ORIGINAL RESEARCH & CONTRIBUTIONS

Multiple Health Behaviors in an Ethnically Diverse Sample of Adults with Risk Factors for Cardiovascular Disease

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Abstract

Background: Health behaviors of adults living with cardiovascular disease (CVD) risk factors affect additional risk, where lifestyle behavioral choices become even more important in controlling disease and preventing additional negative health outcomes. In addition, both lifestyle behaviors and CVD risk factor prevalence can vary by ethnicity.

Objective: We compared multiple health behaviors of adults with diabetes, hypertension, high cholesterol, and obesity to the behaviors of adults without those conditions in a diverse ethnic sample to determine if significant differences existed between groups.

Methods: Data were obtained from 30-minute random-digit-dial telephone surveys in 2007 ($n = 3607$). All data were self-reports. Healthy behaviors included meeting recommendations for intake of fruits and vegetables; consuming low or very low amounts of dietary fat; eating breakfast six or seven days per week; having a healthy diet; and meeting recommendations for walking, moderate, and vigorous physical activity. Unhealthy behaviors included frequent consumption of soda and fast food, smoking, binge drinking, and high stress.

Results: More than 6% of respondents had diabetes, 15.9% had hypertension, 16.4% had high cholesterol, and 18.5% were obese. Significantly fewer healthy and more unhealthy behaviors were reported for those who had CVD risk factors than were reported by those who did not have such conditions. Ethnic differences in CVD risk factor prevalence and health behaviors existed as well ($p < 0.001$). Logistic regression models indicated that not eating a healthy diet (odds ratio [OR] = 1.82) was a significant predictor for diabetes; not eating a healthy diet (OR = 1.52) and not doing vigorous physical activity (OR = 1.79) were significant predictors for hypertension; consumption of high amounts of dietary fat (OR = 1.70) and of fast food (OR = 1.51) were significant predictors for high cholesterol levels; and not eating a healthy diet (OR = 1.52), high consumption of dietary fat (OR = 2.20), not eating breakfast (OR = 1.33) and not performing vigorous physical activity (OR = 1.63), but less consumption of fast food (OR = 0.64) were significant predictors for obesity.

Conclusions: Specifically tailored and culturally sensitive interventions that address multiple health behaviors may be necessary for these high-risk populations.

Introduction

Cardiovascular disease (CVD) is the leading cause of death in the US and in the state of Hawaii.^{1,2} Predictors of CVD include hypertension, high levels of low-density lipoprotein cholesterol, obesity, elevated glucose levels (diabetes), tobacco use, inadequate stress management, physical inactivity, and poor diet.³ Individuals with these risk factors are more likely to develop CVD over time. For example, of all US deaths in 2004, 68% of people with type 2 diabetes died from CVD.⁴

For individuals living with CVD risk factors such as diabetes, hypertension, high cholesterol levels, and obesity, lifestyle behavioral choices become even more important to control the disease and prevent further negative outcomes.^{5,6} Recommended strategies to prevent and treat CVD include increasing healthy behaviors such as eating a diet high in fruits and vegetables, effectively managing stress, engaging in at least 30 minutes of physical activity each day, and avoiding unhealthy behaviors such as smoking and eating and drinking excessively salty or sugary foods and beverages, such as soda.⁷ However, many people with CVD risk factors do not meet these criteria. The 2009 Survey on Living with Chronic Disease in Canada found that among those people who had been told that they

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had hypertension, 58% were physically inactive, 71% were overweight or obese, 58% reported not eating enough fruit and vegetables each day, and 17% reported smoking cigarettes.⁸

Populations with multiple behavior risk factors are at greatest risk for chronic disease and premature death compared with people with single or no behavioral risk factors.⁹ Multiple risk factors are common in the general US adult population, with >50% of the population estimated to have at least two of the following four behavioral risk factors: smoking, heavy alcohol consumption, obesity, and physical inactivity¹⁰; however, little is known about health behavior profiles among individuals living with CVD risk factors.

Clear health disparities also exist for CVD. Minorities in the US are at higher risk for several chronic health conditions and often have lower treatment adherence rates.¹¹ Asians in the US have an elevated diabetes risk.¹² In Hawaii, Native Hawaiians and other Pacific Islanders also have a very high risk for CVD.¹³ In addition, diabetes rates for Native Hawaiians continue to increase.¹⁴

Despite the clear evidence that health behaviors are important in controlling chronic diseases, significant gaps exist in understanding these health disparities, and little has been published in this area in the US.¹⁰ Most studies focus on a single condition or a single behavior in the at-risk population or report on multiple demographic factors as risk factors for chronic disease. Moreover, to our knowledge, there is no published evidence that examines multiple CVD risk factors and multiple health behaviors in such a diverse ethnic population.

Therefore, we sought to determine whether multiple health

behaviors differed significantly between individuals living with the CVD risk factors of diabetes, hypertension, high cholesterol levels, and obesity versus those without these conditions. We hypothesized that those with CVD risk factors would display fewer healthy and more unhealthy behaviors than individuals without those conditions.

Methods

Participants and Data

For this study, we used data from the 2007 Healthy Hawaii Initiative cross-sectional random-digit-dial telephone survey. Using a computer-aided telephone interviewing system, we asked call recipients to complete a household survey about planning future health programs in Hawaii. More than 92% of adults willing to answer questions completed surveys (a 30.3% response rate overall), representing their household, for a total sample of 3607.

Materials

The full survey instrument was designed as a chronic-disease risk-factor surveillance system¹⁵ and included questions about attitudes, norms, behaviors, and perceptions for physical activity, nutrition, and tobacco use.¹⁶ We used a subset of questions that included CVD risk-factor health conditions, health behaviors, and demographic information.

Cardiovascular Disease Risk-Factor Health Conditions

Participants were categorized as having a CVD risk-factor health condition if a physician, nurse, or other medical professional had ever told them that they had diabetes, high blood pressure (hypertension), or high cholesterol.¹⁰ Those with diabetes were asked to specify which type: type 1, type 2, gestational, or borderline. For obesity, participants

reported their height in feet and inches and weight in pounds. Body mass index (BMI) was calculated and used to indicate obesity (ie, BMI ≥ 30 kg/m²).

Respondents answered questions about their current health behaviors, including those related to nutrition, physical activity, cigarette smoking, alcohol consumption, and stress. As outlined in the following sections, each individual was classified as meeting or not meeting each behavior.

Nutrition—Participants were asked how many servings of fruits and how many servings of vegetables on average they ate per day. Respondents consuming five or more daily servings of fruits and vegetables were classified as meeting recommendations.¹⁷ Respondents were classified as having a low dietary fat intake (ie, making a conscious effort to avoid eating foods that were high in fat) if they indicated “often” or “always” doing so. Participants were classified as breakfast eaters if they ate breakfast six or seven days per week. Respondents were classified as eating a healthy diet overall if they indicated that they often or always did so. Unhealthy nutrition behaviors included frequent soda consumption, which was defined as drinking ≥ 12 ounces of sweetened soda per day,¹⁸ and frequent consumption of fast food, which was defined as eating at fast-food restaurants once a week or more.

Physical Activity—For each category of physical activity (walking, moderate, vigorous), respondents were asked the average number of days per week and total minutes per day that they engaged in each activity in a usual week. Respondents who reported walking or engaging in moderate physical activity for ≥ 150 minutes per week for at least

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10 minutes a day on 5 or more days per week or who reported engaging in vigorous physical activity for ≥ 60 minutes per week on 3 or more days per week met recommendations at the time that the data were collected.^{19,20}

Smoking—Respondents who currently smoked cigarettes or who had quit less than six months before the survey were considered smokers.

Binge Drinking—Respondents who reported having four or more drinks in one sitting over the preceding four weeks were considered binge drinkers.

Stress—Respondents who reported their life to be “very” or “extremely” stressful were considered to have high stress levels.

Procedure and Analyses

The household member over age 18 with the most recent birthday was selected as the respondent. Verbal consent was obtained, and the study was approved by the University of Hawaii institutional review board. The survey took approximately 30 minutes to complete.

After summarizing participant demographics and health behaviors for the entire sample, we computed the prevalence of each health behavior by CVD risk factor. We compared differences for each CVD risk condition using the χ^2 test. We used one-way analysis of variance to examine ethnic differences for each health behavior. Then, to determine the prevalence of multiple behavioral risk factors, we

created an index by summing all 12 health behaviors (after first reverse-coding the unhealthy behaviors of consumption of soda and fast food, smoking, binge drinking, and stress). Participants could score from 0 to 12 on this index, with higher scores indicating more health-promoting behaviors. Finally, we conducted separate logistic regression models, with having or not having each CVD risk factor (diabetes, hypertension, high cholesterol level, or obesity) as the independent variable and the health behaviors as dependent variables, controlling for age, sex, and ethnicity. All data were analyzed using IBM SPSS Statistics software (version 16.0; SPSS Inc, Chicago, IL).

Results

Participant Characteristics

The majority of participants were married (59.1%; $n = 2131$), had some college education (72.2%; $n = 2604$), female (65.3%; $n = 2354$), and had a household income of $\leq \$70,000$ (51.4%; $n = 1853$). The average age of participants was 53.9 ± 15.8 years. Participant ethnicities included white (36.5%; $n = 1317$), Asian (28.5%; $n = 1029$), Native Hawaiian or part Hawaiian (17.0%; $n = 612$), and multiple ethnicities (18.0%; $n = 649$).

As shown in Table 1, CVD risk factors were distributed as follows: 6.2% had diabetes ($n = 222$; of those, 62.0% had type 2), 15.9% had hypertension ($n = 573$), 16.4% had high cholesterol levels ($n = 592$), and 18.6% were obese ($n = 670$). Almost 14% of the sample ($n = 494$) reported only 1 risk factor, 8.2% ($n = 298$) reported 2, 4.2% ($n = 153$) reported 3, and 0.8% ($n = 30$) reported having all 4 CVD risk factors (data not shown).

Statistically significant differences were found between ethnicities for diabetes [$f(3,1763) = 14.89$; $p < 0.001$], with whites significantly less

Table 1. Percentage reporting each cardiovascular disease risk factor by ethnicity

Ethnicity	Diabetes (n)	Hypertension (n)	High cholesterol level (n)	Obesity (n)
White	5.9 (37)	26.4 (165)	31.1 (193)	15.1 (195)
Asian	17.4 (90)	39.0 (200)	42.9 (222)	11.7 (118)
Native Hawaiian or part Hawaiian	17.7 (53)	38.5 (115)	30.3 (90)	35.4 (213)
Mixed	13.0 (42)	29.0 (93)	27.2 (87)	22.9 (144)
Total	6.2 (222)	15.9 (573)	16.4 (592)	18.6 (670)

Table 2. Percentage reporting each health behavior by cardiovascular disease risk factor

Behavior	Diabetes		Hypertension		High cholesterol level		Obesity	
	Yes	No	Yes	No	Yes	No	Yes	No
Healthy								
Fruits and vegetables	41.9	46.5	40.3	48.5 ^a	38.9	49.6 ^b	40.1	47.3 ^a
Low dietary fat intake	32.0	38.7 ^c	33.7	40.0 ^c	34.2	39.8 ^a	21.2	43.7 ^b
Breakfast 6 or 7 d/wk	68.5	66.1	66.3	66.6	68.9	65.1	57.5	68.0 ^b
Eating a healthy diet	50.5	66.6 ^b	59.5	67.0 ^b	61.0	66.3 ^c	46.8	70.1 ^b
Walking	37.4	40.6	35.1	42.7 ^a	37.7	41.4	32.7	42.0 ^b
Moderate physical activity	16.7	25.6 ^a	21.6	25.8	20.6	26.2 ^c	19.1	24.2 ^a
Vigorous physical activity	21.2	31.9 ^a	21.6	34.9 ^b	21.5	35.0 ^b	24.8	31.5 ^a
Unhealthy								
Soda consumption	4.1	6.3	5.8	6.2	5.6	6.2	9.0	6.0 ^a
Fast-food consumption	46.2	43.0	44.6	42.8	39.3 ^c	45.5	57.5	40.2 ^b
Smoker	14.9	16.5	14.3	17.2	14.2	17.4	16.5	16.2
Binge drinker	7.2 ^b	13.8	10.6 ^b	14.2	8.5 ^b	15.3	15.2	12.6
High stress level	20.3	18.2	17.3	18.7	18.8	18.3	23.5	17.2 ^a

^a $p < 0.01$; ^b $p < 0.001$; ^c $p < 0.05$.
d/wk = days per week

likely than all other ethnic groups to have diabetes. Statistically significant differences were also found for hypertension [$f(3,1755) = 9.20$; $p < 0.001$], with whites less likely than Asians and Native Hawaiians or those who were part Hawaiian, and those of multiple ethnicities less likely than Asians to report hypertension. Statistically significant differences were also found for cholesterol levels [$f(3,1750) = 9.87$; $p < 0.001$], with Asians significantly more likely to have high cholesterol levels than all other ethnic groups. Statistically significant differences were also found for obesity [$f(3,3525) = 55.68$; $p < 0.001$], with whites and Asians less likely to be obese than both Native Hawaiians and those who were part Hawaiian and those of multiple ethnicities (Table 1).

As shown in Table 2, the most common behaviors were eating breakfast, a healthy diet and consumption of fast food. Eight percent of the entire sample were smokers ($n = 289$), and 6.4% were binge drinkers ($n = 230$). Using χ^2 analyses, statistically significant differences emerged within each CVD risk factor (Table 2). As compared with participants without diabetes, those with diabetes were significantly less likely to report the healthy behaviors of having a low dietary fat intake ($p < 0.05$), eating a healthy diet ($p < 0.001$), and meeting moderate or vigorous physical activity guidelines ($p < 0.01$); however, they were also significantly less likely to report binge drinking ($p < 0.01$). As compared with participants without hypertension, those with hypertension were significantly less likely to report the healthy behaviors of eating fruits and vegetables ($p < 0.05$), having a low dietary fat intake ($p < 0.01$), eating a healthy diet ($p < 0.01$), meeting walking recommendations ($p < 0.01$), and

meeting guidelines for vigorous physical activity ($p < 0.001$); however, they were significantly less likely to report binge drinking ($p < 0.01$). Participants with high cholesterol levels were significantly less likely to report eating fruits and vegetables ($p < 0.001$), having a low dietary fat intake ($p < 0.05$), eating a healthy diet ($p < 0.05$), and meeting moderate ($p < 0.05$) and vigorous ($p < 0.001$) physical activity guidelines, as compared with those without high cholesterol levels. However, those with high cholesterol were also less likely to report the unhealthy behaviors of consumption of fast food ($p < 0.05$) and binge drinking ($p < 0.001$). As compared with all other participants, obese participants were significantly less likely to report the healthy behaviors of eating fruits and vegetables ($p < 0.01$), having a low dietary fat intake ($p < 0.001$), eating breakfast ($p < 0.001$), eating a healthy diet ($p < 0.001$), and meeting walking ($p < 0.001$), moderate ($p < 0.01$), or vigorous ($p < 0.01$) physical activity guidelines. Obese participants were also more likely to report the

unhealthy behaviors of regular soda consumption ($p < 0.01$), consumption of fast food ($p < 0.001$), and having a high stress level ($p < 0.01$).

Using one-way analysis of variance, we found statistically significant differences between ethnic groups for all healthy and unhealthy behaviors except having a high stress level. Table 3 shows the percentage of participants reporting each behavior by ethnicity and provides the exact p value for each. Whites had the most favorable behavior risk profile overall, reporting more healthy behaviors and fewer unhealthy behaviors than all other ethnicities (except engaging in moderate and vigorous physical activity and having high stress levels). Asians reported the lowest physical activity but also the lowest stress levels. Native Hawaiians and those who were part Hawaiian reported the fewest healthy nutrition behaviors but were more likely than other groups to report walking and engaging in moderate and vigorous physical activities. However, they were also more likely to report the unhealthy behaviors of soda con-

Table 3. Percentage reporting each health behavior by ethnicity

Behavior	Ethnicity				p value
	White	Asian	Native Hawaiian or part Hawaiian	Multiple	
Healthy					
Fruits and vegetables	54.7	37.1	38.2	52.9	0.000
Low dietary fat intake	49.0	32.6	28.4	43.4	0.000
Breakfast 6 or 7 d/wk	70.5	68.2	55.7	60.1	0.000
Eating a healthy diet	78.4	56.9	52.7	67.9	0.000
Walking	43.7	35.0	42.6	40.0	0.000
Moderate physical activity	25.4	19.2	25.8	22.9	0.001
Vigorous physical activity	34.2	23.1	31.9	34.4	0.000
Unhealthy					
Soda consumption	5.1	7.0	9.3	5.7	0.006
Fast-food consumption	33.2	52.0	50.5	40.3	0.000
Smoker	28.4	34.2	45.8	48.2	0.000
Binge drinker	17.8	20.2	38.4	23.8	0.000
High stress level	20.3	14.5	20.1	22.2	0.056

d/wk = days per week

Table 4. Average health behavior index scores^a by cardiovascular disease risk factor			
Risk factor	Yes: mean (SD)	No: mean (SD)	χ^2 (p value)
Diabetes	6.76 (1.98)	7.18 (2.19)	22.03 (0.024)
Hypertension	6.86 (2.05)	7.26 (2.21)	35.65 (0.000)
High cholesterol level	6.96 (2.03)	7.21 (2.23)	25.71 (0.007)
Obesity	6.49 (1.92)	7.58 (2.05)	161.50 (0.000)

^aHigher scores indicate more healthy and fewer unhealthy behaviors; range, 0–12.
SD = standard deviation

sumption and binge drinking. Those of multiple ethnicities were most likely to report the healthy behavior of vigorous physical activity and the unhealthy behaviors of smoking and having a high stress level.

Higher health-behavior index scores indicated more healthy and fewer unhealthy behaviors. Index scores were lower for all CVD risk factors, indicating that individuals with each CVD risk factor reported fewer healthy and more unhealthy behaviors than those without the risk factors. Using the χ^2 test, we found these differences to be statistically significant (Table 4).

Logistic Regression Models

After controlling for age, sex, and ethnicity, we found that the logistic regression for diabetes was significant at step 2 [χ^2 (5) = 12.76; $p < .05$]. However, the only significant predictor was being less likely to have a healthy diet ($p < 0.001$). The logistic regression for hypertension was also significant

at step 2 [χ^2 (6) = 30.47; $p < 0.001$]. Significant predictors included being less likely to eat a healthy diet or to meet recommendations for vigorous physical activity. The logistic regression for a high cholesterol level was also significant at step 2 [χ^2 (7) = 31.94; $p < 0.001$]. Significant predictors included being less likely to have low dietary fat intake but being less likely to eat fast food. The logistic regression for obesity was also significant at step 2 [χ^2 (10) = 99.11; $p < 0.001$]. Significant predictors included being less likely to eat a low-fat diet, eat breakfast, eat a healthy diet, or meet recommendations for vigorous physical activity but consuming greater amounts of fast food (Table 5).

Discussion

In our study, multiple health behaviors did differ significantly on the basis of CVD risk-factor health conditions. Our hypothesis was supported in that those with diabetes, hypertension, high cholesterol levels, and

obesity reported fewer healthy and more unhealthy behaviors, compared with those without each condition. In general, key variables for those with CVD risk factors included being less likely to eat a low-fat diet, eat a healthy diet, meet recommendations for vigorous physical activity, or eat breakfast regularly and being more likely to eat fast food.

Despite having been told by a medical professional that they had one or more CVD risk factors, study participants still reported engaging more frequently in unhealthy behaviors and less frequently in healthy behaviors. However, differences did exist between the CVD risk factors. It is interesting that the worst health index overall was found for individuals with obesity. We did not ask people if they were obese; instead, we calculated their BMI on the basis of their self-reported height and weight. This possible lack of knowledge of obesity status may reflect that those who reported the other conditions had already begun to make some changes in health behaviors but still needed to make more changes. Future research might examine specific behavioral differences over time to determine when behavior changes may occur for those with diagnosed CVD risk factors.

The strongest correlate was not eating a healthy diet (significant for all CVD risk factors except a

Table 5. Logistic regression models for predictors of cardiovascular disease risk factors				
Risk factor	Variables	Odds ratio	95% Confidence interval	p value
Diabetes	Lack of a healthy diet	1.82	1.09–3.03	<0.05
Hypertension	Lack of a healthy diet	1.52	1.06–2.18	<0.05
	Lack of vigorous physical activity	1.79	1.26–2.54	<0.001
High cholesterol level	Lack of low dietary fat intake	1.70	1.22–2.36	<0.01
	Fast-food consumption	1.51	1.09–2.10	<0.05
Obesity	Lack of low dietary fat intake	2.20	1.59–3.03	<0.001
	Not eating breakfast	1.33	1.01–1.75	<0.05
	Fast-food consumption	0.64	0.48–0.84	<0.01
	Lack of a healthy diet	1.52	1.13–2.03	<0.01
	Lack of vigorous physical activity	1.63	1.18–2.26	<0.01

high cholesterol level). This single variable was a stronger correlate than meeting recommendations for intake of fruits and vegetables, a frequently promoted strategy for those with chronic diseases.⁷ Dietary fat intake was a significant correlate for a high cholesterol level and obesity, although previous research found a relationship between high dietary fat intake and diabetes.²¹

Individuals with each CVD risk factor were less likely overall to meet recommendations for physical activity than were those without the risk factors. Specifically, less vigorous physical activity was a significant correlate for both hypertension and obesity in our study. Most strategies recommend engaging in moderate physical activity,⁷ because many people with chronic disease are physically inactive.⁸ However, the importance of vigorous physical activity should not be overlooked.

Confirming the results of previous research, Native Hawaiians had significantly higher rates of diabetes, hypertension, and obesity than did other groups.^{13,14} Asians also had significantly higher rates of diabetes,¹² as well as hypertension and high cholesterol levels, than did other groups. Clear differences also existed between ethnicities for healthy and unhealthy behaviors, similar to findings in previous studies,²² with ethnic minorities tending to report fewer healthy and more unhealthy behaviors than whites. Despite these ethnic disparities, significant behavioral correlates existed for each CVD risk factor after controlling for age, sex, and ethnicity.

Interestingly, rates for binge drinking were significantly lower for individuals with diabetes, hypertension, and high cholesterol levels than for those without. The frequency of consumption of fast food was also lower for those with high cholesterol

levels than those without. Contrary to earlier research findings, no significant differences were found for smoking, although ethnic differences were found.¹⁰ Future research could examine whether these findings were intentional behaviors and if they could be built on to decrease other unhealthy behaviors.

Limitations of our study included the use of a cross-sectional design and self-reported data for all CVD risk factors and health behaviors. It is likely that the rates of obesity were underreported, as they were lower than the state average of 21.7%.²³ These data cannot be used to indicate causality. Caution should be used in applying these results to other states, as the ethnic composition of Hawaii is unique. Also, because of the large number of variables, we chose to dichotomize the variables. This was essential for the logistic regression analysis and also for the interpretability of the tables. However, this may have caused the loss of some of the richness of individual variables. For many of the behaviors, there were no clinical guidelines for cut points. In these cases, we determined the most logical cut point in order to separate the healthy from the unhealthy level of each behavior. Thus, some items (eg, consuming fast food once a week) may not be clinically significant.

Conclusion

Culturally and behaviorally tailored interventions should be designed for different CVD risk factors, taking into account whether the person is aware of the risk factor and whether the person has already made any behavioral changes. When addressing diabetes, it is important to emphasize improving the diet overall to be more healthy. When addressing hypertension, important areas

to emphasize include improving the diet overall to be more healthy and increasing vigorous physical activity. When addressing high cholesterol, important areas to emphasize include decreasing dietary fat intake and continuing to avoid consumption of fast food. When addressing obesity, important areas to emphasize include improving the diet overall to be more healthy, eating breakfast more frequently, increasing vigorous physical activity, and decreasing dietary fat intake and consumption of fast food. Enhanced interventions dealing with multiple health behaviors may be important in reducing the number of people with CVD risk factors progressing toward CVD. ♦

Disclosure Statement

The author(s) have no conflicts of interest to disclose.

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Health

Plain living and high thinking will secure health for most of us.

— The Use of Life, *Sir John Lubbock, Baron Avebury, 1834-1913,*
English banker, biologist, archaeologist, and Liberal politician