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`Dietary Patterns in Chinese Americans are Associated with Cardiovascular Disease Risk Factors, The Chinese American Cardiovascular Health Assessment (CHA CHA)

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Abstract

Background: Little is known about the dietary patterns of Chinese Americans. Understanding their dietary patterns can provide insights for addressing cardiovascular disease (CVD) risk among Chinese American immigrants.

Objective: To identify dietary patterns among Chinese American immigrants living in New York City (NYC) and to describe associations with demographic and CVD risk factors.

Methods: A validated Food Frequency Questionnaire assessed usual dietary intake in Chinese American immigrants living in NYC as part of the Chinese American Cardiovascular Health Assessment (CHA CHA) in 2010–2011 (n=1,973, age range: 21–89 years). Principal Components Analysis with varimax rotation retaining three factors with eigenvalues >1.5 identified dietary patterns. Multivariable linear regression models tested associations between CVD risk factors and dietary pattern scores.

Results: In multivariable analyses, each unit of increase in the Sweets factor was associated with 0.76±0.33 (mean±SD) mg/dL higher HDL cholesterol and a 6.2±2.7% increase in HOMA-IR. In contrast, each unit increase in the Fried Noodles factor was associated with a 0.27±0.11 inch greater waist circumference, −0.89±0.40 mg/dL lower HDL cholesterol, and also a 6.9±2.6% increase in HOMA-IR. Each unit increase in the Vegetables factor was associated with a −1.40±0.43 mmHg and −0.95±0.27 mm Hg decrease in systolic and diastolic blood pressure, respectively.

Conclusions: Dietary patterns are significantly associated with CVD risk factors among Chinese American immigrants in NYC. Future work will inform how dietary patterns relate to

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level of acculturation in order to guide the development of dietary interventions to reduce CVD risk.

Keywords

dietary patterns; cardiovascular disease risk; Chinese Americans; urban health; immigrant populations

Background

Asian Americans were the fastest growing race/ethnic group in the U.S. in the last ten years;[1] nationally, the Asian American population is projected to double in size to more than 43 million by 2050.[2] Despite this, Asian Americans are the most understudied racial/ethnic group in the U.S., with 0.01% of published articles from 1966 to 2000 listed in MEDLINE including Asian American or Pacific Islanders.[3] Strategies to improve diet are needed, as Asian Americans have a higher prevalence of cardiovascular risk factors at a given BMI relative to other racial/ethnic subgroups.[4]

Chinese Americans represent the largest Asian subgroup in the U.S. at over 4 million people, comprising 22.8% of all Asian Americans.[5] From 2000 to 2010, the population of Chinese Americans grew by 40% nationally.[5] A convenience sample including 205 Chinese Americans reported more than three-quarters (76.5%) met fewer than four of the American Heart Association's criteria for healthful diet based on intake of fruit and vegetables, fish, whole grains, sugar sweetened beverages, and sodium.[6] However, little is known about the dietary patterns of Chinese Americans.

To develop effective dietary interventions for any group, it is important to first understand the dietary patterns in that population. Factor analysis allows for the examination of which dietary factors account for the variation in food intake reported [7–9], and the findings of such an analysis can guide the development of food-based interventions. Dietary pattern analyses have demonstrated the health-protective effects of prudent dietary patterns: a meta-analysis reported a pooled relative risk (RR) for cardiovascular disease (CVD), coronary heart disease (CHD), and stroke of 0.69 (95% CI 0.60, 0.78), 0.83 (95% CI 0.75, 0.92), and 0.86 (95% CI 0.74, 1.01) comparing the highest to lowest category of prudent dietary pattern in cohort studies[10]. In the United States, higher disease risk has been found among individuals who consume a Western dietary pattern characterized by higher intakes of saturated fats, processed foods, and refined grains compared to a prudent pattern rich in vegetables, fruits, and whole grains [11–16]. In China, a traditional diet (high intake of rice, pork, and vegetables) was inversely associated with obesity, whereas a modern dietary pattern (high intake of fruit, fast food, and processed meat) was positively associated with obesity.[17]

Dietary patterns have been evaluated in relation to demographic and cardiovascular risk factors among ethnic Chinese in Asia [18–28] and in a limited capacity in North America.[29, 30] Chinese immigrants have a higher prevalence of diabetes and hypertension, higher serum cholesterol, poorer dietary patterns, and higher prevalence of obesity and smoking when compared with mainland Chinese[31]. Modifiable cardiovascular risk factors

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identified by the American Heart Association[32], such as hypertension (23.2%, 95% CI 21.9–24.7%) and hypercholesteremic (30.2%, 95% CI 28.6–31.9%),are widespread among Chinese American immigrants living in New York City.[33] However, little is known about how demographic characteristics, dietary patterns, and CVD risk are inter-related within Chinese American immigrants. Food consumption varies by cultural orientation and is also influenced by food access and socioeconomic status. Thus, understanding dietary patterns interrelationships can provide insights for addressing CVD risk among Chinese individuals as they emigrate to the United States [8, 34]. Further, the prevalence of pre-diabetes in the Chinese American immigrant community is high, indicating a need for diet-based interventions in this population [35, 36]. The purpose of this study was to examine how dietary patterns among Chinese American immigrants living in New York City (NYC) relate to cardiovascular risk factors. Understanding dietary patterns and their relationship to CVD risk factors can help inform the development of food-based interventions and health messages for Chinese American immigrants.

Methods

The Chinese American Cardiovascular Health Assessment (CHA CHA) 2010–11 was a cross-sectional survey designed to assess how acculturation, lifestyle, and cardiovascular risk factors are related among Chinese immigrant adults.[37, 38, 35] The CHA CHA participants were first-generation immigrants from mainland China who were recruited from senior citizen centers and community organizations as a community cardiovascular screening initiative. The Chinese Community Partnership for Health (CCPH) disseminated information about the screening program through the Chinese language media as well as senior centers, and businesses located in the Chinese communities in lower Manhattan and Sunset Park Brooklyn. The study recruited a purposive sample of first-generation Chinese immigrants to include a fairly equal distribution of men and women as well as variability in CVD risk status and age. A snowball sampling approach was used to increase enrollment of men, who were initially underrepresented, by providing a free tea thermos to participants, who referred males who enrolled[39]. The study protocol was approved by the Institutional Review Boards at Albert Einstein College of Medicine and the New York-Downtown Hospital. All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. Informed consent was obtained from all participants included in the study. Data were obtained via an interview conducted in Chinese (either Mandarin or Cantonese based on the participant's preference) by trained interviewers.

Questionnaires

Demographic and health history were obtained using a questionnaire. Specifically, participants were asked their current age, sex, how many years in total they've lived in the United States, employment status (employed, unemployed, retired, homemaker), highest level of education (no school, elementary, high school, college and above), smoking status (current, never, former); physical activity was assessed by the World Health Organization's Global Physical Activity Questionnaire[40], and energy intake derived from the food

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frequency questionnaire (FFQ). Medical history questions included self-reported history of hypertension, hyperlipidemia, angina, myocardial infarction, congestive heart failure, and diabetes.

Cardiovascular Risk Factor Measurements

A research nurse obtained physical measurements and fasting blood specimens. Blood pressure (mmHg) was measured three times in the sitting position after at least 5 minutes of rest, using the Omron HEM 780 automated monitor. The mean of the three values was used. Weight (lb) and height (inches) were measured with participants in light clothing and no shoes. Body mass index was computed as weight (lb) / $[\text{height (in)}]^2 \times 703$. The waist circumference (inches) was measured at a level midway between the lowest lateral border of the rib margin and the uppermost lateral iliac crest with the participant in a standing position and breathing out gently. Two measurements were taken and the mean of the two was used for the analyses. Fasting blood samples were obtained to measure lipid panel (total cholesterol, LDL-cholesterol, HDL-cholesterol, triglycerides), glucose, and insulin after a 12-hour fast. The collected blood samples were analyzed in the Analytical Core Laboratory of the Institute for Clinical and Translational Research at the Albert Einstein College of Medicine. Homeostatic model assessment-Insulin Resistance (HOMA-IR) was calculated as fasting insulin (microU/L) × fasting glucose (nmol/L)/22.5[41].

Dietary Assessment

The 96-item Chinese American FFQ was developed by Tseng and Hernandez [42], and demonstrated moderate Spearman correlations (between 0.25 and 0.50 for energy, saturated fat, cholesterol, carbohydrates, protein, folic acid, and iron) when compared with multiple 24-hour recalls. All FFQs were administered via interview using plastic containers ranging in size from 1 to 4 cups and measuring spoons to clarify portion sizes. For each food item, participants were asked the frequency of consumption and the portion typically consumed within the past year. Frequency responses included range options from “never” to “every day”.

Statistical Analysis

Food items from the FFQ were categorized based on nutritional properties. (See Table 1 for categorizations). Foods that were consumed often, such as rice, or foods with nutritional properties that differed significantly from existing food categories, such as pizza, were entered as individual food items. These categorizations resulted in 29 food categories that were entered into the factor analysis. Principal Components Analysis with varimax rotation was used to identify dietary patterns. Rotated factors were retained based on eigenvalues>1.5 and review of scree plots. Factor scores were then calculated for each participant.Demographic factors were examined by quartile of each of the dietary patterns identified to better understand how eating patterns may vary in this population. Differences between quartiles were tested using chi-squared for categorical variables and Kruskal Wallis test for continuous variables. Multivariable linear regression models tested associations between cardiovascular risk factors and scores of each dietary pattern, accounting for participant characteristics and medical history. We compared a series of four nested models: ranging from minimally adjusted models accounting for age and energy intake to those

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accounting for with models accounting for all measured confounders (age, energy intake, sex, level of education, household income, physical activity, smoking status, years lived in the US, medical history (hypertension, hypercholesterolemia, coronary heart disease, myocardial infarction, and diabetes) and report the most parsimonious models using R^2 and AIC as criteria. Level of income was also considered as a covariate, but it was not significantly associated with any of the factors and did not substantively change multivariable associations (data not shown). Homeostatic model assessment-Insulin Resistance (HOMA-IR) was ln-transformed to approximate a normal distribution. For models where HOMA-IR was the outcome variable, the dietary factors were also ln-transformed, and the β coefficient was back-transformed to estimate the percent difference in HOMA-IR per percent difference in each of the dietary factors. As a sensitivity analysis, we repeated the analyses accounting for energy intake when constructing factors. All analyses were conducted using SAS (Version 9.4, Cary, NC).

Results

A total of 2,071 participants completed the FFQ, and 1,973 were included in the analysis after exclusion for extreme energy intakes (i.e., outside of 500 to 3500 calories for women and 600 to 4000 calories for men), as described by Willett.[43] Factor loadings for each of the three factors are displayed in Table 1. Each factor was named for the food categories having the greatest correlations; i.e., the Sweets, Dairy, and Coffee (Sweets) factor included carbohydrate-rich snacks, as well as several beverages in addition to coffee, such as milk and alcohol. The Fried Noodles, Dumplings, Rice, and Meat (Fried Noodles) factor included fried noodles, rice, wheat dough, french fries, as well as other categories such as soda. The Vegetables, Fruit, Tofu, and Nuts (Vegetables) factor was associated with more nutrient dense foods including vegetables, fruits, and protein-rich sources, such as tofu, nuts, and eggs. Each factor described 2% of the variation (Table 1).

Mean age of participants was 53, and over half were female (53.9%) and employed (55.8%) (Table 2). One-third attended some college, 10% were current smokers, mean physical activity was 3,332 metabolic equivalents per week (METs/wk), and mean energy intake was 1,736 calories per day (Table 2). A history of hypertension (25.7%) and hyperlipidemia (27.9%) was about three times more common than heart problems (10.9%) or diabetes (8.2%). Average levels of cardiovascular risk factors were 23.9 kg/m2 for BMI, 32.7 inches for waist circumference, 55.4 mg/dL for HDL, 107.0 mg/dL for LDL, 121.6 mm/Hg for SBP, 73.6 mm/Hg for DBP, 102.6 mg/dL for fasting glucose, and 3.4% for HOMA-IR (Table 2).

Factors were significantly ($P<0.05$) associated with age, years lived in the United States, sex, employment status, education, smoking status, physical activity, and energy intake (Table 3). In univariable analyses, the Sweets factor was positively associated with years in the United States,level of education, smoking, and energy intake. The Fried Noodles factor was positively associated with employment, smoking, physical activity and energy intake, but inversely associated with age, years in the US, female sex, and medical history of hypertension, hyperlipidemia, heart disease, and diabetes. The Vegetables factor was positively associated with age, female sex, retirement higher level of education, never smoking, energy intake, and medical history except for hyperlipidemia.

In multivariable analyses, each unit of increase in the Sweets factor was associated with 0.76±0.33 mg/dL higher HDL cholesterol and a 6.2±2.7 % increase in HOMA-IR (Table 4). In contrast, each unit increase in the Fried noodles factor was associated with a 0.27±0.11 inch greater waist circumference,−0.89±0.40 mg/dL lower HDL cholesterol, and also a 6.9±2.6 % increase in HOMA-IR. Each unit increase in the Vegetables factor was associated with a −1.40±0.43 and −0.95±0.27 mm Hg decrease in systolic and diastolic blood pressure, respectively.

Discussion

Our exploratory factor analysis yielded three dietary patterns: 1) Sweets, Dairy, and Coffee (Sweets); 2) Fried noodles, Dumplings, Rice, and Meat (Fried Noodles); and 3) Vegetables, Fruit, Tofu, and Nuts (Vegetables). Differences in dietary patterns were associated with age, years lived in the United States, sex, employment status, education, smoking status, physical activity, energy intake, and medical history. Dietary patterns were significantly associated with CVD risk factors among Chinese American immigrants in NYC. Whereas the Sweets and Fried Noodles patterns were associated with some adverse cardiovascular patterns, the Vegetables pattern was consistently associated with an improved cardiovascular risk profile.

To our knowledge, this is the largest study to examine the relationship between Chinese American dietary patterns and cardiovascular disease risk using a food frequency questionnaire adapted for Chinese Americans. The Multi-Ethnic Study of Atherosclerosis (MESA) (n=6,814) included 663 Chinese Americans and reported the Fats and Processed Meat dietary pattern was positively (Hazard Ratio 1.82; 95% CI: 0.99, 3.35 comparing quintile 5 versus quintile 1), while the Whole Grains and Fruit dietary pattern was inversely associated with cardiovascular disease risk (Hazard Ratio 0.54; 0.33, 0.91 comparing quintile 5 versus quintile 1) of CVD after adjustment for demographic and lifestyle confounders [44]. Among South Asian immigrants in the United States (n=982) reported a fruit, vegetable, nut, and legume pattern was associated with lower hypertension and HOMA-IR.[45] The other two patterns (animal protein and fried sweets, snacks, and high fat dairy) were associated with adverse cardiometabolic risk factors. Taken together, these findings suggest emphasizing a dietary pattern rich in vegetables and vegetable protein sources may contribute to lower cardiometabolic risk.

Studies focused on specific ethnic groups frequently yield dietary patterns characterized by foods traditionally consumed by that group.[46–49] Associations between these traditional patterns and disease risk have been debated, and evidence suggests that maintenance of traditional dietary patterns are associated with increased chronic disease risk.[50] Variables such as language preference and years in the U.S. are frequently used as proxies for acculturation [51, 52]. As dietary interventions are developed to target these populations, one aspect of dietary education may be to provide relevant strategies and opportunities for maintaining healthy aspects of traditional diets which can be incorporated in the changing context of their immigrant lives. [53, 50, 54]

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Our findings should be interpreted in the context of the following limitations. There are inherent challenges and biases associated with deciding what foods to include in the dietary pattern analyses. Over 90% of the variance was left unexplained by the three factors: we repeated the analyses accounting for energy intake when constructing factors, but this did not substantively change the proportion of the variance explained by the factors or the associations with cardiovascular risk factors. There are also inherent biases with using FFQs to collect dietary data, as they do not capture intraindividual variation in food intake and may not capture all commonly consumed foods in the population,[55, 9] Finally, the cross-sectional design precludes us from establishing temporality for observed associations. Further research in another Chinese American sample using confirmatory factor analysis could help us to better understand whether the factors identified are robust.

In conclusion, we identified three dietary patterns among Chinese American immigrants in NYC. As dietary interventions are developed to target these populations, one important aspect of dietary education may be to provide strategies and opportunities for maintaining healthy aspects of traditional diets. [53, 50, 54]

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Table 1.

Food category factor loadings derived by principal components analysis in CHA CHA (n=1,973)

Food Category Description	Sweets, dairy, coffee	Fried noodles, dumplings, rice, and meat	Vegetables, fruit, tofu, and nuts
100% orange or grapefruit juice, other juices such as apple or grape			0.15
Apples or pears, bananas, oranges or tangerines, grapefruit, grapes, fresh peaches or plums, papayas or mango, cantaloupe, watermelon			0.26
Beef-roasted, broiled, or barbecued, including steak, roast beef, and hamburger; in stew or in soup; stir fried, meatballs		0.19	
Beer, wine, liquor			
Bread (including in sandwiches and hamburgers), bagel or English muffin, pancakes or waffles, cold breakfast cereal, cooked cereals such as oatmeal	0.11	−0.14	0.19
Butter, margarine, salad dressing	0.12		
Chinese sweet pastry such as bean paste cake or buns; deep fried wheat dough stick; Chinese sweet soups		0.14	
Coffee	0.32		−0.11
Donuts, cake, cookies, pastry, pie, chocolate candy, other candy such as sesame candy, ice cream, syrup, jelly, jams	0.32		
Eggs, boiled, fried, scrambled or stir-fried			0.18
Fish-including steamed, broiled or baked, other seafood such as shrimp or crab		0.15	
French fries or other fried potatoes		0.21	
Fried chicken-including nuggets and in sandwiches		0.19	
Fried fish including fish sticks or sandwiches		0.18	
Fried noodles, fried rice, fried wheat dough		0.23	
Jook, soup or broth of any kind including noodle, vegetable or meat, Chinese sweet soup such as sweet green bean soup, or sweet taro soup	−0.12	0.10	0.14
Liver such as chicken liver, other organ meats		0.12	
Macaroni, spaghetti, lasagna, and other Italian style pasta w/ tomato sauce			
Milk, cheese, yogurt	0.31		
Other fowl, such as duck or squab		0.19	
Peanuts or other nuts or seeds, peanut butter on bread or vegetables		−0.11	0.25
Pork-roasted, broiled or barbecued such as pork chops, roast pork or barbecued pork, pork-stir-fried, pork-steamed or in stew; spareribs		0.15	
Rice	−0.13	0.11	
Salty snacks such as potatoes chips, rice	0.14		
crackers or popcorn			

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Food Category Description	Sweets, dairy, coffee	Fried noodles, dumplings, rice, and meat	Vegetables, fruit, tofu, and nuts
Sandwiches with ham, bacon, or sausage			
Soda		0.19	
Steamed dumpling, steamed buns		0.10	0.11
Tofu, soy milk			0.25
Vegetables: Broccoli or Chinese broccoli, cauliflower, cabbage or Napa cabbage, dark green, leafy vegetables such as bok choy, spinach or mustard greens, carrots, raw or cooked, , celery, bell peppers, asparagus, tomatoes, bean sprouts, turnips or radishes, preserved vegetables such preserved mustard greens or preserved radishes, tossed salad, scallions or onions			0.32
Variance explained, %	2.3	2.3	2.1

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Table 2.

Demographic Characteristics and Cardiovascular Risk Factors (n=1973)

Age, mean years ± SD	53 ± 14
Years in the United States, mean ± SD	13 ± 10
Female, (%)	53.9
Employment status, %	
Employed	55.8
Unemployed	11.1
Retired	22.2
Homemaker	11.1
Education, %	
No school	1.3
Elementary (1–6 yr)	14.1
High school (7–12 yr)	51.1
Any college (>12 yr)	33.5
Smoking, %	
Never	76.0
Former	14.1
Current	10.0
Physical Activity, METs/wk[b] , mean ± SD	3332 ± 4801
Energy Intake, kcal/day[b], mean ± SD	1736 ± 617
Medical history, %	
Hypertension	25.7
Hyperlipidemia	27.9
Heart problem[c]	10.9
Diabetes	8.2
Cardiovascular Risk Factors, mean ± SD	
BMI, kg/m2	23.9±3.2
Waist circumference, inches	32.7±3.9
HDL Cholesterol, mg/dL	55.4±14.0
LDL Cholesterol, mg/dL	107.0±33.2
SBP, mm/Hg	121.6±18.0
DBP, mm/Hg	73.6±9.9
Fasting glucose, mg/dL	102.6±20.8
HOMA-IR, %c	3.4±2.1

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Table 3.

Univariable Associations Between Demographic Characteristics by Quartile of each Factor (n=1,973)

	Sweets, Dairy, coffee					Fried noodles, dumplings, rice, and meat					Vegetables, fruit, tofu, and nuts				P-value *a*
	Q1 *b*	**Q2**	**Q3**	**Q4**	**P**	**Q1**	**Q2**	**Q3**	**Q4**	**P**	**Q1**	**Q2**	**Q3**	**Q4**	
Age, mean (SD)	52 ± 12	52 ± 13	53 ± 14	52 ± 15	0.67	58 ± 12	55 ± 13	52 ± 13	46 ± 13	**<0.0 001**	49 ± 13	51 ± 13	55 ± 13	56 ± 14	**<0.00 01**
Years in the United States	11 ± 8	13 ± 10	14 ± 10	16 ± 12	**<0.0 001**	14 ± 12	14 ± 11	13 ± 10	12 ± 9	**0.00 09**	13 ± 10	13 ± 10	13 ± 11	13 ± 10	0.51
Female, (%)	52. 1	58. 8	50. 8	54. 0	0.06	63. 9	57. 0	51. 0	43. 8	**<0.0 01**	44. 6	53. 4	57. 3	60. 5	**<0.00 1**
Employment Status					0.4					**<0.0 01**					**<0.00 1**
Employed	56. 0	56. 0	54. 9	56. 4		44. 6	51. 3	56. 9	70. 2		63. 9	57. 6	52. 2	49. 3	
Unemployed	12. 6	12. 2	9.9	9.5		10. 6	12. 0	11. 5	10. 1		13. 2	11. 4	8.9	10. 8	
Retired	19. 1	20. 9	25. 1	23. 5		34. 1	25. 6	19. 8	9.1		13. 4	19. 5	27. 1	28. 6	
Homemaker	12. 3	11. 2	10. 1	10. 6		10. 8	11. 2	11. 7	10. 6		9.5	11. 6	11. 7	11. 4	
Education					**<0.0 01**					0.61					**<0.00 1**
No school	2.2	2.2	0.4	0.4		1.2	1.6	0.8	1.6		1.8	0.8	1.4	1.2	
Elementary (1–6 yr)	18. 9	14. 2	11. 9	11. 4		12. 6	14. 2	14. 2	15. 4		14. 8	16. 6	13. 0	12. 0	
High school (7–12 yr)	55. 0	52. 1	51. 2	46. 0		49. 5	52. 1	50. 2	52. 5		58. 2	50. 7	51. 2	44. 2	
Any college (>12 yr)	23. 9	31. 4	36. 4	42. 2		36. 7	32. 1	34. 8	30. 4		25. 2	31. 9	34. 4	42. 6	
Smoking					**0.00 2**					**<0.0 01**					**<0.00 1**
Never	73. 8	81. 9	75. 3	73. 0		84. 4	81. 1	71. 3	67. 1		68. 6	72. 4	78. 5	84. 6	

	Sweets, Dairy, coffee					Fried noodles, dumplings, rice, and meat					Vegetables, fruit, tofu, and nuts				P-value[a]
Former	16.9	10.2	15.6	13.6		11.6	13.0	17.5	14.2		14.8	15.7	14.0	11.8	
Current	9.4	7.9	9.1	13.4		4.1	5.9	11.2	18.7		16.6	12.0	7.5	3.7	
Physical Activity, METs/wk[b]	3666 ± 5693	3189 ± 4857	3270 ± 4394	3213 ± 4136	0.41	2810 ± 3792	3086 ± 4309	3183 ± 5053	4264 ± 5743	**<0.0001**	3766 ± 6013	3199 ± 4315	3225 ± 4406	3153 ± 4284	0.19
Energy Intake, kcal/day[b]	1661 ± 589	1625 ± 604	1735 ± 583	1923 ± 650	**<0.0001**	1466 ± 535	1537 ± 516	1760 ± 558	2182 ± 593	**<0.0001**	1427 ± 540	1585 ± 540	1766 ± 548	2168 ± 581	**<0.0001**
Medical history, %															
Hypertension	24.30	28.20	26.10	23.90	0.4	34.1	28.4	24.5	15.6	**<0.0001**	20.10	24.80	29.20	28.60	**0.003**
Hyperlipidemia	25.40	31.60	29.60	25.00	0.05	32.70	32.10	28.30	18.50	**<0.0001**	27.00	26.20	30.20	28.20	0.53
Heart problem[c]	10.60	11.20	11.90	9.90	0.77	14.20	13.60	10.10	5.70	**<0.0001**	8.70	9.10	11.10	14.6	**0.01**
Diabetes	7.90	8.10	9.50	7.30	0.63	10.30	10.30	7.70	4.50	**0.002**	5.40	11.0	8.50	8.1	**0.01**

[a] Differences between quartiles were tested using chi-squared for categorical variables and Kruskal Wallis test for continuous variables.

[b] Q=quartile; METs/wk=metabolic equivalents per week;kcal/day=kilocalories per day

[c] Includes angina, myocardial infarction, congestive heart failure

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Table 4.

Multivariable associations[a] between CVD[b] risk factors and dietary pattern scores (n=1,973)

	Sweets, Dairy, coffee	Fried noodles, dumplings, rice, and meat	Vegetables, fruit, tofu, and nuts
BMI, kg/m^2	−0.01±0.08	0.05±0.09	−0.04±0.09
Waist circumference, inches	−0.06±0.11	**0.27±0.11**	−0.06±0.11
HDL Cholesterol, mg/dL	**0.76±0.33**	**−0.89±0.40**	−0.13±0.40
LDL Cholesterol, mg/dL	0.54±0.80	−0.57±0.98	−1.4±0.97
SBP, mm/Hg	−0.68±0.36	−0.06±0.44	**−1.40±0.43**
DBP, mm/Hg	−0.07±0.23	−0.08±0.27	**−0.95±0.27**
Fasting glucose, mg/dL	−0.78± 0.45	−0.32± 0.55	−0.17±0.54
HOMA-IR, %[c]	**6.2± 2.7**	**6.9± 2.6**	0.74±3.0

[a]Models adjusted for age, energy intake, sex, level of education, physical activity, smoking status, years lived in the US+ medical history (hypertension, hypercholesterolemia, coronary heart disease, myocardial infarction, diabetes). Bold denotes statistical significance (P<0.05).

[b]CVD, Cardiovascular Disease; BMI, Body Mass Index; HDL, High-density lipoprotein; LDL, Low-density lipoprotein; SBP, Systolic blood pressure; DBP, Diastolic blood pressure; HOMA-IR, Homeostatic model assessment-Insulin Resistance

[c]HOMA-IR and dietary pattern scores were ln-transformed, and after back-transformation β equals percent difference in HOMA-IR for each percent difference in dietary pattern score