findings suggest that the type of island foods consumed by PIHS participants may include high levels of fruits and vegetables that are part of a heart-healthy diet.

This dissertation is a first step in understanding dietary patterns of Pacific Islander Americans and has generated several hypotheses that could be used to inform future work. Showing how island food consumption in this small, but growing population will one day inform both policy makers and targeted dietary interventions.

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Introduction

The Pacific Islands are genetically, culturally, and geographically diverse, but share a legacy of colonization and occupation by economically and politically powerful nations such as the United States, the United Kingdom, Germany, France, and Japan. Changes in the islands' political, economic, and social systems as a result of colonization have lead to a dependence on imported consumer goods including foods that provide low-cost calories and are also efficient to transport (Gewertz & Errington, 2010; Hughes & Lawrence, 2005; Hughes & Marks, 2009). For example, social, economic, and cultural shifts following the conversion of communal land holding to individual land tenure in Hawai'i were powerful enough to disenfranchise native Hawaiian families from their traditional land base, many of whom moved to cities in order to participate in the urban cash economy rather than living a subsistence lifestyle (Kame'eleihiwa, 1992; Kirch, 1996; Linnekin, 1987). Hawai'i currently imports between 85-90% of its food, much of which is processed, refined, and contributes to chronic illnesses (Department of Business Economic Development & Tourism & Department of Agriculture, 2012). An excess supply of mutton flaps in New Zealand and Australia and demand for low-cost meat in the islands have sent these high-fat cuts to smaller Pacific nations such as Samoa, Papua New Guinea, and Fiji (Evans, Sinclair, Fusimalohi, & Liava'a, 2001, 2002; Gewertz & Errington, 2010). Following nuclear weapons tests on Enetewok and Bikini atolls in the Marshall Islands in the 1940's and 1950's Marshall Islanders were forced to abandon both their homes and traditional diets due to radioactive contamination. Marshall Islanders were advised to consume "no more than one coconut a day," a daunting task for a people whose islands often do not have a steady

supply of fresh water and instead drink coconut water (Niedenthal, 1997, 2001). Sea level rise resulting from climate change is also a significant factor in the Pacific dietary shift. There are countless islands throughout the Pacific that are struggling to support traditional crops as seawater slowly contaminates the little freshwater available (Ahlgren, Yamada, & Wong, 2014).

While the level of dependence on imported goods and the preceding global mechanisms vary throughout the Pacific region, the inclusion of high-fat meats such as turkey tails, corned beef, mutton flaps, Spam®, tinned fish, instant noodles, and white rice in addition to more traditional foods has become increasingly more common in the past 70 years (Lako & Nguyen, 2001). The relationship between imported island foods and socioeconomic status is a complex one. Imported foods making up a contemporary island eating pattern are consumed out of necessity, but are also comfort foods that have an enjoyable taste and provide high economic value (Aitaoto et al., 2015; Gewertz & Errington, 2010; Haden, 2009; Jones, Dempewolf, Armstrong, Gallucci, & Tavana, 2011; Singer, 2014). In some parts of the Pacific, imported foods signify increased Westernization and the ability to enter a cash-economy, representing high status. For example, mutton flaps have evolved into somewhat of a status food in Papua New Guinea and have found a place in social ceremonies that require the exchange of food items (Gewertz & Errington, 2010). In much of the urban Pacific, however, canned meats are seen as a marker of lower socioeconomic status and luxury goods are fresh, traditional foods such as seaweeds, poi[1], or raw fish.

[1] A Hawaiian starchy staple made from baked and pounded taro root.

More than just simple fuel, these island foods encompass the narratives of globalization, colonization, and Pacific migration. Migration from traditional homelands to Westernized metropolitan regions such as Honolulu, Los Angeles, Brisbane, Sydney, and Auckland makes access to traditional foods difficult or impossible for many Pacific Islanders. However, other, "new" island foods such as the ones previously described are inexpensive and easily accessible in host countries and have become comforting symbols of "home" and a way to reaffirm Pacific identity throughout the diaspora (Aitaoto et al., 2015; Lassetter, 2011; Singer, 2014). Through migration and food consumption, the legacy of colonization is embodied within the foods consumed by Pacific Islanders. In the past, taro, breadfruit, and fish fueled long canoe journeys across a vast ocean. Now, fast food, soda, and mutton flaps meet modern day voyagers on the other side of a plane.

Although there is a body of literature describing the effects of globalization and colonization on the diets of Pacific Islanders, there is little describing the distribution of contemporary island foods within the United States or its relation with cardiovascular risk. The questions addressed in the following papers are not intended to cover the entire effect of globalization and migration on the dietary shift experienced throughout the American Pacific. Nor are they intended to delve into a thick description of the influence of culture on dietary consumption among Pacific migrants. Rather, it is a first step to understanding the social and demographic distribution of island food consumption, the association between cultural affinity and island food consumption, and the association between island food consumption and cardiovascular risk among a sample of Pacific Islanders living in California.

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Chapter 1: Sociodemographic factors influencing island food consumption in the Pacific Islander Health Study

Introduction

According to data from the 2011 National Health Interview Survey, Native Hawaiians and Pacific Islanders (NHPI) are 1.4 times more likely to be overweight and 1.3 times more likely to be obese compared to non-Hispanic Whites (Schiller, Lucas, & Peregoy, 2012). Although NHPI make up 0.4% of the national population, approximately 1.2 million individuals identified themselves as NHPI alone or in combination on the 2010 census and NHPI are the second fastest growing racial group in the country (Hixson, Hepler, & Kim, 2012). This is a small, but growing population that exhibits significant diet-related cardiovascular and metabolic health disparities (Mau, Sinclair, Saito, Baumhofer, & Kaholokula, 2009).

Historically, data from Pacific Islander Americans has been aggregated with Asian Americans until the Office of Management and Budget required separate data collection of these two very distinct racial groups in 1997 (OMB, 1996). This study will use data collected for the Pacific Islander Health Study (PIHS), which is a pilot questionnaire, adapted from the National Health information Survey and the National Survey of American Life that provides health data for Pacific Islander Americans (S. V. Panapasa, Jackson, Caldwell, Herringa, et al., 2012). Understanding how foods associated with a contemporary eating pattern is distributed among Pacific Islander Americans in California may shed light on how socio-environmental factors influence dietary choices. This analysis is a novel effort

to describe variation in contemporary island food consumption among Pacific Islander Americans living in Southern California by key sociodemographic variables including age, ethnicity, gender, socioeconomic status, and migration history.

Demographic factors such as age, gender, and marital status will be important components of this analysis. Previous literature has shown differences in dietary patterns between Pacific Islander elders and youth. Bell, Swinburn, Amosa, Scragg, and Sharpe (1999) found that individuals under the age of 40 ate significantly more calories from dairy, takeaway foods, soft drinks, and snacks compared to those over the age of 40 who ate more calories from meat/pulses/eggs, fruit and vegetables, starchy staples, and traditional foods. In the same study, men of all ages ate slightly more traditional foods compared to women (Bell et al., 1999). In a multi-ethnic cohort in Los Angeles, male gender was associated with a dietary pattern high in fat and meat while Native Hawaiian ethnicity and physical activity were associated with dietary patterns high in vegetable consumption (Park et al., 2005). However, another study found no significant differences in dietary patterns by gender (Finau, Prior, & Maddill, 1986). These disparate findings indicate that gender is also an important factor to explore. No previous literature includes a focus on dietary patterns by marital status among Pacific Islanders, but studies have found differences in diet healthfulness based on marital status in other ethnic and cultural groups. For example, results from the Whitehall II study of London civil servants indicated that higher proportions of participants reporting an "unhealthy" or "very unhealthy" diet were unmarried compared to the proportion of unmarried participants reporting a "healthy," "very healthy," or "sweet" diet (Martikainen, Brunner, & Marmot, 2003). Basic demographic variables such as these can often help explain dietary patterns as they are

highly correlated with explanatory variables such as gender, marital status, or employment status.

Socioeconomic status is also a driving factor behind food choices. Perceived food cost and availability influences food choice in low SES, minority communities as does the differential reinforcement value of foods in within the socioeconomic gradient (Buchthal, 2014; Epstein, Leddy, Temple, & Faith, 2007; Lin, Carr, Fletcher, & Epstein, 2013; Mhurchu et al., 2013; Young, Batch, & Svetkey, 2008). In the previously mentioned Hawaii-Los Angeles Multiethnic Cohort Study, a positive, dose-response relationship was observed between educational attainment – a proxy for SES – and dietary patterns rich in vegetables, fruit, and milk while the opposite pattern was seen for a dietary pattern high in fat and meat (Park et al., 2005). A study determining the perceived availability and perceived nutrition of both imported and traditional foods in Tonga among individuals of high and low socioeconomic status found that participants with lower socioeconomic status perceived a higher availability of imported foods compared to participants with higher socioeconomic status who perceived a higher availability of indigenous complex carbohydrates and uncommon traditional foods (Evans, Sinclair, Fusimalohi, & Liava'a, 2002). Rush, Puniani, Snowling, and Paterson (2007) found that food insecurity – being uncertain about one's household's access to regular and adequate food – was high (43.6%) among Pacific Islander families living in Auckland. Participant families who reported food insecurity also reported purchasing less unhealthy luxury items such as alcohol, soft drinks, ice cream, and fruit juice and more nutrient dense foods such as bread, meat/chicken. However, purchase of healthy staples such as milk, fruit and vegetables also decreased (Rush et al., 2007).

A final layer of factors that may drive island food consumption are cultural variables such as birthplace and cultural affinity. There is a large body of research documenting both the traditional dietary patterns of Pacific Islanders living in rural environments as well as the dietary shifts experienced by Pacific Islanders as a results of increased dependence on imported food products of emigration to urban centers within Oceania such as Auckland, Honiara, or Port Moresby (Gewertz & Errington, 2010; Hughes & Lawrence, 2005; Hughes & Marks, 2009). Limited previous literature has examined the dietary patterns of Native Hawaiians, but only one study (Moy, Sallis, & David, 2010) included non-Hawaiian Pacific Islanders and focused on fruit and vegetable consumption rather than traditional or imported island food consumption (Harmon et al., 2015; Kim, Park, Grandinetti, Holck, & Waslien, 2008; Lassetter, 2011; Maskarinec et al., 2006; McEligot et al., 2012; Sharma, Wilkens, Shen, & Kolonel, 2013; Takata et al., 2007). Moy, Sallis, and David (2010) evaluated several health indicators including fruit and vegetable consumption from a convenience sample of Pacific Islanders recruited from cultural events and religious organizations in Southern California and found that participants ate a mean number of 0.8±1.3 daily servings of fruit and vegetables with women eating slightly more than men. Within this sample, 99% indicated consuming fewer than the recommended 5 daily servings of fruit and vegetables. The same study reported that only 76.9% of a chronologically comparable U.S. population consumed less than the recommended amount. Although this study had limitations, including small sample size (n=100) and a low response rate (29.2%), it was a novel contribution to the body of literature describing NHPI dietary patterns in the United States. There is no known literature, however, that describes

dietary patterns among Pacific Islander Americans with a specific emphasis on island food consumption.

Previous research has examined the dietary shifts seen in populations of other migrants. For example, first generation Mexican-Americans tend to have a healthier diet, with more fruits and vegetables, compared to their second and third generation counterparts (Espinosa de Los Monteros, Gallo, Elder, & Talavera, 2008; Sharkey, Johnson, & Dean, 2011). The same pattern is seen among Asian migrants (Gadgil, Anderson, Kandula, & Kanaya, 2014). Tillotson et al. (1973) showed a strong gradient of dietary acculturation among men of Japanese ancestry living in Japan, Hawai'i, and California. Proportion of Japanese food consumed decreased with geographic (and presumably, cultural) distance from Japan while proportion of Western foods consumed increased. Striking differences in prevalence of diabetes mellitus between Pima Indians living in Mexico versus their counterparts living on the U.S.-side of the border suggest dietary acculturation and adoption of a Western lifestyle contribute to negative obesity-related health outcomes (Ravussin, Valencia, Esparza, Bennett, & Schulz, 1994; Schulz et al., 2006). These findings support the idea that populations living in home countries consume a more traditional diet and adopt a Westernized diet upon migration to the United States.

In light of the patterns seen in other American minority groups and the scarcity of literature exploring the dietary patterns of Pacific Islander Americans, this paper will explore the sociodemographic distribution of island food consumption among a population of Samoan and Tongans living in California. Specifically, this analysis will calculate the distribution of times individuals reported eating island foods during the past week and explore the bivariate relationships between island food consumption and key

sociodemographic variables. Finally, the relationships between island food consumption and sociodemographic characteristics will be examined in a series of multivariable regression models. Within the context of the previous research presented in this introduction, it is expected that characteristics such as increased age, male gender, currently married, foreign birth, and high cultural affinity will be positively associated with island food consumption. The effect of socioeconomic status, could produce an inverted-U shaped relationship with island food consumption: lower socioeconomic status, as measured by lower educational attainment, under- or unemployment, and food insecurity could constrain food choice while higher socioeconomic status could indicate higher levels of assimilation to American culture and diet, weakening the association with island foods. Performing this analysis will accomplish two goals: 1) provide valuable dietary information about Pacific Islander Americans as a part of America's multi-ethnic environment and 2) understanding of the sociodemographic characteristics influencing dietary choices that could inform future interventions for this unique population.

Methods

Pacific Islander Health Study sample

The PIHS is a pilot questionnaire, which is adapted from the National Health Interview Survey, California Health Interview Survey, the National Survey of American Life, and Chicago Community Adult Health Study and provides health data for Pacific Islander Americans (S. V. Panapasa, Jackson, Caldwell, Herringa, et al., 2012). Historically, data from Pacific Islander Americans has been aggregated with Asian Americans until the Office of Management and Budget required separate data collection of these two very distinct racial

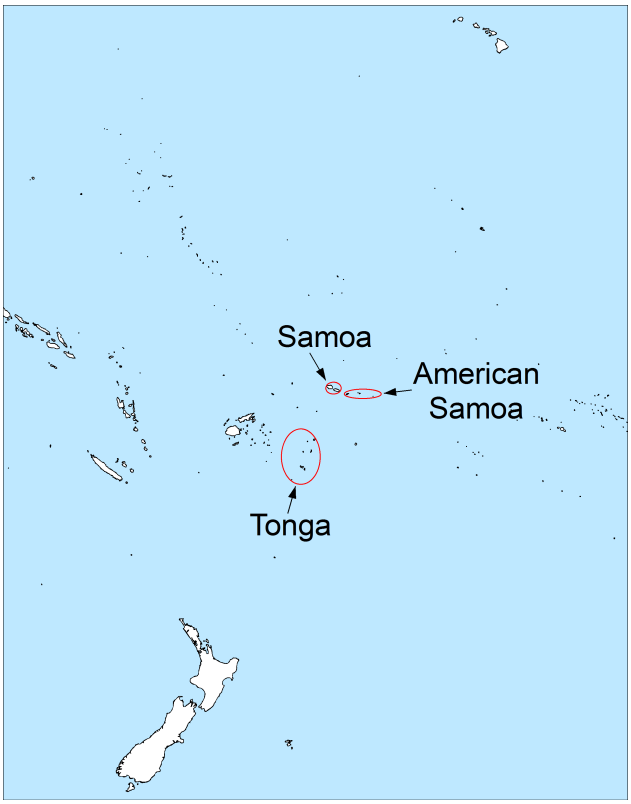

Figure 1. Map of the southwestern Pacific Islands

groups in 1997 (OMB, 1996). The collection of disaggregated NHPI health data will significantly increase the ability of health researchers to report and monitor health disparities within this community (S. V. Panapasa, Jackson, Caldwell, Heeringa, et al., 2012; S. V. Panapasa, Jackson, Caldwell, Herringa, et al., 2012).

The PIHS collected data during the 2-year project, beginning in June 2009, from adults and adolescents in 300 Samoan and Tongan households in California (S. V. Panapasa, Jackson, Caldwell, Heeringa, et al., 2012). Research partners and community religious organizations used a community-based participatory research framework to design and implement the PIHS. A stratified random sample frame was used to recruit participants from 20 Samoan and Tongan community religious organizations located respectively in Los Angeles County and San Mateo County in order to access a social network that is central to the lives of Pacific Islander Americans. Data collection occurred as an in-person interview and questions covered health status and conditions, health behaviors, healthcare access and utilization, personal demographics, mental health, financial status, life events, and religion. The response rate was 79.67% and 240 households completed the survey, yielding a final sample size of 240 adults and 240 adolescents. The data was weighted, post-collection, so that the results are generalizable to

the population of Pacific Islanders in California. This sample utilizes the 240 adult participants only.

Variables

Island food consumption is operationalized as the self-reported number of times a participant has eaten "island foods" during the previous 7 days. Participants are prompted with a list that includes cassava, taro, yams, corned beef, SPAM, turkey tail or seafood, meat or pastry cooked in coconut milk, but are also allowed to define "island foods" in their own way. The count of incidents was restricted fro 0 to ≥6.

Ethnicity is Samoan or Tongan. *Age* is calculated using the participant's birth year and date. *Gender* is reported by household member. *Marital status* is defined by three categories: "married" includes participants who are currently living with their partners, with or without legal marriage, "formerly married" includes participants who are separated from their spouse, divorced, or widowed, "never married" includes participants who have never been married and are not currently living with a partner.

Education is defined by three categories including "less than a high school diploma," "a high school diploma," and "more than a high school diploma." *Employment status* is also defined by three categories which includes "full-time work," "part-time work," and "not currently working/other." *Financial insecurity* is operationalized as a categorical variable using a composite financial security score. Participants were asked if they have needed to liquidate assets, postpone medical care, borrow money, apply for government assistance, obtain a loan, or alter living arrangements due to financial difficulties during the past year in a series of 7 questions. For each affirmative answer 1-point is added to the financial

security score. Lower scores indicate less financial insecurity while higher scores indicates more financial insecurity.

Birthplace is self-reported by participants as United States, American Samoa, Samoa, and Tonga. *Pacific cultural affinity* is a continuous variable using a composite cultural identity score with a range of 11 to 44 that was specifically developed for use in the PIHS. However, in the regression analysis cultural affinity was centered about the mean in order to produce more interpretable results. Participants are asked how often they participate in a series of 11 different Tongan or Samoan cultural activities including: speaking Samoan or Tongan language, listening to Samoan or Tongan music, cooking Samoan or Tongan food, spending time with Samoan or Tongan friends, time spent with Samoan or Tongan friends growing up, identifying oneself as a Samoan/Tongan American, identifying oneself as only Samoan or Tongan, identifying oneself as only American, listening to Samoan or Tongan radio, watching Samoan or Tongan TV shows, and reading Samoan or Tongan news or other materials. Each activity is given a numeric score based on the following frequencies: very often – 1, fairly often – 2, not too often – 3, and never – 4. However, for this analysis, all questions except "How often do you identify your self as only American?" were reverse coded.

Analysis plan

All statistical analyses were completed using STATA 12.0. Univariate analyses were performed to examine the distribution of each variable. Means and proportions for each variable were calculated for the entire sample as a whole as well as for Samoans and Tongans, independently. Given the historic and political differences between Samoans and

Tongans, tests of difference were performed to identify sociodemographic differences between these two culturally and politically disparate groups at the alpha=0.10 level as this analysis uses a small pilot sample. Bivariate analyses were performed to assess the correlation and distribution for each variable. The final portion of the analysis used the SVYSET command, which applied population weights and corrected for clustering within community religious organization. Four Poisson models were created to assess the effects of sociodemographic variables on island food consumption. The first model includes a block of "demographic" covariates that includes age, gender, ethnicity, and marital status:

$$g\{E(y)\} = \beta_0 + \beta_1 age + \beta_2 gender + \beta_3 ethnicity + \beta_4 marital\ status + \varepsilon$$

where $g = \ln\{E(y)\} = ln\{E(island\ foods\ consumption)\}$ and $y \sim Poisson$.

The second model adds a block of "socioeconomic" covariates that includes educational attainment, employment status, and a financial insecurity score:

$$g\{E(y)\} = \beta_0 + \beta_1 age + \beta_2 gender + \beta_3 ethnicity + \beta_4 marital\ status + \beta_5 education + \beta_6 employment\ status + \beta_7 financial\ insecurity + \varepsilon$$

where $g = \ln\{E(y)\} = ln\{E(island\ foods\ consumption)\}$ and $y \sim Poisson$.

The third model adds birthplace:

$$g\{E(y)\} = \beta_0 + \beta_1 age + \beta_2 gender + \beta_3 ethnicity + \beta_4 marital\ status + \beta_5 education + \beta_6 employment\ status + \beta_7 financial\ insecurity + \beta_8 birthplace + \varepsilon$$

where $g = \ln\{E(y)\} = ln\{E(island\ foods\ consumption)\}$ and $y \sim Poisson$.

The fourth and final model adds the cultural affinity score:

$$g\{E(y)\} = \beta_0 + \beta_1 age + \beta_2 gender + \beta_3 ethnicity + \beta_4 marital\ status + \beta_5 education + \beta_6 employment\ status + \beta_7 financial\ insecurity + \beta_8 birthplace + \beta_9 cultural\ affinity + \varepsilon$$

where $g = \ln\{E(y)\} = ln\{E(island\ foods\ consumption)\}$ and $y \sim Poisson$.

The QIC-u (Quasi-likelihood under the Independence Criterion model) goodness of fit statistic was obtained for each model to assess model fit while also adjusting for model size. This statistic is used as an alternative to the R^2 statistic that normally accompanies regression models as likelihood-based model fit statistics are not applicable to complex survey data with multiple levels of clustering and strata such as the PIHS (Cui & Qian, 2007).

Results

Descriptive statistics

The distribution of all variables in the total samples as well as between ethnic groups was examined. Two-sided t-tests, chi-squared, and Fischer's exact tests indicated significant differences between the two groups in employment status, birth country, cultural affinity, and island food consumption. In the full sample, 36.66±2.91% work full-time, 8.91±2.71% work part-time, and 54.43±4.17% are not working or are engaged in another type of work. While there were no differences in the proportion of Samoans and Tongans engaged in full-time work, there were significantly more Tongans reporting part-time work and significantly more Samoans reporting not working or performing "Other" work. Significant differences in birth country were found between Samoans and Tongans, but there were no differences in the proportion of those who reported being born in the United States. In the total sample 35.48±3.11% were born in the United States, 19.89±6.50% were born in Samoa, 26.68±4.75% were born in American Samoa, and 17.95±3.85% were born in Tonga. The total sample has an average cultural affinity score of

Table 1 Means and proportions of demographic variables and island food consumption*

Variable		Total (n=240) Mean (S.E.)	Samoan (n=137) Mean (S.E)	Tongan (n=103) Mean (S. E.)	*p***
Age		39.74 (1.51)	39.52 (2.01)	40.31 (1.24)	0.73
Male gender (%)		49.63 (3.25)	50.39 (4.21)	47.67 (4.90)	0.69
Marital (%)	Living with partner	60.01 (4.46)	60.00 (5.55)	60.40 (5.55)	0.57
	Formerly married	9.40 (2.63)	10.10 (3.33)	7.58 (3.31)	
	Never married	30.50 (5.25)	29.91 (7.15)	32.02 (4.31)	
Education (%)	Less than HS	13.60 (3.32)	12.28 (3.96)	17.01 (6.13)	0.71
	High School	45.45 (5.80)	45.51 (7.46)	45.31 (5.85)	
	More than HS	40.94 (6.26)	42.41 (8.62)	37.68 (3.94)	
Employ. (%)	Full-time	36.66 (2.91)	35.26 (3.30)	40.27 (6.18)	**0.04**
	Part-time	8.91 (2.71)	5.21 (3.01)	18.42 (5.57)	
	Not working/Other	54.43 (4.17)	59.52 (5.33)	41.31 (4.89)	
Financial Insecurity		1.20 (1.28)	1.30 (0.15)	0.95 (0.17)	0.17
Birth country (%)	United States	35.48 (3.11)	36.21 (4.21)	33.60 (3.98)	**<0.001**
	Samoa	19.89 (6.50)	27.23 (7.75)	0.97 (0.84)	
	American Samoa	26.68 (4.75)	35.97 (6.90)	2.74 (2.12)	
	Tonga	17.95 (3.85)	0.58 (0.59)	62.69 (3.27)	
Cultural affinity score		33.09 (0.28)	33.68 (0.25)	31.57 (0.38)	**<0.001**
Island Foods		2.93 (0.17)	2.69 (0.17)	3.54 (0.28)	**0.02**

*May not equal 100% due to rounding
**Difference between Samoan and Tongans

33.09±0.28% (out of 44), among Samoans alone the average score was 33.68±0.25 and among Tongans alone the average score was 31.57±0.38 with the difference between the groups reaching statistical significance ($p<0.001$). The number of times participants consumed island foods in the previous week ranges from the 16.67% of the sample who reported no incidents to the 20.42% who reported eating island foods 6 or more times. Among the total sample, island foods were consumed an average of 2.93±0.17 times in the previous week. Tongans had significantly higher consumption of island foods being eaten an average of 3.54±0.28 times over the course of the previous week and only 2.69±0.17 times for Samoans ($p=0.02$).

Table 2 Frequency of island food consumption in past week

	Frequency	Percent
0	40	16.67
1	40	16.67
2	40	16.67
3	27	11.25
4	21	8.75
5	23	9.58
≥6	49	20.42
Total	240	100.00

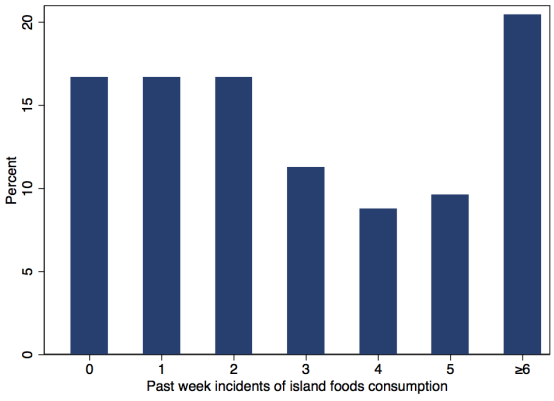

Figure 2 Frequency of island food consumption in past week

Table 3 Bivariate correlations between island food consumption and demographic covariates

r (p)	Island foods	Ethnicity	Age	Gender	Marital status	Education	Employ-ment	Financial insecurity	Foreign birth	Cultural affinity
Island foods	1.00									
Ethnicity (Samoan)	**-0.21 (<0.01)**	1.00								
Age	**0.19 (<0.01)**	**-0.16 (0.01)**	1.00							
Gender (Male)	0.04 (0.49)	0.07 (0.29)	-0.08 (0.25)	1.00						
Marital status	-0.06 (0.34)	0.04 (0.57)	**-0.49 (<0.01)**	0.11 (0.10)	1.00					
Education	**-0.15 (0.02)**	0.04 (0.52)	**-0.16 (0.01)**	**-0.13 (0.05)**	0.06 (0.33)	1.00				
Employ-ment	0.03 (0.64)	0.06 (0.43)	0.05 (0.44)	0.06 (0.33)	**0.24 (<0.01)**	**-0.29 (<0.01)**	1.00			
Financial insecurity	0.07 (0.30)	0.10 (0.14)	0.01 (0.86)	-0.06 (0.35)	**-0.14 (0.04)**	**-0.13 (0.05)**	**0.18 (0.01)**	1.00		
Foreign birth	**0.26 (<0.01)**	**-0.50 (<0.01)**	**0.54 (<0.01)**	-0.05 (0.43)	**-0.39 (<0.01)**	-0.07 (0.26)	0.03 (0.65)	-0.05 (0.41)	1.00	
Cultural affinity	**0.28 (<0.01)**	**0.20 (<0.01)**	**0.16 (0.02)**	-0.06 (0.46)	**-0.13 (0.05)**	-0.10 (0.12)	0.01 (0.84)	**0.13 (0.05)**	0.05 (0.45)	1.00

Bivariate analyses showed that older age, birthplace outside of the U.S., and higher cultural affinity – characteristics related to a more "traditional" lifestyle – was associated with more island food consumption. Island food consumption is negatively correlated with Samoan ethnicity and educational attainment; characteristics that could be proxies for with exposure to American culture were associated with lower island food consumption. Among other combinations, variables were only slightly correlated with one another except birth country, which was moderately correlated with ethnicity ($r(238)=-0.50$, $p<0.01$) and age ($r(238)=0.54$, $p<0.01$) and marital status, which was correlated with age ($r(238)=-0.49$, $p<0.01$).

Figure 3 shows a bivariate density map of participant responses to past week island food consumption. These images show the distribution of responses across two correlated variables and can be read in the same way as a heat map, with warmer color indicating more participants who reported that particular response value. Response categories shown with blue lines alone indicate smaller sub-populations where there is not enough data to create a distribution map. Overall, these images show that responses form a bimodal distribution for many of the sociodemographic characteristics: participants frequently reported either very high or very low levels of island food consumption with few participants reporting moderate levels. Ethnicity and birth country stand out as exceptions with more Tongans reporting higher frequencies of consumption than reporting lower frequencies and more Samoans reporting lower frequencies. Similarly, more participants born in Tonga report higher frequencies whereas those born in the United States, Samoa, or American Samoa report lower frequencies of past week island food consumption.

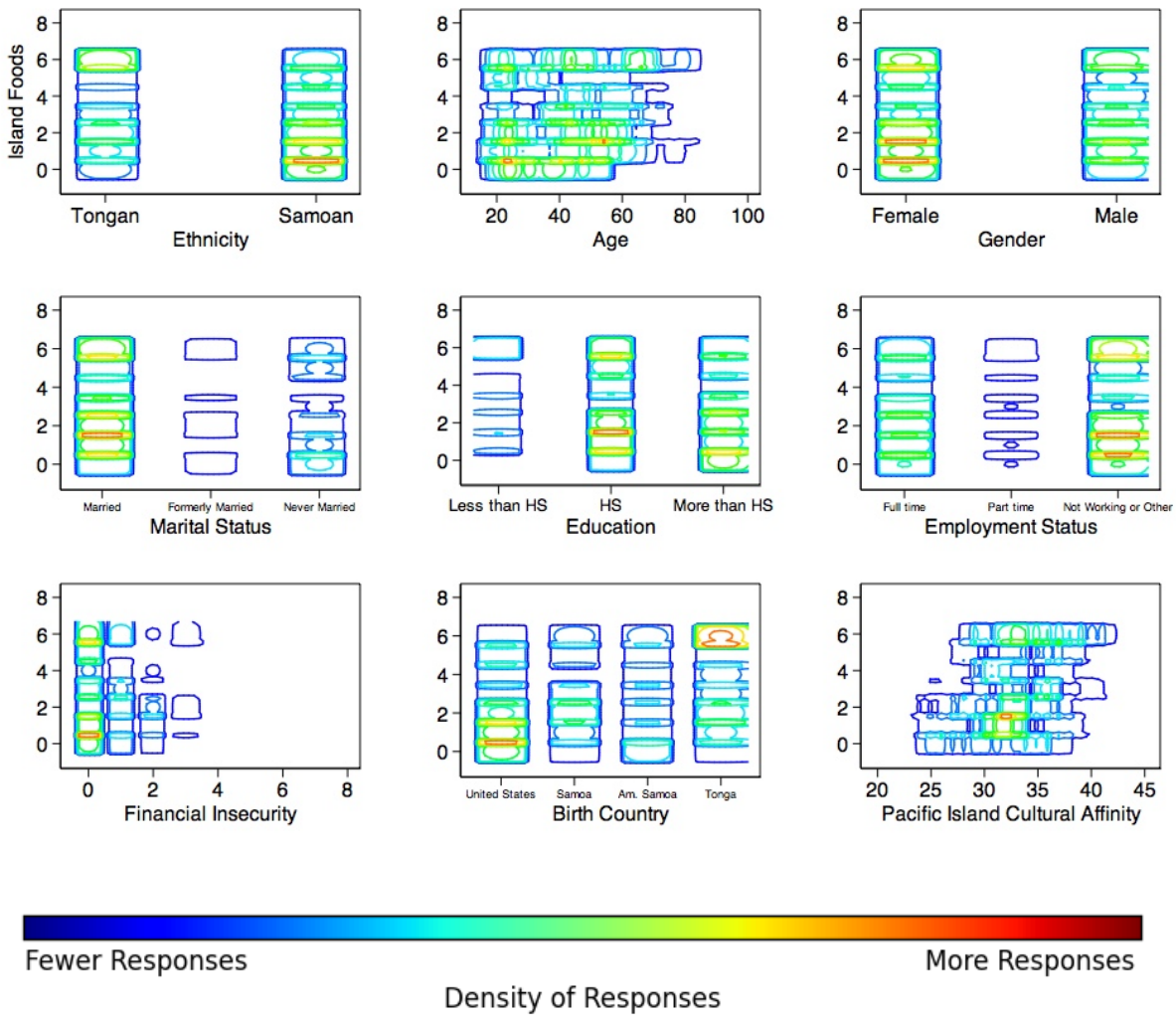

Figure 3 Bivariate density of participant responses to past week island food consumption

Multivariable analysis

Table 4 shows the coefficients for island food consumption in the past week after adjustment for four blocks of sociodemographic covariates. Within the first model, increased age was associated with a slight and moderately significant increase in weekly incidents of island food consumption (*IRR*=1.01±0.004, p=0.09) while Samoan ethnicity and being formerly married were both associated with fewer incidents of island foods

Table 4 Incident rate ratios from Poisson regression for island food consumption in past 7 days after adjustment for four sets of covariates*

	Demographic[1]	SES[2]	Birth Country[3]	Cultural Affinity[4]
	B (S.E.)	B (S.E.)	B (S.E.)	B (S.E.)
Age	**1.01+ (0.004)**	**1.01+ (0.004)**	1.01 (0.01)	1.00 (0.01)
Ethnicity (Samoan)	**0.77* (0.07)**	**0.76* (0.07)**	0.90 (0.15)	0.81 (0.14)
Gender (Male)	1.16 (0.19)	1.14 (0.18)	1.14 (0.18)	1.15 (0.16)
Marital Status Married (Ref.)	-	-	-	-
Formerly married	**0.71* (0.10)**	**0.68* (0.08)**	**0.72* (0.10)**	**0.74* (0.10)**
Never married	1.11 (0.63)	1.22 (0.25)	1.28 (0.27)	1.22 (0.21)
Education <HS (Ref.)	-	-	-	-
HS	-	0.94 (0.12)	0.95 (0.12)	0.90 (0.12)
>HS	-	0.86 (0.12)	0.86 (0.15)	0.88 (0.13)
Emp. Status FT (Ref.)	-	-	-	-
PT	-	0.90 (0.14)	0.92 (0.13)	0.93 (0.13)
Not working/ Other	-	0.95 (0.14)	0.94 (0.14)	0.99 (0.13)
Fin. Insecurity	-	1.07 (0.04)	**1.08+ (0.04)**	1.06 (0.04)
Birthplace US (Ref.)	-	-	-	-
Samoa	-	-	1.02 (0.20)	0.90 (0.17)
Am. Samoa	-	-	1.09 (0.21)	0.97 (0.17)
Tonga	-	-	**1.36+ (0.23)**	1.25 (0.22)
Cultural Affinity	-	-	-	**1.06* (0.02)**
Constant	2.42 (0.50)	2.38 (0.39)	2.02 (0.43)	0.40 (0.18)
QIC-u	1038	990	978	875

** p<0.001, *p<0.05, +p<0.10; all models adjusted for clustering by religious institution
[1]Demographic covariates (age, gender, ethnicity, marital status)
[2]Socioeconomic covariates (education, employment status, financial insecurity)
[3]Birth country (United States, American Samoa, Samoa, Tonga)
[4]Cultural affinity score

consumption (*IRR*=0.77±0.07, p=0.01 and *IRR*=0.71±0.10, p=0.02, respectively). When socioeconomic variables are added in the second model, these same three variables retain their significance. Age is still associated with a slight, but significant increase (*IRR*=1.01±0.004, p=0.06) and Samoan ethnicity and being formerly married are associated with larger decreases in island food consumption (*IRR*=0.76±0.007, p=0.01 and *IRR*=0.68±0.08, p=0.01, respectively). However, both age and ethnicity lose their significant associations with the final two models.

With the addition of birth country in the third model, the formerly married category retained significance and was associated with *IRR*=0.72±0.09 (p=0.02) times fewer incidents of island food consumption compared to those who are currently married. An increased financial insecurity score and Tongan birthplace were both marginally, but significantly associated with more incidents of island food consumption (*IRR*=1.08±0.04, p=0.08 and *IRR*=1.36±0.23, p=0.09, respectively). In the fourth and final model cultural affinity was added. Again, being formerly married was associated with a large decrease in island food consumption (*IRR*=0.74±0.10, p=0.04), but financial insecurity and Tongan birthplace lost significance. Cultural affinity was slightly, but significantly associated with an increase in island food consumption. Centered about a mean score of 32.75, a one-point increase in cultural affinity is associated with a 6% increase in weekly incidents of island food consumption (*IRR*=1.06±0.02, p=0.002).

Discussion

Although just over 16% of participants reported not eating any island foods during the previous week, over 20% reported eating island foods at least 6 times. Using the

bivariate density map (Figure 3), many participants either report very high or very low levels of island food consumption with relatively few participants reporting mid-range values. This may speak to multiple driving factors such as availability and affordability of island foods, normative eating behaviors within subgroup communities, individual eating habits, and expression of culture and identity – some of which are addressed in the multivariable analysis.

In the first multivariable model, age, ethnicity, and formerly married were significantly associated with increased island food consumption. Given that older individuals in this sample were more likely to be born outside of the United States and may be more used to eating island foods, this is not a surprising finding (Bell et al., 1999). A study of the dietary preferences of Samoan teenagers in Auckland showed that the children preferred Westernized "junk" foods such as fast foods, fizzy drinks, sweets, and fried foods although traditional foods were eaten when purchased by older female relatives (Fuamatu, 1997). Pacific Islander Americans are a young population and these types of foods have been linked to negative health outcomes such as obesity and diabetes (Duffey, Steffen, Van Horn, Jacobs, & Popkin, 2012; Grimes, Riddell, Campbell, & Nowson, 2013; Liese, Weis, Schulz, & Tooze, 2009; McNaughton, Mishra, & Brunner, 2008; S. Panapasa, 2009; van Dam, Rimm, Willett, Stampfer, & Hu, 2002). If this eating pattern exhibited among the youth of Auckland is widespread among Pacific Islander youth, the population could face even worse health consequences in coming decades.

Upon addition of socioeconomic variables in the second multivariable model, age and ethnicity retain significance while formerly married gains statistical significance. This finding is surprising since age is significantly correlated with marital status – those

formerly married are, on average, 63.18 years of age while those living with partners are 48.12 years, and those never married are 25.32 years old – and older individuals in this population report higher island food consumption. However, this result is shown in a model that already controls for the effect of age. This means that for individuals of the same age, those who are formerly married are less likely to eat island foods compared to those who are living with a partner or never married. Although it is beyond the scope of this study, perhaps these individuals are turning to Western convenience foods. One further layer of conclusion in this finding is that of the 28 individuals who reported being formerly married, only six are men and 22 are women. Recall that the Bell et al. (1999) reported men eating slightly more traditional foods than women. It is possible that an aspect of gender roles within Pacific Islander communities are influencing the types foods men and women eat.

One notable socioeconomic variable that did not reach statistical significance except for at a very marginal level in the third model and then was attenuated during the final model was financial insecurity. In other settings, the consumption of some types of island foods such as mutton flaps or corned beef has been linked to lower cost in comparison to leaner meats (Evans et al., 2002; Gewertz & Errington, 2010). However, this analysis suggests that island food consumption is not driven by financial difficulties in this population. This lends even more weight to the suggestion that island food consumption is primarily driven by personal habit or cultural factors.

In the final two multivariable models, the cultural variables birth country and cultural affinity were both statistically significant predictors of island food consumption, but the effect of birth country was attenuated once cultural affinity was added in the final

model. The significant difference in island food consumption between Samoans and Tongans may be explained by differences in birth country, since a higher proportion of Samoans were born either in the United States or American Samoa compared to Tongans. This is supported by the loss of significance for the effect of ethnicity upon the addition of birth country. Evidence for variation in Pacific Islanders' dietary patterns based on island nativity and subsequent migration to a more Western or urbanized environment is plentiful and suggests that individuals living in more Westernized or urbanized environments eat fewer traditional foods and more Western foods (Pawson & Janes, 1981; Stanhope & Prior, 1980; Stanhope, Sampson, & Prior, 1981). The finding that Tongan birthplace was significantly associated with increased island food consumption is not surprising. Tonga is, by far, the most rural, least Americanized, and geographically distant of the three foreign birthplaces. Culturally, Tonga stands proud as the only Pacific Island nation never to surrender its sovereignty to a foreign power and does not have the political ties to the United States that American Samoa has.

Finally, cultural affinity is one of two strong, significant predictors of island food consumption in the final model. Given that all other predictors are identical between two PIHS participants, the one with a higher reported cultural affinity score is expected to also report a higher level of island food consumption. However, this result does not explain what aspect of cultural affinity is responsible for this association. Social norms, habit, identity, or political assertion could all be potential driving factors of culturally-related food choice. For example a study of Native Hawaiian migrants to Las Vegas, Nevada revealed that consumption of Hawaiian foods was associated with well-being, mitigating homesickness, and comfort (Lassetter, 2011). The migrants also indicated that they

believed some Hawaiian foods to be "unhealthy" and that portion control was difficult, suggesting an emotional connection between food consumption and culture; eating increased portions of foods that reminded them of home lessened feelings of isolation and homesickness (Lassetter, 2011). This conclusion is beyond the scope of this analysis, but future work may be better able to inform the relationship between cultural affinity and island food consumption.

There are multiple strengths and limitations of this analysis that should be addressed. There are no other known studies that have examined patterns of island food consumption among Pacific Islander Americans. This study also used robust statistical techniques to account for potential confounders and community-level clustering to create a dataset whose responses are generalizable to the entire population of Samoans and Tongans living in California. However, there are also limitations. First, the PIHS is a pilot test of a larger, forthcoming project. Therefore, ethnic diversity within the sample is limited and participants were chosen specifically from Samoan and Tongan faith-based organizations (S. V. Panapasa, Jackson, Caldwell, Heeringa, et al., 2012). The inclusion of two ethic groups and recruitment from religious organizations may limit the generalizability of this sample. Second, these data are cross-sectional in nature, which makes causal inference impossible and self-report data could introduce social desirability or recall bias. Third, the high alpha value chosen for tests of significance in order to show trending within a relatively small data set greatly increased the possibility of type I error. Lastly, the global nature of the island foods variable made nuanced interpretation difficult. For example, there are many types of island foods that vary greatly in availability and nutritional content. Coconut milk and canned pork products are lower in nutritional

quality, but are widely available in the continental United States. Fresh, high-quality produce or fish may be less available to the participants of this study. The island foods variable used in this analysis did not differentiate between the type or nutritional quality of island foods consumed. Future research should explore how foods consumed by participants vary by nutritional quality.

This analysis is simply the first step in answering important questions regarding the dietary choices of one of the fastest growing ethnic groups in California that also experiences elevated rates of diet-related health outcomes such as obesity, cardiovascular disease, and diabetes. Although the results of this study are not generalizable to a national population, they contribute to the larger body of knowledge regarding culture, migration, and dietary patterns in Pacific Islander Americans. Understanding the food choices of this population could help policy makers and community members to address diet-related health disparities in this and other minority populations. Furthermore, this analysis generates other questions for future research such as which specific aspects of cultural affinity influence island food consumption or how the relationships between various characteristics and island food consumption are moderated by cultural affinity.

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Chapter 2: Association of cultural affinity and island food consumption in the Pacific Islander Health Study

Introduction

Previous research has shown that culture, as defined by lifestyle, identity, or level of Western acculturation, has been a predictor of food choice among Pacific Islanders for several decades, whether this means consuming new, imported foods or savoring traditional foods within the diaspora (Cassels, 2006; Clark, 1980; Dancause et al., 2011; Englberger, Marks, & Fitzgerald, 2003). For example, mutton flaps have become the guilty pleasure of Papua New Guineans and serve an important role in social exchange while a Native Hawaiian migrant living in Las Vegas describes poi – a Hawaiian staple made out of boiled and mashed taro root – as "like gold" and its consumption mitigates homesickness (Errington & Gewertz, 2008; Lassetter, 2011). In a previous paper, the association between island food consumption and several demographic, socioeconomic, and cultural variables was assessed and Pacific Islander cultural affinity stood out as a strong and significant predictor of increased island food consumption (Baumhofer, 2016). In this analysis, cultural affinity, which can be equated with Tajfel's (1974) concept of "social identity" – one's emotional closeness to and in-group identification to a specific subculture – is further explored by examining the psychometric properties of the cultural affinity scale used in the Pacific Islander Health Study (PIHS). Second, this paper will assess the way in which the association between cultural affinity and island food consumption varies by levels of other key covariates such as age, gender, ethnicity, education, and birth country.

Culture, its measurement, and its effect on health have been the subject of complicated and contested debate, a full account of which is far beyond the scope of this project (Kagawa-Singer, Dressler, George, & Elwood, 2014). Nevertheless, its importance to health is undeniable and a brief introduction to the concept of culture can be introduced here. Social anthropologists Jean and John Comaroff (Comaroff & Comaroff, 1991) write "culture [is] the space of signifying practice, the semantic ground on which human beings seek to construct and represent themselves and others – and, hence, society and history." In other words, culture is the process by which we create (and discard) symbols and engage in activities that represent us as belonging to one group or another. By using such a definition, food – island food – is not just fuel for the human body; it is a participant in the decisions individuals make to represent themselves and to solidify membership in social spaces (Appadurai, 1988; Haden, 2009). For example, in Samoan culture, food is viewed as a conduit for health and plays an important role in the material and social aspects of caregiving (Capstick, Norris, Sopoaga, & Tobata, 2009; Pollock & Finau, 1999). This concept is well-illustrated in a quote from an extended study on Samoan medical belief and practice: "people who eat well are less likely to get sick; people become sick when they do not have enough to eat; people who are ill need to be fed well if they are to recover; and the return of appetite is a sign of recovery" (Macpherson, 1990, p. 188).

Although this paper does not explore the sociocultural reasons for island food consumption, the point is that a can of Spam® is not just a can of Spam®, but rather a cultural vehicle imbued with layers of meaning. Understanding this symbolism is important since these symbolic choices can have a direct and tangible effect on physical health (Capstick et al., 2009; Haden, 2009; Hubbell, Luce, & McMullin, 2005). A recent report on

culture and health from the National Institutes of Health acknowledges culture as a complex, but powerful driver of health behaviors. The authors emphasizes the need for health researchers to critically evaluate and re-evaluate the way in which "culture" is measured so that the "potential explanatory power of culture" is not missed (Kagawa-Singer et al., 2014). Some studies have reduced cultural affinity or acculturation to a single question – often, which language is spoken at home. This approach misses the complexity and nuance inherent in the ways that culture drives behavior. A comprehensive measure of culture that encompasses multiple dimensions is needed, especially when subscribing to a definition such as the one previously described. This paper seeks to understand how the relationship between cultural affinity and island food consumption varies by key demographic covariates, which is an intermediate step on the theoretical pathway between food as a cultural representation and health outcomes. Central to this analysis is the 11-item, multi-factor cultural affinity scale developed specifically for use in the PIHS.

One of the interactions considered in this paper is how the effect of cultural affinity on island food consumption may vary by birthplace. Pacific Islanders both within the United States and the greater Pacific region are experiencing a nutrition transition that ranges from traditional diets (largely based on fruits, vegetables, and lean proteins) to a diet inclusive of some imported goods (such as flour, sugar, and canned meats or fish) to a fully Western diet (Sitaleki Finau & Wainiqolo, 2004; Gewertz & Errington, 2010; Hughes & Lawrence, 2005; Hughes & Marks, 2009; Vainikolo, Vivili, & Guthrie, 1993). This transition is occurring concurrently as Pacific Islanders are leaving rural homes for urban centers such as Los Angeles and Sydney and as the West infiltrates the Pacific in Honolulu, Auckland, and Suva (Errington & Gewertz, 2008; Evans, Sinclair, Fusimalohi, & Liava'a,

2001; Vainikolo et al., 1993). Through the vehicle of migration, the effect of culture on food choices can vary greatly. The recent adoption of some imported foods that are now considered "island foods" (e.g. Spam®, mutton flaps, turkey tails, canned corn beef) makes the relationship between food, culture, health, and identity – this foodscape – even more complicated (Adema, 2007). In rural locales island foods, whether they are imported or traditional, may be the only thing available and are eaten on a daily basis. Upon migration to the United States, these island foods may be sought out as a reminder of home, or simply the foods that are most familiar and most comforting to consume (Lassetter, 2011; Vainikolo et al., 1993). For individuals born in the United States, island foods might be a way to express their affiliation with their island culture rather than mainstream American culture. In other words, an increase in cultural affinity may be associated with a larger increase in island food consumption among those born in the United States who use food as an expression of culture and identity compared to the increase in island foods among those born in Tonga or Samoa who eat island foods out of habit regardless of change in cultural affinity

Beyond birthplace, ethnicity and the political relationships between Tonga, Samoa, American Samoa, and the United States suggests that cultural affinity may have a differential effect on island food consumption for Tongan versus Samoans. An extensive body of previous research has shown that differential levels of modernization and exposure to Western culture have influenced a dietary shift among Pacific Islanders (Bindon & Baker, 1985; Cassels, 2006; Dancause et al., 2011; Denman & Dewey, 1989; Evans, Sinclair, Fusimalohi, Laiva, & Milton, 2003; S. Finau, Prior, & Maddill, 1986). For example, the population of Kosrae in the Federated States of Micronesia has experienced a

well-documented dietary shift and subsequent rise in chronic illnesses such as diabetes and obesity following over 100 years of colonization and an economic shift from a traditional subsistence to a MIRAB (Migration, Remittance, Foreign Aid, and Public Bureaucracy) economy (Cassels, 2006). For example, a study of height and weight among Samoans living in Samoa, American Samoa, Hawai'i and California, found an increase in both height and weight as distance from Samoa increased (Pawson & Janes, 1981).

Occupied by the United States Navy since 1872, American Samoa became an unincorporated territory of the United States when control of the island state passed from the Navy to the Department of the Interior in 1951. American Samoans are not automatically U.S. citizens, but rather U.S. nationals, and are entitled to live and work in the United States without restriction, apply for a U.S. passport, and apply for citizenship via the process of naturalization, but cannot vote or hold elected office. Just 40 miles to the west, lies the Independent State of Samoa, which was controlled by Germany from 1900-1914 and then by New Zealand from 1914-1962 before gaining independence. Although a British protectorate until 1970, the Kingdom of Tonga stands alone as the only Pacific nation to never loose its independence to a colonizing power. Citizens of the Samoa and the Kingdom of Tonga do not have legal ties to the United States, but the geographic proximity of Samoa to American Samoa ensures at least some spillover of the American diet and culture. It has been argued that this relationship between increasing exposure to Western culture and increasing girth is influenced by the increasing availability of "junk" foods (A. C. Bell, Swinburn, Amosa, Scragg, & Sharpe, 1999; Snowdon et al., 2013). Food choice is influenced by several factors, including preference, cultural norms, emotional reinforcement, and availability, among others (Epstein, Leddy, Temple, & Faith, 2007). Therefore, if Western

foods are ubiquitous in an individual's environment, it is hypothesized that the effect of cultural affinity on island food will be greater in such environments.

The strength of the effect of cultural affinity on island food consumption may also vary by age. Previous research shows that older individuals are more likely to eat a more traditional diet (Baumhofer, 2016; A. C. Bell et al., 1999). However, this association may be due to older individuals eating island foods out of habit regardless of their cultural affinity. Increased cultural affinity among younger individuals may have more of an effect on island food consumption since younger individuals may have had more exposure to other types of foods and be more inclined to have a wider variety of diet. Younger individuals with a lower cultural affinity might be more attracted to Western foods. A study examining racial and ethnic health disparities in diet and physical activity among middle-aged and elderly individuals hypothesized that the effects of acculturation would moderate the size of the disparities between the two age groups examined (August & Sorkin, 2011). The analysis concluded that there was, in fact, a wider variance of behaviors seen in the younger (and presumably more acculturated) participants compared to the elderly participants (August & Sorkin, 2011). Given this evidence, it can be hypothesized that the effect of cultural affinity on island foods may increase with age, meaning that given the same level of island food consumption a younger individual would be expected to have a higher cultural affinity score compared to an older individual.

Another variable, which may have a moderating effect on the relationship between cultural affinity and island food consumption, is educational attainment. Participation in a Western-educational system can drive a cultural wedge between members of a minority or immigrant community by exposing the educated individual to social norms that may be

discordant with their traditional culture, including dietary habits (Deyhle, 1991; Deyhle & Swisher, 1997; Fanon, Farrington, & Sartre, 1963; Kaomea, 2001; Said, 1993; Sanchez & Stuckey, 1999; Smith, 1999). Maori activist and academic, Linda Tuhiwai Smith deftly describes this divide:

> "…at the same time these same communities want their members to gain Western educations and high-level qualifications. But they do not want this to be achieved at the cost of destroying people's indigenous identities, their languages, values and practices" (Smith, 1999).

Although this quote describes an extreme example of community fears that follow some Maori students to university, educational experience socializes one into a community that most Pacific Islanders cannot call their own. Since educational systems in Samoa, American Samoa, and Tonga strongly follow either the British or American systems it can be assumed that a higher level of educational attainment, regardless of birthplace, is associated with an increased exposure to Western culture and diet. Prior work has shown that individuals with more than a high school education reported only 77% of the incidents of past week island foods consumed as those who had less than a high school education (Baumhofer, 2016). While educational attainment may be inversely related to island food consumption, the ability of cultural affinity to influence this association may increase with education. Individuals with both high educational attainment and high cultural affinity may specifically seek out island foods as a means to remain grounded within cultural traditions or identity. This is in contrast to individuals with high educational attainment and low cultural affinity who may eat non-island foods as a matter of convenience or assimilation or individuals with low educational attainment who may eat island foods out of habit or preference regardless of cultural affinity. In other words, a high level of cultural affinity

may have a stronger association with increased island food consumption with a person of high educational attainment compared to an individual with low educational attainment.

Lastly, there is a potential for financial insecurity to have a significant interaction with the association between cultural affinity and island food consumption. The consumption and growing popularity of fatty meats in the islands has been linked to macroeconomic forces (Cameron, 1997; Errington & Gewertz, 2008; Evans, Sinclair, Fusimalohi, & Liava'a, 2002; Snowdon et al., 2013; Snowdon & Thow, 2013). These forces have increased the availability of certain islands foods (e.g. mutton flaps, tinned beef, tinned pork, instant noodles, and white rice), while more traditional foods have decreased in availability throughout the Pacific, especially in more urbanized areas (Hughes & Lawrence, 2005; Hughes & Marks, 2009). Their affordability and increased availability tends to encourage increased consumption even when traditional favorites are still preferred for taste and nutrition (Evans et al., 2003; Evans et al., 2002; Jones, Dempewolf, Armstrong, Gallucci, & Tavana, 2011). However, in highly urban America, food choices may be more limited, especially under financial pressure (Buchthal, 2014; Mhurchu et al., 2013; Rush, Puniani, Snowling, & Paterson, 2007; Young, Batch, & Svetkey, 2008). If financial insecurity tends to limit food choice, it is expected that the strength of cultural affinity's effect on the association between financial insecurity and island food consumption would strengthen as financial insecurity increases.

Methods

Pacific Islander Health Study sample

This analysis uses a sample of 240 Samoan and Tongan adults living in California from the PIHS. A stratified random sampling scheme was employed to select 300 households from 20 different community religious organizations. From these 300 households one adult and up to two adolescents (from 13 to 17 years of age) were randomly selected to participant in an interview. All responses were collected in bilingual face-to-face interviews with study participants over a two-year period, beginning in June 2009. The sample analyzed were, on average, 39.74±1.51 years of age, were 49.63% male, 60.01% reported being currently married or living with a partner, 45.45% have a high school diploma, and 36.66% have full-time employment (Baumhofer, 2016). The details of the methodology used in the PIHS are described elsewhere as (S. V. Panapasa, Jackson, Caldwell, Heeringa, et al., 2012; S. V. Panapasa, Jackson, Caldwell, Herringa, et al., 2012).

Variables

Island food consumption is operationalized as the self-reported number of times a participant has eaten "island foods" during the previous 7 days. Participants were prompted with a list that includes cassava, taro, yams, corned beef, SPAM, turkey tail or seafood, meat or pastry cooked in coconut milk, but were also allowed to define "island foods" in their own way. *Island foods* is a count variable that ranges from 0 to ≥6.

Ethnicity is Samoan or Tongan. *Age* is calculated using the participant's birth year and date. *Gender* is reported by household member. *Marital status* is defined by three

categories: “married” includes participants who are currently living with their partners, with or without legal marriage, “formerly married” includes participants who are separated from their spouse, divorced, or widowed, “never married” includes participants who have never been married and are not currently living with a partner.

Education is defined by three categories: “less than a high school diploma,” “a high school diploma,” and “more than a high school diploma.” *Employment status* is also defined by three categories which includes “full-time work,” “part-time work,” and “not currently working/other.” *Financial insecurity* is operationalized as a continuous variable using a composite financial security score. Participants were asked if they ever needed to do any of the following seven things due to financial difficulties during the past year: liquidate assets, postpone medical care, borrow money, apply for government assistance, obtain a loan, or alter living arrangements. For each affirmative answer 1-point is added to the financial insecurity score such that higher scores indicate more financial insecurity.

Birthplace is self-reported by participants as United States, American Samoa, Samoa, and Tonga. *Pacific cultural affinity* is a continuous variable using a composite cultural identity score with a range of 11 to 44. Participants were asked how often they participated in a series of 11 different Tongan or Samoan cultural activities including: speaking Samoan or Tongan language, listening to Samoan or Tongan music, cooking Samoan or Tongan food, spending time with Samoan or Tongan friends, time spent with Samoan or Tongan friends growing up, identifying oneself as a Samoan/Tongan American, identifying oneself as only Samoan or Tongan, identifying oneself as only American, listening to Samoan or Tongan radio, watching Samoan or Tongan TV shows, and reading Samoan or Tongan news or other materials. Each activity is given a numeric score based on their responses: very often

– 1, fairly often – 2, not too often – 3, and never -4. The exception is the question "How often do you identify your self as only American?" which was reverse coded.

PD9. How often do you do each of the following?				
	VERY OFTEN (1)	FAIRLY OFTEN (2)	NOT TOO OFTEN (3)	NEVER (4)
a) How often do you speak (Tongan/Samoan)? Would you say very often, fairly often, not too often or never?	1	2	3	4
b) How often do you listen to (Tongan/Samoan) music?	1	2	3	4
c) How often do you or your family cook (Tongan/Samoan) food?	1	2	3	4
d) How often do you spend time with (Tongan/Samoan) friends?	1	2	3	4
e) How often did you spend time with (Tongan/Samoan) friends while you were growing up?	1	2	3	4
f) How often do you identify yourself as (Tongan/Samoan) American?	1	2	3	4
g) How often do you identify yourself as only (Tongan/Samoan)?	1	2	3	4
h) How often do you identify yourself as only American?	1	2	3	4
i) In an average week, how often do you listen to (Tongan/Samoan) radio?	1	2	3	4
j) In an average week, how often do you watch (Tongan/Samoan) TV shows?	1	2	3	4
k) In an average week, how often do you read (Tongan/Samoan) news or other materials?	1	2	3	4

Figure 1 Cultural affinity scale used in the PIHS

Analysis plan

All statistical analyses were completed using STATA 12.0. A key variable in this analysis, cultural affinity, was developed specifically for use in the PIHS. Initially, univariate and bivariate statistics were assessed to understand the distribution of the cultural affinity score and its unadjusted relationships with other key covariates.

During the next step of the analysis the psychometric properties of the cultural affinity scale were evaluated. First the Cronbach's alpha of the entire scale was calculated. Exploratory factor analysis using varimax rotation and loadings of ≥0.3 was done to confirm the existence of factors within the scale. In order to understand the importance of each item to the total scale the alpha for the mean, variance, and alpha of the scale if each item was deleted and the item-total correlations were calculated. Following the factor analysis, the cultural affinity scale was split into two subscales. The "Cultural affinity activity" subscale includes items A-E, and G-H while the "Cultural affinity media subscale" includes items I-K. The two subscales were used in the remainder of the analysis.

It was hypothesized that the effect of cultural affinity on island food consumption might vary by age, ethnicity, gender, education, or birth country. Using the SVY command to apply population weights and correct for clustering within community religious organization, the following five models were used to individually test for interactions between the cultural affinity subscales and each of these covariates:

$$g\{E(y)\} = \beta_0 + \beta_1 age + \beta_2 gender + \beta_3 ethnicity + \beta_4 marital\ status + \beta_5 education + \beta_6 employment\ status + \beta_7 financial + \beta_8 birthplace + \beta_9 cultural\ affinity\ activities + \beta_{10} cultural\ affinity\ media + \beta_{11} cultural\ affinity\ activities * age + \beta_{12} cultural\ affinity\ media * age + \varepsilon, where\ g = \ln\{E(y)\} = ln\{E(island\ foods\ consumption)\}\ and\ y \sim Poisson.$$

$$g\{E(y)\} = \beta_0 + \beta_1 age + \beta_2 gender + \beta_3 ethnicity + \beta_4 marital\ status + \beta_5 education + \beta_6 employment\ status + \beta_7 financial + \beta_8 birthplace + \beta_9 cultural\ affinity\ activities + \beta_{10} cultural\ affinity\ media + \beta_{11} cultural\ affinity\ activities * ethnicity + \beta_{12} cultural\ affinity\ media * ethnicity + \varepsilon, where\ g = \ln\{E(y)\} = ln\{E(island\ foods\ consumption)\}\ and\ y \sim Poisson.$$

$$g\{E(y)\} = \beta_0 + \beta_1 age + \beta_2 gender + \beta_3 ethnicity + \beta_4 marital\ status + \beta_5 education + \beta_6 employment\ status + \beta_7 financial + \beta_8 birthplace + \beta_9 cultural\ affinity\ activities + \beta_{10} cultural\ affinity\ media + \beta_{11} cultural\ affinity\ activities * financial + \beta_{12} cultural\ affinity\ media * financial + \varepsilon, where\ g = \ln\{E(y)\} = ln\{E(island\ foods\ consumption)\}\ and\ y \sim Poisson.$$

$$g\{E(y)\} = \beta_0 + \beta_1 age + \beta_2 gender + \beta_3 ethnicity + \beta_4 marital\ status + \beta_5 education + \beta_6 employment\ status + \beta_7 financial + \beta_8 birthplace + \beta_9 cultural\ affinity\ activities + \beta_{10} cultural\ affinity\ media + \beta_{11} cultural\ affinity\ activities * education + \beta_{12} cultural\ affinity\ media * education + \varepsilon, where\ g = \ln\{E(y)\} = ln\{E(island\ foods\ consumption)\}\ and\ y \sim Poisson.$$

$$g\{E(y)\} = \beta_0 + \beta_1 age + \beta_2 gender + \beta_3 ethnicity + \beta_4 marital\ status + \beta_5 education + \beta_6 employment\ status + \beta_7 financial + \beta_8 birth\ country + \beta_9 cultural\ affinity\ activities + \beta_{10} cultural\ affinity\ media + \beta_{11} cultural\ affinity\ activities * birth\ country + \beta_{12} cultural\ affinity\ media * birth\ country + \varepsilon, where\ g = \ln\{E(y)\} = ln\{E(island\ foods\ consumption)\}\ and\ y \sim Poisson.$$

The final step of the analysis was to further examine the relationship between island food consumption and independent variables in the models where significant interactions were observed by performing a series of subgroup analyses. The effect of cultural affinity

on island food consumption was separately determined in each of these subgroups while controlling for all other covariates in the models described above. All results were considered statistically significant at alpha=0.10. This alpha was chosen in order to increase sensitivity to detect trends within this small sample. Given that little is known about this population, the ability to identify potential trends during exploratory analysis is important.

Results

Descriptive statistics

The mean score for cultural affinity was 33.09±0.28 with a range of 21 to 44. Figure 2 shows that the distribution of scores is roughly normal, with 50% of the responses ranging between 30 and 36. The cultural affinity activity subscale has a mean of 23.92±0.16 out of a possible 28 points and the cultural affinity media subscale has a mean of 6.03±0.22 out of a possible 12 points. Bivariate associations shown in Table 1 indicate that the cultural affinity score is significantly and positively correlated with island food consumption, Samoan ethnicity, and age.

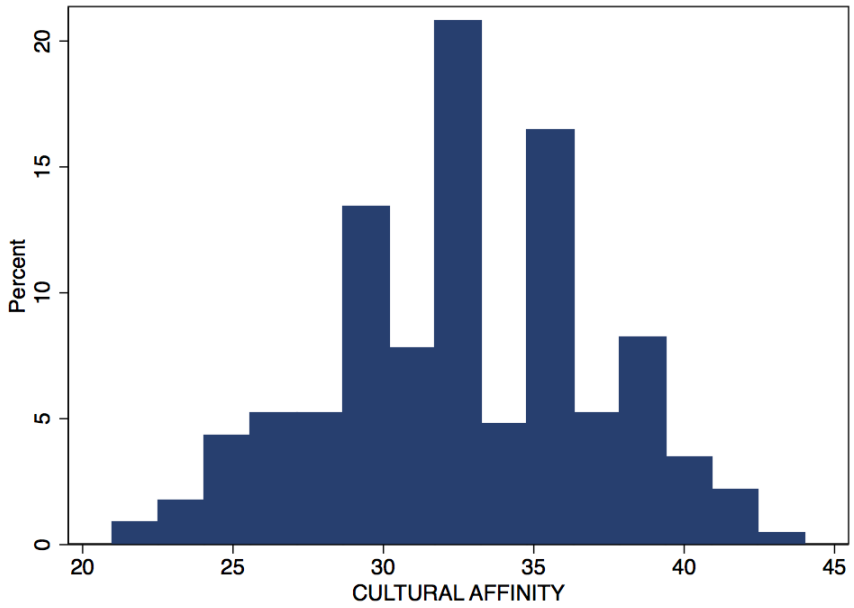
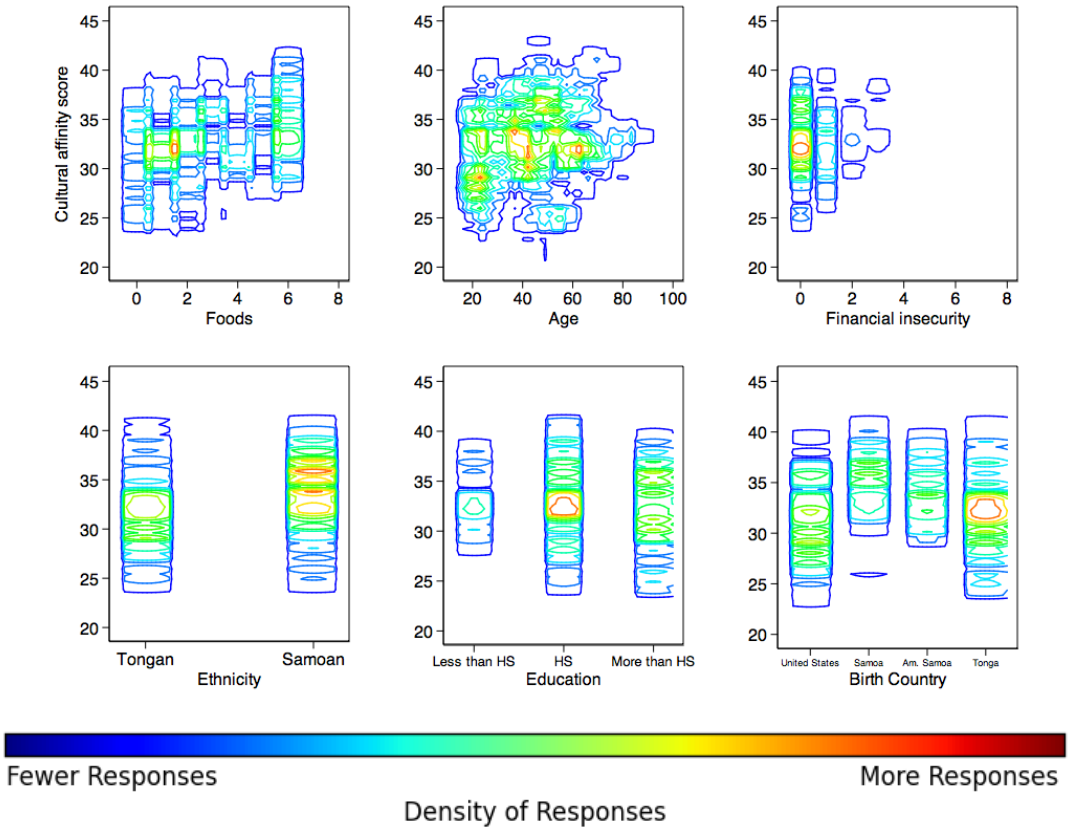


Figure 2 Frequency of cultural affinity score

Table 1 Correlations between cultural affinity and key covariates

r (p)	Culture	Island foods	Ethnicity	Age	Gender	Education	Birth country
Culture	1.00						
Island foods	**0.28 (<0.01)**	1.00					
Ethnicity	**0.20 (<0.01)**	**-0.21 (<0.01)**	1.00				
Age	**0.16 (0.02)**	**0.19 (<0.01)**	-0.16 (0.01)	1.00			
Gender	-0.05 (0.46)	0.04 (0.49)	0.07 (0.29)	-0.08 (0.25)	1.00		
Education	-0.10 (0.12)	**-0.15 (0.02)**	0.04 (0.52)	-0.16 (0.01)	-0.13 (0.05)	1.00	
Birth country	0.05 (0.45)	**0.26 (<0.01)**	**-0.50 (<0.01)**	**0.54 (<0.01)**	-0.05 (0.43)	-0.08 (0.26)	1.000

Figure 3 Bivariate density of participant responses to cultural affinity scale



The bivariate density graphs illustrated in Figure 3 shows the correlations between cultural affinity score and selected covariates in a graphical rather than numerical manner. Read like a heat or topographic map, warmer colors and closely spaced lines indicate a higher frequency of response at that level. The image showing island food consumption and cultural affinity shows a positive, dose-response correlation; cultural affinity does not seem to vary strongly with change in financial insecurity score; Samoans have higher scores compared to Tongans while those born in Tonga exhibit higher scores than those born elsewhere; and individuals with a high school education may have a slightly higher score than those in other categories.

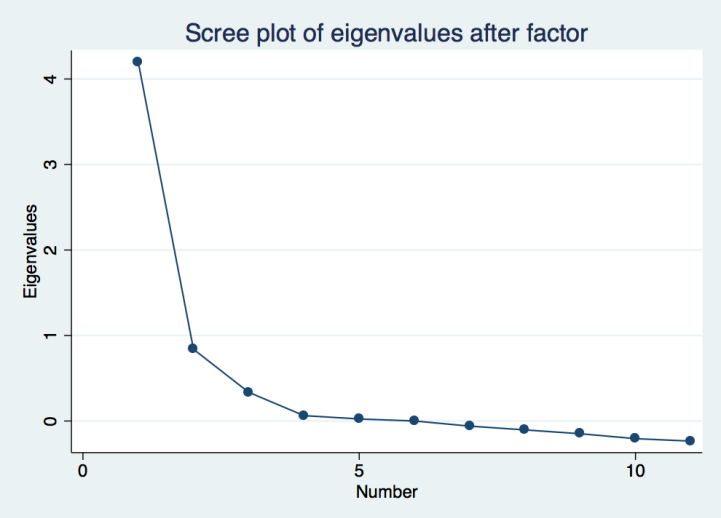
Evaluation of psychometric properties

Table 2 shows a summary of the item-total statistics calculated. The entire scale had high internal consistency (α=0.85) and removal of any one item did not increase the reliability enough to warrant dropping the item. Total-item correlations ranged from 0.06 (item H) to 0.66 (item K).

Table 2 Item-total statistics of the cultural affinity scale

Item	Scale mean if item deleted	Scale std. dev. if item deleted	Item-total correlation	Cronbach's alpha if item deleted
A	29.64	0.25	0.55	0.83
B	29.82	0.25	0.59	0.83
C	29.62	0.28	0.42	0.83
D	29.65	0.28	0.43	0.83
E	29.37	0.26	0.45	0.83
F	29.94	0.28	0.30	0.86
G	29.28	0.28	0.28	0.83
H	29.91	0.30	0.06	0.86
I	31.18	0.24	0.52	0.85
J	31.24	0.23	0.60	0.84
K	30.64	0.24	0.66	0.84

Figure 4 Scree plot of eigenvalues in the cultural affinity scale



A screeplot (Figure 4) indicated one underlying factor. The factor pattern after varimax rotation (Table 3) indicates two factors with eigenvalues ≥1. Accepting a loading of ≥0.3, Table 3 shows that items A-E and G-H load on to the first factor comprised of cultural activities, items I-K load onto a second factor of media use, and only item F loads onto a third factor. Following the factor analysis, two subscales were created. The cultural affinity activity subscale had high internal consistency (α=0.85), but the internal consistency of the cultural affinity media subscale was moderate (α=0.71). The correlation between the two subscales was 0.51.

Table 3 Components of factors and factor loadings

Item	Factor 1	Factor 2	Factor 3
A	**0.71**	0.38	0.03
B	**0.46**	0.43	0.33
C	**0.62**	0.22	0.24
D	**0.58**	0.15	0.38
E	**0.75**	0.21	0.12
F	0.14	0.23	**0.47**
G	**0.74**	0.17	0.11
H	**0.60**	-0.08	-0.15
I	0.12	**0.64**	0.19
J	0.23	**0.62**	0.07
K	0.37	**0.56**	0.04
Eigenvalue	**3.10**	**1.64**	0.63

Multivariable analysis

Table 4 shows the incident rate ratios of island food consumption for the past week after adjustment for demographic, socioeconomic, and cultural variables in five different models – each with a different interaction term. The model in the second column showed a marginally significant interaction between the cultural affinity activity subscale and ethnicity (*IRR*=1.08±0.04; p=0.067). Increased cultural affinity in the form of Samoan media consumption was associated with more island food consumption in Samoans than the same level of Tongan media consumption in Tongans. The marginal relationship of the cultural affinity subscale was also positively and significantly associated with island food consumption (*IRR*=1.12±0.02, p<0.001) in this model, but there was no significant

Table 4. Incident rate ratios from Poisson regression for island food consumption in past week and demographic covariates and cultural affinity activity and media subscale interactions

Interaction variable:	Age	Ethnicity	Financial insecurity	Education		Birth country[1]	
	IRR (S.E.)	IRR (S.E.)	IRR (S.E.)	IRR (S.E.)		IRR (S.E.)	
Age	1.01 (0.01)	1.01 (0.01)	1.01 (0.01)	1.01 (0.01)		1.01 (0.01)	
Ethnicity (Samoan)	0.84 (0.14)	1.00 (0.17)	0.87 (0.14)	0.86 (0.13)		0.85 (0.15)	
Education <HS (Ref.)	-	-	-	-		-	
HS	0.87 (0.11)	0.91 (0.11)	0.91 (0.11)	0.78 (0.14)		0.93 (0.12)	
>HS	0.84 (0.13)	0.89 (0.13)	0.89 (0.13)	0.94 (0.18)		0.91 (0.14)	
Fin. Insecurity	**1.08+ (0.04)**	1.07 (0.04)	1.05 (0.05)	1.06 (0.04)		**1.08+ (0.05)**	
Birthplace US (Ref.)	-	-	-	-		-	
Samoa	0.86 (0.15)	0.83 (0.14)	0.86 (0.16)	0.81 (0.12)		1.13 (0.25)	
Am. Samoa	0.93 (0.16)	0.95 (0.17)	0.96 (0.17)	0.94 (0.18)		1.06 (0.24)	
Tonga	1.16 (0.18)	1.25 (0.18)	1.18 (0.19)	1.13 (0.20)		1.16 (0.15)	
Cultural Affinity Activity subscale	1.16+ (0.09)	**1.12** (0.02)**	1.06 (0.04)	1.08 (0.06)		**1.12+ (0.06)**	
Cultural Affinity Media subscale	**1.12+ (0.07)**	0.99 (0.03)	**1.07+ (0.04)**	1.02 (0.05)		**1.09+ (0.04)**	
Activity subscale Interaction	1.00 (0.002)	0.05 (0.04)	1.02 (0.01)	<HS	(omitted)	S	0.91 (0.06)
				HS	1.06 (0.06)	AS	0.90 (0.07)
				>HS	0.92 (0.05)	T	1.00 (0.07)
Media subscale Interaction	1.00 (0.001)	**1.08+ (0.04)**	0.98 (0.01)	<HS	(omitted)	S	**0.90+ (0.04)**
				HS	1.00 (0.05)	AS	1.03 (0.09)
				>HS	1.11 (0.08)	T	**0.90* (0.04)**
Constant	1.02 (0.55)	1.84 (0.46)	2.11 (0.60)	2.24 (0.53)		1.92 (0.52)	

** p<0.001, *p<0.05, +p<0.10; all models adjusted for clustering by religious institution, gender, marital status, and employment status

[1]U.S. omitted, S=Samoa, AS=American Samoa, T=Tonga

interaction found with ethnicity. The model in the fifth column of Table 4 indicates a significant interaction between the cultural affinity media subscale and birth country. Higher culturally specific media consumption was associated with a decrease in island food consumption among those born in Samoa (*IRR*=0.90±0.004, p=0.052) and Tonga (*IRR*=0.90±0.04, p=0.034). However, there was no significant interaction found for those

born in the United States or American Samoa. The cultural affinity media subscale did not have a varying effect on island food consumption by age, financial insecurity score, or educational attainment. There were also no significant interactions found between the cultural affinity activity subscale and any of the demographic factors tested.

Subgroup analyses

Table 5. Incident rate ratios showing effect of the cultural affinity media subscale on island food consumption in selected subgroups

Ethnicity[1]			
Samoan (N=127) IRR (S.E.)		Tongan (N=96) IRR (S.E.)	
1.07 (0.05)		1.02 (0.03)	
Birth country[2]			
U.S. (N=62) IRR (S.E.)	Am. Samoa (N=43) IRR (S.E.)	Samoa (N=47) IRR (S.E.)	Tongan (N=71) IRR (S.E.)
1.10* (0.03)	**1.09+ (0.05)**	**0.95+ (0.03)**	1.05 (0.03)

[1]Adjusted for age, gender, marital status, education, employment, financial insecurity, foreign birthplace, and cultural affinity activity subscale
[2]Adjusted for age, gender, marital status, education, employment, financial insecurity, and cultural affinity activity subscale
** p<0.001, *p<0.05, +p<0.10; all models adjusted for clustering by religious institution

In order to further explore the interactions found in Table 4 a series of subgroup analyses were performed. Table 5 shows a summary of the disparate effect of cultural affinity on island food consumption by different levels of the three covariates that were found to have significant interactions in Table 4. The effect of the cultural affinity activity and cultural affinity media subscales on island food consumption was found for Samoans and Tongans separately. Although there was a significant interaction between the cultural affinity media subscale and ethnicity there was no significant effect when each ethnic subgroup was separately analyzed. The opposite result was found with the cultural affinity

activity subscale. In Table 4, there was no significant interaction, but there was a strong marginal effect of the activity subscale on island food consumption.

Describing the interaction with birthplace seen in Table 4, the effect of the cultural affinity media subscale on island food consumption varied by birthplace. This effect was positive and strongest among those born in the United States (*IRR*=1.10±0.03, p=0.005) ad positive, but slightly weaker among those born in American Samoa (*IRR*=1.09±0.05, p=0.092). The direction of the association switched from positive to negative and was only marginally significant among those born in Samoa (*IRR*=0.95±0.03, p=0.066). The effect among those born in Tonga was positive and intermediate between those born in American Samoa and those born in Samoa, but was not statistically significant (*IRR*=1.05±0.03, p=0.194). An increase in the cultural affinity activity score was associated with an increase in island food consumption among those born in both the United States and in Tonga (*IRR*=1.11±0.06, p-0.077 and *IRR*=1.12±0.02, p=0.001, respectively). The effect was not significant among those born in either American Samoa or Samoa (*IRR*=1.00±0.04, p=0.956 and *IRR*=1.03±-0.03, p=0.298, respectively).

Discussion

Although culture is a complex concept, the cultural affinity scale used in the PIHS measures multiple aspects of culture relating to identity, language, media, food, and social contacts. It's moderate, but significant correlation with island food consumption is expected given that the more an individual identifies with a particular culture, the more of it's foods they are likely to consume given adequate access. The lack of a significant correlation with birth country was surprising in that foreign-born migrants generally have

a higher affinity for the home culture compared to native-born individuals (Birman & Trickett, 2001). However, this could be explained by the relative recent nature of Samoan and Tongan migration to the United States. It is possible that many of the individuals born in the United States are children of immigrants themselves and grew up in more traditional households compared to third generation individuals of other immigrant groups.

The moderation analysis revealed two significant interactions between cultural affinity as defined by culturally specific media use with ethnicity and Samoan or Tongan birth. The interactions between cultural affinity and age, financial insecurity, and educational attainment were not significant. With the exception of age, the remaining four variables can be broadly split into two categories: financial insecurity score and educational attainment can represent socioeconomic status and ethnicity and birthplace represent identity and cultural orientation. In very broad strokes, the results of this portion of the analysis suggest that the effect of cultural affinity associated with island food consumption varies more by subgroup in variables related to identity and culture than by subgroup in variables related to socioeconomic status.

The differential effect of cultural affinity on island food consumption by birthplace regardless of ethnicity suggests that there may be variation by political, geographic, and cultural nuance. Although Samoa, American Samoa, and Tonga are bounded by a close cultural and religious heritage, they are nonetheless separate and independent from one another (Hau'ofa, 1994). Their disparate relationships with colonial powers have created more cultural divergence in the past century than possibly ever before (Wendt, 1982). In this analysis, there was a significant decrease in the effect of cultural affinity on island food consumption if an individual was born in Samoa or Tonga compared to the United States.

There was no significant interaction among those born in American Samoa. One possible explanation of this result is qualitative differences in migrants from American and immigrants born in Samoa or Tonga. As a United States territory, there is a long history of American Samoa migration and cultural exchange between American Samoa to the United States ranging from Americanization to biculturalism to multicultural, multinational identity in both home and diasporic Samoans (Hau'ofa, 1994; Henderson, 2010; Thomas, 1981; Wendt, 1982).

Multiple studies have shown a geographic association with dietary shifts within the Pacific with individuals living in rural areas adhering to a more traditional diet and those living in urban locales consuming more of a Western diet (Bindon & Baker, 1985; S. Finau et al., 1986; Sitaleki Finau & Wainiqolo, 2004; Tillotson et al., 1973). Cultural affinity may not have as large as an effect on island food consumption among those born in Samoa or Tonga because those individuals may eat island foods out of habit or lifelong preference. For those born in the United States and American Samoa the consumption of island foods may serve a more symbolic purpose: a representation of an island foodscape distinct from a growing McDonaldized global diet and culture (Keesing, 1989; Ritzer, 2011, pp. 9-14). Cooking, eating, and sharing food of reinforces identity and cultural bonds between members of a group and ties individuals within the diaspora back to a distant homeland (Appadurai, 1988; D. Bell & Valentine, 1997; Lee, 2007; Povey, 2006).

A significant interaction between the cultural affinity media subscale and ethnicity was also found. Similar to the interaction found with birthplace, this result could potentially be explained by differences in the political relationship between Samoa, Tonga, American Samoa, and the United States, which in turn, influence sociodemographic,

economic, and cultural differences between the two ethnic groups. In this study population, there were statistically significant differences between Samoans and Tongans in both employment and cultural affinity: Samoans have a higher cultural affinity score and a higher proportion of individuals reporting not working or doing non-standard work while Tongans had a higher proportion of individuals working part-time. There were no differences in age, educational attainment, financial insecurity, full-time work. It is possible that this interaction could be explained by unmeasured differences in socioeconomic status or cultural capital such as preservation of fa'a Samoa – the "Samoan way" – within the Samoan diaspora and a relatively high level of social support among migrant Samoans versus a high value placed on cosmopolitan goods and desire to adopt a multicultural identity among second and third generation Tongans (Baldauf Jr, 1981; Besnier, 2004; Hanna, 1998; Lee, 2006, 2007). When tested in Samoans and Tongans in separate subgroup analyses, there was a trend towards an increased influence of this subscale on island food consumption among Samoans compared to Tongans. However, this association did not reach statistical significance in either group. This result could possibly be due to differences in sample size or variance between the two ethnic subgroups.

The null findings for interactions between cultural affinity and variables that represent socioeconomic status are also important to address. Socioeconomic status has been shown to affect dietary habits across populations and cultures with a broad generalization that individuals of lower socioeconomic status are more likely to consume calorie-dense foods such as refined carbohydrates and sugars and fatty meats, but fewer fresh fruits and vegetables and individuals of higher socioeconomic status more likely to consume leaner meat and seafood and more fresh produce (Buchthal, 2014; Darmon &

Drewnowski, 2008; Martikainen, Brunner, & Marmot, 2003; Mhurchu et al., 2013). Individuals experiencing financial hardship may be more limited to high-calorie, low-cost, high-convenience foods (Drewnowski, 2003). While some island staples such as fresh fish may be out of the budget for many, several "island foods" such as tinned pork, corned beef, coconut milk, instant noodles, and white rice fall into this category (Errington & Gewertz, 2008; Mhurchu et al., 2012; Mhurchu et al., 2013; Rush et al., 2007). The wide range of cost of various island foods may provide an affordable and available option to individuals of any socioeconomic position.

However, there are limitations that should be addressed. First, the PIHS study is a pilot test of a larger, forthcoming project. Therefore, ethnic diversity within the sample is limited to Samoans and Tongans and participants were chosen as part of a complex sample drawn from Pacific Islander faith-based organizations in California, both of which may limit the generalizability of this pilot sample (S. V. Panapasa, Jackson, Caldwell, Heeringa, et al., 2012). Second, these data are cross-sectional in nature, which makes temporal ordering impossible and self-report data could introduce social desirability or recall bias. The global nature of the island foods variable made nuanced interpretation difficult. For example, there are many types of island foods that vary greatly in availability and nutritional content. Coconut milk and canned pork products are lower in nutritional quality, but are widely available in the continental United States, Fresh, high-quality produce or fish may be less available to the participants of this study. The island foods variable used in this analysis did not differentiate between the type or nutritional quality of island foods consumed. Future research should focus on specific foods and explore how foods consumed by participants vary by nutritional quality. Lastly, although the cultural affinity

scale used in this study captured multiple aspects of closeness to Samoan and Tongan culture, but did not simultaneously measure affinity to American culture aside from a single item. For example, the three questions in the media subscale ask about consumption of Samoan or Tongan media, but not American radio, television, or news. Therefore, a bidimensional acculturation measure would be better able to capture whether an individual aligns with traditional culture, American culture, is fully bicultural, or is marginalized from both cultures (Kaholokula, Nacapoy, Grandinetti, & Chang, 2008; Lara, Gamboa, Kahramanian, Morales, & Hayes Bautista, 2005).

Despite these limitations, there are multiple strengths. This study uses a sample that captures multiple sub-groups of one of America's numerically small and under-studied racial groups (S. Panapasa, 2009). There are no other known studies that have identified interactions between cultural affinity and sociodemographic characteristics that influence patterns of island food consumption among Pacific Islander Americans. A novel, multi-item scale was used to measure the complex construct of cultural affinity.

In conclusion, this analysis begins to answer the question of the extent to which cultural affinity may interact with age, educational attainment, and birthplace to influence island food consumption within two populations of Pacific Islander Americans in California. Results of regression models showed significant interaction effects between culture and age, educational attainment, and birthplace. These three significant interactions could be considered together as a larger sociocultural pattern. Globalization, Westernization, and migration generate identity change on both an individual and population level. The increasing importance of cultural affinity to island food consumption – especially if viewed within the context of a larger foodscape – to younger and more highly educated Pacific

Islander Americans, speaks to an interesting trend. Those who are dually separated from their home cultures by both diasporic space and by educational attainment could be making more conscious decisions about the identity expressed through food. Future work will examine how these dietary choices influence cardiovascular risk.

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Chapter 3: Association of island food consumption and cardiovascular risk in the Pacific Islander Health Study

Introduction

Pacific Islander Americans experience significant disparities in cardiometabolic disease compared to the country as a whole (Mau, Sinclair, Saito, Baumhofer, & Kaholokula, 2009). One potential explanation for this disparity is a global shift from diets rich in lean proteins and fruits and vegetables to one high in fats, refined sugar, and processed foods (Kennedy, 2004; Kuhnlein, Erasmus, Spigelski, & Burlingame, 2013; Popkin, Adair, & Ng, 2012). This new dietary pattern has been linked to obesity, diabetes, and cardiovascular disease. An analysis of data from U.S. adults in the National Health and Nutrition Examination Survey from 1999 to 2010 showed a trend of increasing prevalence of diabetes, hypertension, and dyslipidemia in participants of normal weight, overweight, and obesity, respectively (Saydah et al., 2014). Another study of U.S. adults showed that obese individuals died between 1.6 and 5.0 years earlier, depending on level of obesity, compared to normal weight individuals (Borrell & Samuel, 2014). When these conditions are clustered, life expectancy is lowered with the addition of each condition (DuGoff, Canudas-Romo, Buttorff, Leff, & Anderson, 2014).

More interesting, is the racial and ethnic differences in the life expectancy among individuals with and without chronic illnesses. Cantu, Hayward, Hummer, and Chiu (2013) found that among men, foreign-born Hispanics had significantly fewer chronic morbidity conditions compared to native-born Whites, native-born Blacks, and native-born Hispanics.

The life expectancy of foreign-born Hispanic men was significantly higher than native-born Whites while native-born Blacks had a significantly lower life expectancy and the difference between native-born Hispanics and native-born Whites was not significantly different (Dennett & Connell, 1988). The patterns among women were similar. The authors conclude these patterns are partially accounted for by lifestyle factors such as lowered tobacco usage, diet, healthy immigrant bias, and social relationships (Cantu et al., 2013). Pacific Islanders are currently experiencing similar patterns, either as Western food infiltrates the region or as Pacific Islanders migrate to urban centers such as Auckland, Brisbane, Honolulu, or Los Angeles.

An inundation of the Pacific region with imported, processed foods and a decrease in a traditional diet following land use changes, economic shift, and increased Westernization, globalization, and food aid has been offered as an explanation for an alarming increase in obesity, diabetes, and cardiovascular disease (Ahlgren, Yamada, & Wong, 2014; Beaglehole, 1992; Cassels, 2006; Crews & MacKeen, 1982; Errington & Gewertz, 2008; Foliaki & Pearce, 2003; Galanis, McGarvey, Quested, Sio, & Afele-Fa'Amuli, 1999; Gewertz & Errington, 2010; Hughes & Marks, 2009; Plahe, Hawkes, & Ponnamperuma, 2013). A few specific favorite island foods such as mutton flaps and corned beef have been specifically suggested as driving forces behind this epidemic (Errington & Gewertz, 2008; Gewertz & Errington, 2010). Other island foods such as fish, taro, and moderate consumption of fresh coconuts are part of a heart healthy diet (Chowdhury et al., 2012; Li et al., 2013; Prior, Davidson, Salmond, & Czochanska, 1981). This paper is a novel attempt to explore the associations between island food consumption, key sociodemographic variables, and cardiovascular risk and will answer three main

questions. First, a cardiovascular risk score will be created and its distribution within the PIHS sample will be determined. Multiple cardiovascular risk or cardiovascular health scoring systems have been created and used. Second, the bivariate correlations between the cardiovascular risk score and individual risk factors will be determined. Lastly, the associations between island food consumption, key demographic variables and cardiovascular risk score will be examined in a multivariable analysis.

Methods

Pacific Islander Health Study sample

The Pacific Islander Health Study collected data from one adult and up to two adolescents (from 13-17 years of age) from 300 Samoan and Tongan households nested within 20 community religious organizations from California in a stratified random sample over a two-year period, beginning in June 2009 (S. V. Panapasa, Jackson, Caldwell, Heeringa, et al., 2012; S. V. Panapasa, Jackson, Caldwell, Herringa, et al., 2012). Further details of the methodology used in the PIHS are described elsewhere (S. V. Panapasa, Jackson, Caldwell, Heeringa, et al., 2012; S. V. Panapasa, Jackson, Caldwell, Herringa, et al., 2012). This analysis uses the sample of 240 adults who agreed to participate in the study. The individuals included in this analysis were, on average, 39.74±1.51 years of age, were 49.63% male, 60.01% reported being currently married or living with a partner, 45.45% have a high school diploma, and 36.66% have full-time employment (Baumhofer, 2016).

Variables

Island food consumption is operationalized as the self-reported number of times a participants has eaten "island foods" during the previous 7 days. Participants were prompted with a list that includes "cassava, taro, yams, corned beef, SPAM, turkey tail or seafood, meat or pastry cooked in coconut milk", but are also allowed to endorse an "other" category of island foods. The count of incidents ranged from 0 to ≥6.

Ethnicity is Samoan or Tongan. *Age* is calculated using the participant's birth year and date. *Gender* is reported by household member

. *Marital status* is defined by three categories: "married" includes participants who are currently living with their partners, with or without legal marriage, "formerly married" includes participants who are separated from their spouse, divorced, or widowed, "never married" includes participants who have never been married and are not currently living with a partner.

Education is defined by three categories including "less than a high school diploma," "a high school diploma," and "more than a high school diploma." *Employment status* is also defined by three categories which includes "full-time work," "part-time work," and "not currently working/other." *Financial insecurity* is operationalized as a categorical variable using a composite financial security score. Participants were asked, in a series of 7 questions, if they have needed to liquidate assets, postpone medical care, borrow money, apply for government assistance, obtain a loan, or alter living arrangements due to financial difficulties during the past year. For each affirmative answer 1-point is added to the financial security score. Lower scores indicate less financial insecurity while higher scores indicates more financial insecurity.

Birthplace is self-reported by participants as United States, American Samoa, Samoa, and Tonga. *Pacific cultural affinity* is a continuous variable using a composite cultural identity score with a range of 11 to 44 that was specifically developed for use in the PIHS. However, in the regression analysis, cultural affinity was centered about the mean in order to produce more interpretable results. Participants are asked how often they participate in a series of 11 different Tongan or Samoan cultural activities including: speaking Samoan or Tongan language, listening to Samoan or Tongan music, cooking Samoan or Tongan food, spending time with Samoan or Tongan friends, time spent with Samoan or Tongan friends growing up, identifying oneself as a Samoan/Tongan American, identifying oneself as only Samoan or Tongan, identifying oneself as only American, listening to Samoan or Tongan radio, watching Samoan or Tongan TV shows, and reading Samoan or Tongan news or other materials. Each activity is given a numeric score based on the following frequencies: very often – 1, fairly often – 2, not too often – 3, and never – 4. However, for this analysis, all questions except "How often do you identify your self as only American?" were reverse coded.

Cardiovascular risk score is a continuous composite variable constructed from nine components listed in Table 1 and modeled after cardiovascular health scores used in previous literature: smoking status, healthy diet score, past year alcohol consumption, past week physical activity, BMI, if the participants has ever had a doctor or other health professional tell them they have hypertension, high cholesterol, diabetes, or if the participant has ever had a previous heart attack or stroke (Folsom et al., 2011; Fryer & Ervin, 2013; Jackson et al., 2015; US Department of Health and Human Services, 2015). Responses from each of the nine components were divided into high, moderate, and low

categories of risk and a value of 0 assigned to the low-risk categories, 0.5 assigned to moderate-risk, and 1 assigned to high-risk. The nine components were summed for a potential cardiovascular risk score ranging from a possible 0 to 9 points.

Table 1. Definitions of CVD risk score components

Component	Risk level	Definition
Smoking	High	Current smoker
	Moderate	Former smoker
	Low	Never smoker
Healthy diet	High	≥2 of the following: fast food consumption at least once in the past week, at least one serving of SSB yesterday, less than 7 servings of fruit and vegetables consumed yesterday
	Moderate	One of the above risk factors
	Low	None of the above risk factors
Alcohol consumption	High	>2 per day or >5 drinks on one occasion for men >1 per day or >4 drinks on one occasion for women
	Moderate	<2 per day or <5 drinks on one occasion for men <1 per day or <4 drinks on one occasion for women
	Low	No alcohol in past year
Physical activity	High	60+ minutes of physical activity on 0-2 days per week
	Moderate	60+ minutes of physical activity on 3-5 days per week
	Low	60+ minutes of physical activity on 6-7 days per week
BMI	High	BMI ≥40
	Moderate	BMI ≥30 to <40
	Low	BMI ≥18.5 to <30
Hypertension	High	Self-report hypertension
	Low	Normal blood pressure
High cholesterol	High	Self-report high cholesterol
	Low	Normal cholesterol
Diabetes	High	Self-report Type 1 or Type 2 diabetes
	Low	No diabetes
Prior MI or stroke	High	Self-report prior heart attack or stroke
	Low	No prior heart attack or stroke

Analysis Plan

All statistical analyses were completed using STATA SE 12.0. Univariate analyses were performed in order to examine the distribution of the CVD risk score and individual components throughout the study sample. Means and proportions were calculated for each variable in the total sample as well as in Samoans and Tongans separately. T-tests and chi-square tests were performed to detect statistical differences between the two ethnic

groups (α=0.05). The prevalence of weight categories, hypertension, high cholesterol, diabetes, and prior heart attack or stroke for the sample as a whole and for Samoans and Tongans separately were also calculated. Whole sample calculations were compared to the same values in a sample of adults surveyed in the 2012 National Health Interview Survey, which was also collected in the same year using face-to-face, self-report interviews (National Center for Health Statistics, 2012). Z-tests were calculated to detect significant differences (α=0.05) between the PIHS and NHIS samples. Correlations between CVD risk, island foods, and each of the CVD risk score components were found.

In the final portion of the analysis, the SVYSET command was used to apply population weights that adjust for clustering within community religious organization and the complex sampling design used during data collection. A series of four liner regression equations were created in order to assess the association of island food consumption with CVD risk after adjustment for blocks of key sociodemographic covariates.

Age adjusted model:

$$g\{E(y)\} = \beta_0 + \beta_1 age + \varepsilon,$$

$$where\ g = \{E(y)\} = \{E(CVD\ risk\ score)\}\ and\ y \sim Normal.$$

Adjusted for demographic covariates:

$$g\{E(y)\} = \beta_0 + \beta_1 age + \beta_2 ethnicity + \beta_3 gender + \beta_4 marital\ status + \varepsilon$$

$$where\ g = \{E(y)\} = \{E(CVD\ risk\ score)\}\ and\ y \sim Normal.$$

Adjusted for previous covariates and socioeconomic variables:

$$g\{E(y)\} = \beta_0 + \beta_1 age + \beta_2 ethnicity + \beta_3 gender + \beta_4 marital\ status + \beta_5 education$$
$$+ \beta_6 employment\ status + \beta_7 financial\ insecurity + \varepsilon$$

$$where\ g = \{E(y)\} = \{E(CVD\ risk\ score)\}\ and\ y \sim Normal.$$

Adjusted for previous covariates and cultural variables:

$$g\{E(y)\} = \beta_0 + \beta_1 age + \beta_2 ethnicity + \beta_3 gender + \beta_4 marital\ status + \beta_5 education + \beta_6 employment\ status + \beta_7 financial\ insecurity + \beta_8 birth\ country + \beta_9 cultural\ affinity + \varepsilon$$

$$where\ g = \{E(y)\} = \{E(CVD\ risk\ score)\}\ and\ y \sim Normal.$$

Results of the multivariable analysis were considered statistically significant at the α=0.10 level. This value was chosen in order increase the ability to detect trends in this initial exploratory analysis and because this analysis uses a small pilot sample.

Results

Descriptive statistics

Table 2. Means and proportions of health behaviors

Variable	PIHS (n=240)	Samoan (n=137)	Tongan (n=103)	p^{***}
	Mean (S.E.)	Mean (S.E.)	Mean (S.E.)	
Current Tobacco usage (%)	24.27 (3.73)	23.11 (4.61)	27.28 (4.47)	0.52
Past week incidents of fast food consumption	2.49 (0.33)	2.62 (2.16)	2.16 (0.54)	0.23
Servings of SSB yesterday	1.48 (0.16)	1.55 (0.20)	1.30 (0.24)	0.45
Past year servings of alcohol	17.27 (5.80)	15.20 (6.82)	22.66 (8.89)	0.34
Days last week of 60+ min. of physical activity	3.63 (0.24)	3.59 (0.33)	3.72 (0.26)	0.77
Servings of fruits & vegetables yesterday	3.56 (0.30)	3.29 (0.40)	4.27 (0.47)	0.36

There were no statistically significant differences between Samoans and Tongans within the PIHS in current tobacco usage, past week incidents of fast food consumption, servings of sugar sweetened beverages consumed yesterday, past year servings of alcohol, days last week with ≥60 minutes of physical activity, or servings of fruit or vegetables

yesterday. The only significant difference in the CVD risk factors examined in this study was an excess of high cholesterol among Samoans. The differences become more pronounced when comparing the entire PIHS study to the 2012 NHIS sample. The NHIS national sample had significantly more participants who were either normal weight or overweight compared to the PIHS sample, which had significantly more obese and morbidly obese individuals. Despite these large differences in weight status, there were no differences between the two samples in hypertension or high cholesterol. The PIHS sample had slightly more diabetes, but fewer previous heart attacks or strokes.

Table 3. Proportions of CVD risk factors

	Variable	U.S. adults*	PIHS (n=240)	*p***	Samoan (n=137)	Tongan (n=103)	*p****
		Mean (S.E.)	Mean (S.E.)		Mean (S.E.)	Mean (S.E.)	
BMI (%)	Underweight	1.67 (0.07)	<0.01	0.29	<0.01	<0.01	-
	Normal	33.43 (0.25)	4.73 (1.87)	**<0.001**	3.97 (2.28)	6.68 (3.20)	0.50
	Overweight	33.24 (0.25)	13.22 (2.34)	**<0.001**	10.44 (2.51)	20.43 (4.22)	0.07
	Obese	23.31 (0.23)	46.53 (3.59)	**<0.001**	47.35 (4.09)	44.42 (7.77)	0.75
	Morbid obesity	8.34 (0.15)	35.52 (3.40)	**<0.001**	38.24 (4.21)	28.46 (4.48)	0.12
Hypertension (%)		32.72 (0.25)	28.59 (3.03)	0.17	31.47 (3.45)	21.14 (3.18)	0.05
High cholesterol (%)		27.48 (0.24)	27.06 (2.32)	0.10	29.67 (3.00)	20.28 (1.90)	**0.01**
Diabetes (%)		10.22 (0.16)	16.23 (2.82)	**0.002**	15.89 (3.47)	17.12 (4.13)	0.82
Prior MI or stroke (%)		6.18 (0.13)	2.68 (1.13)	**0.02**	2.05 (1.32)	4.40 (2.07)	0.37

* 2012 NHIS adult public use dataset
**Difference between US adults in NHIS sample and PI adults in PHIS sample
***Samoan and Tongans in PIHS sample

The distributions of the nine CVD risk score components defined in Table 1 were examined. Figure 1 indicates that most participants were categorized as low risk for

tobacco use, alcohol, hypertension, high cholesterol, diabetes, and previous heart attack or stroke. A majority of participants were at moderate risk only in the BMI component and risk in physical activity was nearly evenly spread out between low, moderate, and high. Diet score stood out as the only component in which the overwhelming majority of participants scored in the high-risk category. Further analysis of the three subcomponents in the diet score showed that 75.42% were classified as "high" on fast food consumption meaning they ate fast food more than once in the previous week; 50.42% were classified as "high" on sugar sweetened beverage consumption meaning that they had at least one serving of SSB the previous day; 86.25% were classified as "high" on fruit and vegetable consumption meaning that they did not consume at least 7 servings of fruits or vegetables the previous day. Overall, the mean CVD risk score was 3.45±0.10 and ranged from 0.5 to 8 out of a possible 9 points.

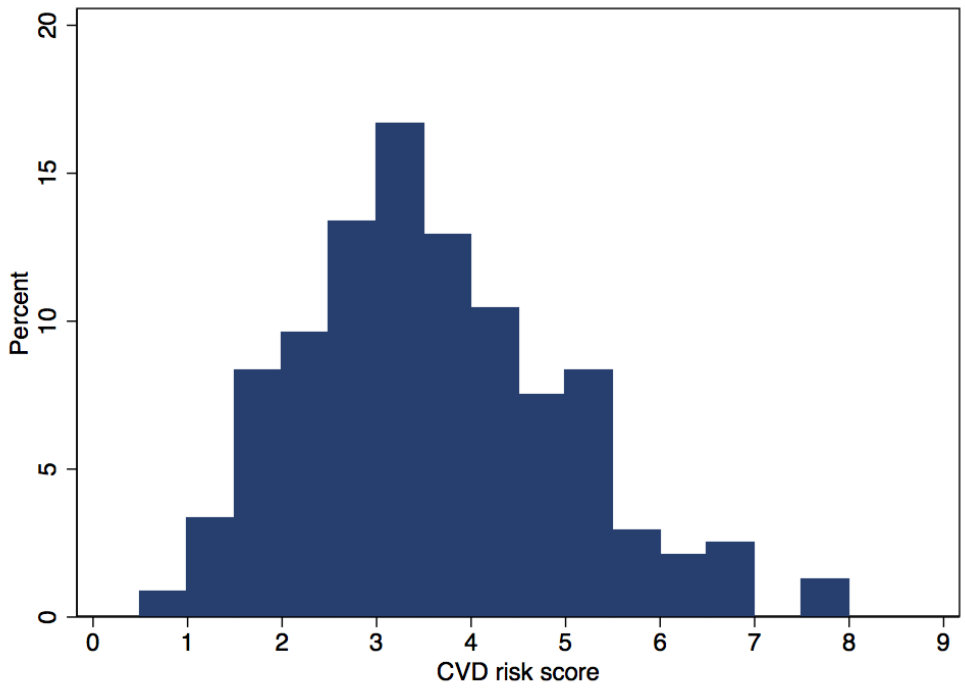

Figure 1. Distribution of CVD risk score

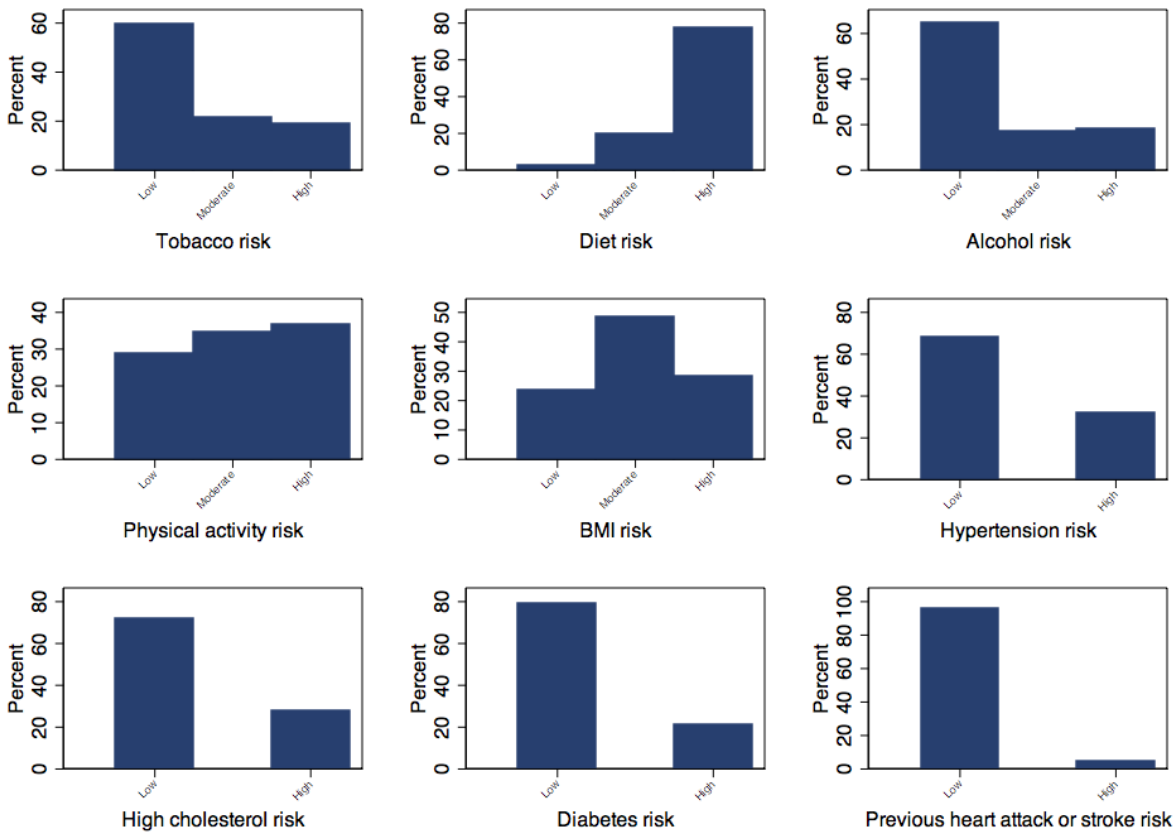

Figure 2. Distribution of CVD risk score components

The bivariate correlations found in Table 4 indicate that CVD risk was positively and significantly associated with current tobacco usage, increased BMI, hypertension, high cholesterol, diabetes, and previous heart attack or stroke and the correlations ranged from 0.14 to 0.67. It was negatively correlated with fruit and vegetable consumption ($r(238)=-0.15$, $p=0.02$) and physical activity ($r(238)=-0.40$, $p<0.01$). Island food consumption was only significantly correlated with just one variable: increased fruit and vegetable consumption ($r(238)=0.12$, $p=0.06$). Fast food consumption, tobacco usage, and alcohol consumption were all positively and weakly or moderately correlated with one another. BMI was only significantly associated with hypertension, but not high cholesterol, diabetes, or previous heart attack or stroke. Figure 3 shows a bivariate density map of how CVD

score is distributed across different levels of the covariates included in this analysis. Read like a topographic or heat-map, warmer colors indicate more responses at the combined levels of the covariate and the CVD risk score. For example, the range of CVD scores appears larger among Samoans than in Tongans and the density of CVD score and age have a positive, roughly linear relationship. Women, individuals never married, individuals with higher than a high school education, individuals not working or engage in some alternate type of work, individuals with lower financial insecurity, and those born in the United States have lower average CVD scores than others.

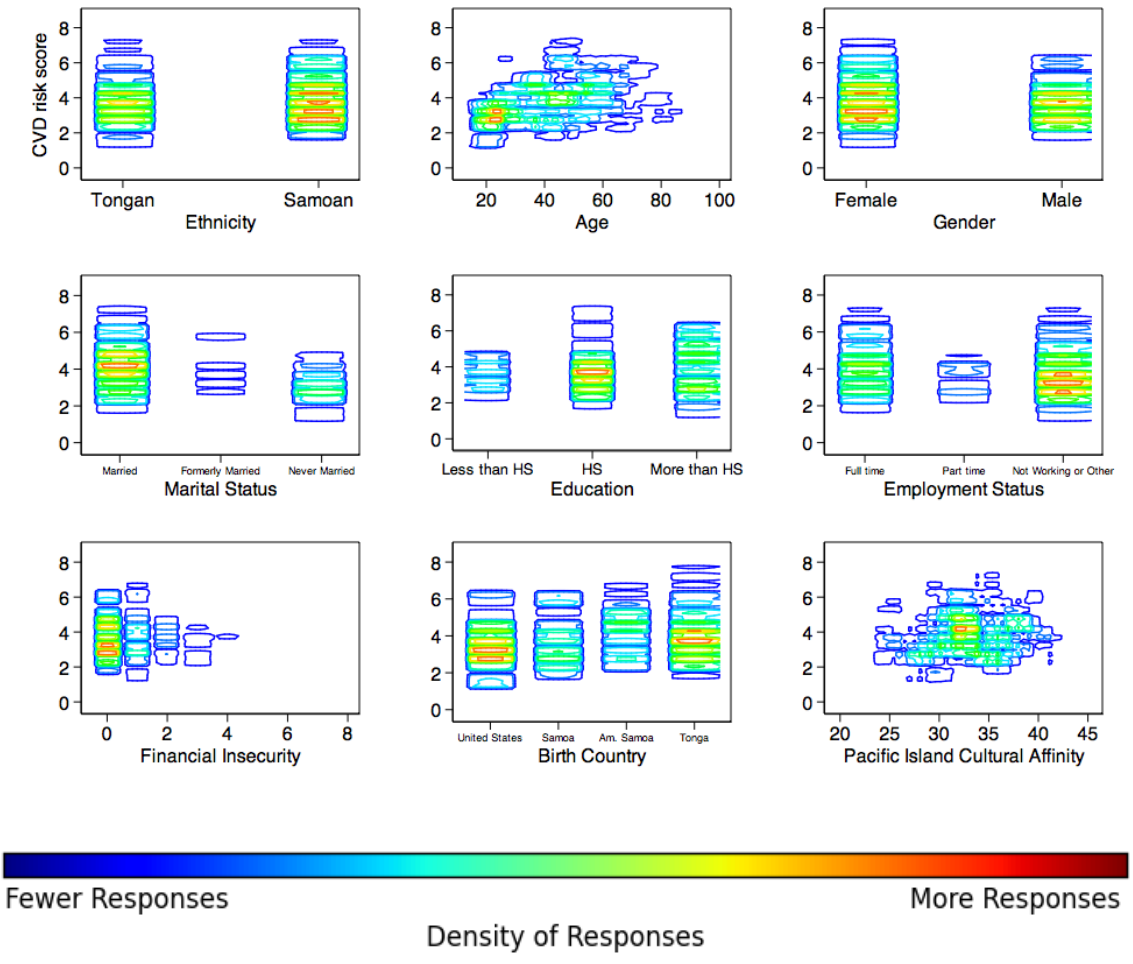

Figure 3. Bivariate density of CVD risk score and demographic covariates

Table 4. Correlations of CVD risk score with components

r (*p*)	CVD risk	Island foods	Current tobacco	SSB	Fast food	F&V	Alcohol	PA	BMI	HTN	HLD	T2DM	MI or Stroke
CVD risk	1.00												
Island foods	-0.02 (0.78)	1.00											
Current tobacco	**0.14 (0.02)**	-0.05 (0.49)	1.00										
SSB cons.	0.09 (0.15)	0.01 (0.94)	**0.20 (0.01)**	1.00									
Fast food cons.	0.04 (0.55)	-0.06 (0.35)	**0.14 (0.03)**	**0.35 (<0.01)**	1.00								
F&V cons.	**-0.15 (0.02)**	**0.12 (0.06)**	-0.10 (0.14)	0.11 (0.08)	-0.01 (0.93)	1.00							
Alcohol cons.	0.01 (0.90)	0.10 (0.14)	**0.31 (<0.01)**	0.10 (0.11)	**0.16 (0.01)**	-0.01 (0.86)	1.00						
Physical activity	**-0.40 (<0.01)**	-0.10 (0.13)	0.04 (0.59)	0.04 (0.58)	0.02 (0.74)	0.11 (0.08)	<0.01 (0.95)	1.00					
BMI	**0.33 (<0.01)**	-0.07 (0.30)	-0.05 (0.49)	0.11 (0.09)	0.11 (0.08)	0.01 (0.84)	-0.07 (0.32)	-0.11 (0.10)	1.00				
Hypertension	**0.67 (<0.01)**	-0.04 (0.50)	-0.10 (0.12)	0.07 (0.30)	-0.01 (0.87)	-0.05 (0.45)	-0.07 (0.28)	-0.05 (0.46)	**0.16 (0.01)**	1.00			
High cholesterol	**0.66 (<0.01)**	-0.02 (0.80)	**-0.13 (0.04)**	-0.09 (0.14)	-0.10 (0.12)	-0.08 (0.23)	-0.08 (0.19)	**-0.17 (0.01)**	0.09 (0.19)	**0.45 (<0.01)**	1.00		
Diabetes	**0.59 (<0.01)**	0.06 (0.36)	-0.12 (0.08)	-0.06 (0.33)	-0.05 (0.43)	-0.05 (0.45)	**-0.12 (0.05)**	-0.08 (0.19)	<-0.01 (0.96)	**0.39 (<0.01)**	**0.46 (<0.01)**	1.00	
Prior MI or Stroke	**0.29 (<0.01)**	-0.03 (0.66)	-0.05 (0.47)	-0.09 (0.17)	-0.09 (0.17)	-0.01 (0.90)	-0.02 (0.75)	**-0.13 (0.04)**	-0.08 (0.20)	**0.17 (<0.01)**	**0.15 (0.02)**	**0.20 (<0.01)**	1.00

Multivariable analysis

Table 5. Association between CVD risk and island foods after adjustment for four blocks of covariates

	Island Foods[1] B (S.E.)	Demographic[2] B (S.E.)	SES[3] B (S.E.)	Culture[4] B (S.E.)
Island Foods	-0.03 (0.04)	-0.01 (0.03)	-0.01 (0.03)	-0.01 (0.03)
Age	**0.02+ (0.01)**	-0.001 (0.01)	0.001 (0.01)	0.01 (0.01)
Ethnicity (Samoan)	-	0.08 (0.20)	0.03 (0.21)	0.02 (0.22)
Gender (Male)	-	0.03 (0.22)	0.05 (0.20)	0.08 (0.18)
Married (omitted)	-	-	-	-
Formerly married	-	-0.07 (0.27)	-0.003 (0.26)	-0.05 (0.28)
Never married	-	**-0.90* (0.30)**	**-0.78* (0.31)**	**-0.86* (0.35)**
<HS (omitted)	-	-	-	-
HS	-	-	0.32 (0.35)	0.25 (0.34)
>HS	-	-	0.28 (0.27)	0.27 (0.27)
FT (omitted)	-	-	-	-
PT	-	-	**-0.62* (0.20)**	**-0.59* (0.21)**
Not working/Other	-	-	-0.30 (0.20)	-0.28 (0.21)
Fin. Insecurity	-	-	0.03 (0.07)	0.03 (0.07)
Birthplace (US)	-	-	-	0.34 (0.29)
Cultural Affinity	-	-	-	0.005 (0.04)
Constant	2.91 (0.41)	3.70 (0.44)	3.53 (0.07)	3.16 (1.22)
R^2	0.0340	0.0952	0.1215	0.1310

*p<0.001, *p<0.05, +p<0.10; all models adjusted for clustering by religious institution
[1] Age-adjusted island food consumption
[2] Demographic covariates (age, gender, ethnicity, marital status)
[3] Adds SES covariates (education, employment status, financial insecurity)
[4] Adds cultural covariates (birth country, cultural affinity)

In the multivariable analysis island food consumption was not associated with the CVD risk score. Of the other demographic covariates, age only achieved marginal significance in the age-adjusted only model and was positively associated with the CVD risk score whereas never married was negatively associated with the outcome and retained significance throughout the final model. Upon addition of the socioeconomic covariates working part-time was negatively associated with CVD risk score and also retained

significance throughout the final model. Within the cultural covariates, neither cultural affinity nor foreign birthplace was significantly predictive of CVD risk score.

Discussion

While there were no differences in hypertension and cholesterol and moderate differences in diabetes and prior heart attack or stroke seen between the total PIHS sample and U.S. adults as a whole, the PIHS participants had strikingly higher BMIs. This echoes other results that have been found for Pacific Islanders who tend to have a higher proportion of lean muscle mass compared to other ethnic groups. Studies using dual-energy X-ray absorptiometry have found that Pacific Islanders have a higher proportion of lean muscle mass at the same BMI than Asians or Whites (Rush, Freitas, & Plank, 2009; Swinburn, Ley, Carmichael, & Plank, 1999). Previous research among U.S. adults has found an association with increased percent body fat and decreased insulin sensitivity (Hartz, Rupley, Kalkhoff, & Rimm, 1983; Lear, Kohli, Bondy, Tchernof, & Sniderman, 2009). This means that individuals with less lean muscle mass will have less insulin sensitivity and be at higher risk for diabetes compared to another individual with more lean muscle mass at the same body mass index.

Overall patterns of CVD risk score and risk factor distribution show that the PIHS sample, as whole are at low to moderate risk of cardiovascular disease, despite their high BMIs . No individuals scored the highest possible number of points and 62% of participants scored less than half of the total possible number of points. The distributions of CVD risk score factors indicate that this population is low-risk in regards to alcohol and tobacco use, at moderate risk in regards to physical activity and BMI, but only at high risk for the diet

component. One explanation for these findings is that cultural norms in the Pacific Islander community regarding alcohol and tobacco use and diet. Alcohol use in the Pacific is generally restricted to urban males with rural individuals and women rarely partaking (Finau, Stanhope, & Prior, 1982). Especially within this particular sample, which was recruited from 20 different community religious organizations, including the Church of Latter Day Saints and Seventh Day Adventists, both of which strongly discourage the use of alcohol (Fraser, 1999; Slattery & West, 1993). Sports, such as rugby and American football are frequently enjoyed by Pacific Islander men and boys and considered a potentially viable pathway to employment (Horton, 2012). Although young Pacific Islander men may eagerly participate in vigorous sports activities, women and older individuals may not be getting enough physical activity. For example, older individuals may view physical activity as something to engage in while completing chores such as housework, food gathering, food preparation, or transportation, but not as something for fun or health benefit (Kolt, Paterson, & Cheung, 2006; Levy-Storms & Lubben, 2006; Mavoa & McCabe, 2008).

The bivariate correlations shown in Table 4 point to larger patterns of consumption and activity. Current tobacco usage is significantly and positively correlated with fast food and sugar sweetened beverage consumption, while alcohol is positively correlated with tobacco consumption. This suggests that these health behaviors tend to be clustered with each other and are associated with an urban lifestyle (Finau et al., 1982; Fuamatu, 1997). Further examination of how tobacco, alcohol, fast food, and SSB consumption are distributed by demographic factors shows that current tobacco use is significantly correlated with age ($r(238)=-0.29$, $p<0.001$), but not birth country ($r(238)=0.0043$, p-0.95). There were significant differences in SSB consumption by birth country with United States

being highest, American Samoa second highest, then Samoa and Tonga with the least ($F(3,236)=4.28$, $p=0.006$) and by decreasing age ($r(238)=-0.30$, $p<0.001$). The same pattern was seen both for alcohol (birth country differences ($F(3,236)=4.21$, $p=0.006$) and age ($r(238)=-0.24$, $p=0.0002$)) and fast food consumption (birth country differences ($F(3,236)=16.10$, $p<0.0001$) and age ($r(238)=-0.37$, $p<0.0001$)). As new generations of Pacific Islanders are born in the United States, this trend may continue and adversely affect the cardiovascular health of this population.

Island food consumption was positively correlated with fruit and vegetable consumption ($r(238)=0.12$, $p=0.006$), which is expected since many island foods are fruits, vegetables, or root vegetables, while fruit and vegetable consumption was negatively correlated with cardiovascular risk score ($r(238)=-0.15$, $p=0.02$). While island food consumption was lower among those born in the United States and American Samoa versus Samoa and Tonga ($F(3,236)=6.72$, $p=0.0002$) and increased with age ($r(238)=0.19$, $p=0.004$), there were no significant differences in fruit and vegetable consumption by birth country ($F(3,236)=0.60$, $p=0.62$) or age ($r(238)=0.04$, p-0.60). This is promising in the light of the previous discussion of alcohol, tobacco, fast food, and SSB consumption. Even if the next generation of Pacific Islander Americans consume fewer island foods, which do include fruits and vegetables, it is possible that their diets may simply exchange fruits and vegetables common in American grocery stores for those more common in the islands (Fuamatu, 1997). If this dietary pattern can be maximized and SSB, fast food, alcohol, and tobacco consumption can be minimized, cardiovascular risk could be improved.

In the multivariable analysis, increasing age was marginally associated with increased CVD risk in the age-adjusted model, but this significance was lost with the

addition of other demographic covariates. Only being never married and engaging in part-time work remained significant after the addition of all covariates with both factors associated with decreased CVD risk. A study examining the association of marital status with all-cause mortality showed that compared to being married, being divorced/separated, widowed, or never married were all separately associated with increased odds of mortality from cardiovascular causes among both blacks and whites except among never married Black men, aged 65 or older (Johnson, Backlund, Sorlie, & Loveless, 2000). One potential explanation for this difference is a very strong sense of social support given to all family members, especially younger and older members who are revered as cultural treasures (Capstick, Norris, Sopoaga, & Tobata, 2009; Hanna, 1998). Previous research examining the relationship between social support and physiological processes concluded that emotional and familial support may be important buffers against adverse cardiovascular outcomes (Uchino, 2006; Uchino, Cacioppo, & Kiecolt-Glaser, 1996). Work stress has been associated with poor cardiovascular outcomes with secure, high-control, full-time work being considered the most protective of positive health (Benach et al., 2014; Bosma, Peter, Siegrist, & Marmot, 1998; Marmot, Bosma, Hemingway, Brunner, & Stansfeld, 1997). Although part-time employment may be associated with lower income and more financial stress, it may also promote more work-life balance and may mitigate some of the negative health outcomes associated with work stress, especially given strong networks of social support and obligatory responsibility in Pacific Islander families (Capstick et al., 2009; Hau'ofa, 1994; Lunau, Bambra, Eikemo, van der Wel, & Dragano, 2014).

Of note is the lack of association between island food consumption and cardiovascular risk in the multivariable analysis. In each model, increased island food consumption was associated with lower cardiovascular risk, which is expected given the significant association with island food consumption and fruit and vegetable consumption. However, this association did not reach statistical significance. One explanation is the global nature of the island foods variable. This category includes both heart-healthy foods such as fruits and vegetables and lean proteins such as fish and chicken as well as high fat foods such as canned meats and instant noodles or white rice. Future research should differentiate between these two broad categories of nutritional value.

This analysis has limitations that should be addressed. First, the global nature of the island food consumption variable makes detection of differences in cardiovascular health by nutritional value of island food difficult. Second, the PIHS study is a pilot test of a larger, forthcoming project and participation was limited to two ethnic groups from a sample of community religious organizations in California, which may limit generalizability of this sample (S. V. Panapasa, Jackson, Caldwell, Heeringa, et al., 2012). Third, these data are cross-sectional in nature, which makes temporal ordering impossible. Fourth, the low alpha used in this analysis and multiple tests of significance could have lead to some spurious results. However, further work on forthcoming PIHS datasets will help to confirm or revise the conclusions reached in this paper. Lastly, the cardiovascular risk score used in this analysis was modeled after similar scores used in previous research, but the data available did not allow for inclusion of other important cardiovascular health risk factors such as specific blood pressure or cholesterol values (Folsom et al., 2011). Also, existence of diabetes, high cholesterol, hypertension, or experience of previous heart attack or stroke

were not objectively validated. However, despite these limitations, this analysis has several strengths. There are no other known studies examining the association between island food consumption and cardiovascular risk among Pacific Islander Americans. This analysis partially addresses this gap in the health literature as an initial step to assessing these relationships within a numerically small and under-studied racial group (S. Panapasa, 2009).

In conclusion, island food consumption may not contribute to increased cardiovascular risk. However, healthy behaviors such as fruit and vegetable consumption and vigorous physical activity should be encouraged while alcohol, tobacco, fast food, and SSB consumption should be limited, especially among younger individuals and those born in the United States. There is a long-standing tradition of strong family values, social support, and filial piety among Pacific Islanders. These networks could be utilized to promote social norms that encourage heart-healthy behaviors. Continued monitoring of the cardiovascular health of future generations of Pacific Islander Americans should be supported by both the public health community and policy makers given the expected growth in this population over the course of the coming decades.

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Conclusion

This collection of papers is an initial effort to understanding the distribution of island food consumption by Pacific Islanders living in California, the association between cultural affinity and island food consumption, and the contribution to cardiovascular risk made by eating island foods. Within these analyses, three main findings stand out. First, being formerly married and having a higher reported level of cultural affinity were associated with increased island food consumption after the inclusion of multiple sociodemographic covariates. Second, when cultural affinity is broken into two sub-factors culturally relevant media consumption had a moderating effect on the relationships between ethnicity and island food consumption and birth country and island food consumption, with media consumption having a larger effect on Samoans and a smaller effect on individuals born in Samoa and Tonga. Third, island food consumption was not significantly associated with increased cardiovascular risk after the addition of key covariates.

These findings help to tell the story of how food and bodies cross the lines of culture and country. As the global culture mingles with the cultures of the islands, economies shift, farming and fishing wane, and families leave home, looking for a new life in a new country. That diets also change with this process is inevitable. As future generations of Pacific Islanders make their homes in the United States, understanding how island foods fits into their changing diet is an essential part of understanding how to target interventions that could reduce the risk of obesity-related chronic illnesses within this population. The global obesity epidemic will surely have consequences for generations to come. Simply

understanding that Pacific Islanders living in the United States eat a more Westernized diet than their counterparts living within the Pacific is not enough. Digging into the sociodemographic variability of dietary patterns gives a more complete picture of what Pacific Islander Americans eat.

Following this, two potential pathways for future work emerge. The first is to complete future work within the PIHS and gain a better understanding of *who* is eating *what* kinds of island foods. The sample used in these analyses is a smaller pilot study. The larger, national sample will include a much larger sample and have individuals of several different ethnic groups throughout the country. A national sample would allow for exploration of variation in island food consumption between multiple ethnic groups in different regions. Another useful question to answer using the PIHS is a closer examination of specific types of island foods consumed and their sociodemographic distribution. Within the PIHS participants were allowed to self-define island foods, which includes both traditional and imported, contemporary foods. These two groups of foods are distinct in nutritional context, accessibility, affordability, and historical context. The variability between these two very distinct food groups may have vastly different sociodemographic distributions and may be associated with different health outcomes.

A second body of work to be completed would help to develop a deeper understanding of *why* specific island foods are consumed. This could be accomplished through rich, qualitative study and an investigation of how culture and cultural identity influences the dietary choices of Pacific Islander Americans. This work would involve delving further into the reasons why Pacific Islanders migrate to the United States, the nature of relationship Pacific Islander migrants have with their home islands, and how

subsequent generations of Pacific Islander Americans are or are not adhering to their family's dietary traditions.

Future work would allow public health practitioners to target interventions aimed at reducing the disparities in obesity, cardiovascular disease, and diabetes that burden this community. Improving the health of all populations within the United States, no matter how small, is a goal that is necessary for the achievement of health equity. The diet shift of Pacific Islanders and Pacific Islander Americans may also serve as another example of dietary shifts experienced by other ethnic minority groups.