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Improved dietary variety and adequacy but lower dietary moderation with acculturation in Chinese women in the United States

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Abstract

Acculturation is associated with increased chronic disease risk among Asian Americans, but its association with different aspects of diet quality remains unclear. Associations of acculturation with diet quality were examined in a convenience sample of 243 Chinese participants in a study of diet and mammographic density in the Philadelphia region between January, 2002 – May, 2003. An acculturation index was created based on self-reported English proficiency and within-and cross-ethnicity social interactions. Diet Quality Index-International (DQI-I) scores were based on responses to an 88-item food frequency questionnaire. Odds ratios (ORs) for falling into a higher vs. lower quartile for DQI-I and its components (variety, adequacy, moderation, balance) were estimated with logistic regression analysis for polytomous outcomes. In the sample (mean (standard deviation (SD)) age 53.2 (10.5) years, body mass index 24.1 (3.5) kg/m^2), acculturation was significantly associated with improved dietary variety (OR=2.4 (95% confidence interval (CI) 1.5–3.8)) and adequacy (OR=1.6, 95% CI 1.0–2.6), and lower dietary moderation (OR=0.6 (95% CI 0.4–0.9), but these associations were evident only among women with less than a high school education. Acculturation and education were not associated with overall diet quality or balance. While an association of less dietary moderation with acculturation suggests the likely importance of acculturation-related dietary change to chronic disease risk, these findings highlight the need for flexible dietary interventions among immigrant populations to discourage the adoption of some new dietary habits while encouraging the retention of other, traditional ones.

Key words/phrases

acculturation; diet quality; education; Asian American

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Introduction

Rates of metabolic disorders, cardiovascular diseases, and certain cancers are lower in China than in the United States (US) but increase among Chinese immigrants to the US (1–9). Acculturation into mainstream US culture has been associated with a decrease in diet quality that may contribute to increased risk for chronic diseases among Asian Americans (5,10–12). However, some studies note significant increases in consumption not only of fats and sweets, but also of grains, dairy products, fruits, and vegetables (13–15). Thus, the effect of acculturation on dietary intake is likely more complex than suggested in previous work.

While most studies examined single nutrients and foods or food groups, few examined acculturation in relation to indicators of diet quality. Indices such as the Diet Quality Index (DQI) (16) and Healthy Eating Index (17) provide quantitative measures of overall intake relative to dietary guidelines and have been associated with chronic disease risk and mortality (18,19). The DQI-International (DQI-I) (20) is a composite measure of four aspects of diet quality – variety, adequacy, moderation, and balance – allowing for identification of aspects of diet that warrant improvement.

The present study examined the association of acculturation with diet quality and its components in a sample of US Chinese immigrant women. The analysis is the first to investigate how acculturation is related to different aspects of diet quality among immigrants undergoing the transition from low to high chronic disease risk. Because acculturation is correlated with level of education (21), stratified analyses were also conducted to quantify associations for acculturation independent of level of education.

Methods

Study sample

Participants were US Chinese women who gave their written, informed consent to participate in a cross-sectional study on diet and breast density (21). Between January, 2002, and May, 2003, 250 women were recruited from community organizations and contacts, mammography screening programs, and newspaper advertisements in the Philadelphia region. Women were eligible if they were of Chinese heritage, were ≥40 years old, and had received a mammogram within the previous three months. Exclusion criteria included: history of breast augmentation or reduction, prophylactic mastectomy, or any cancer except non-melanoma skin cancer; breastfeeding currently or within last nine months; and current pregnancy. Participants received $20 as reimbursement for their time. The study was approved by the Fox Chase Cancer Center Institutional Review Board.

Data collection

Health history and food frequency questionnaires (FFQ) were interviewer- (n=184) or self- (n=66) administered in English or Chinese. Level of acculturation was quantified using a scale that assessed two dimensions of acculturation – adult English proficiency and level of interaction with members of mainstream society (structural assimilation) (22). To assess adult English proficiency, participants gave one of five possible responses ranging from Chinese only to English only (coded 1–5) to three separate questions of what language they preferred to speak, read, and write (23). Structural assimilation included three questions on primary relationships (neighbors, close friends, and co-workers), each assessed on a three-level scale (coded 1–3) ranging from mostly/all to few/none Chinese. An acculturation score was calculated as the sum of the scores for the six questions, with values ranging from six (least acculturated) to 24 (most acculturated). Values were imputed for each of the two acculturation dimensions separately, for two women who responded to two of the three questions on English

proficiency and for 72 women who responded to two of the three questions on structural assimilation, by using the mean of the two non-missing responses. Of the 72 women for whom we imputed a structural assimilation score, 56 were missing the response for co-workers' ethnicity because they were unemployed at the time. Odds ratio estimates were similar when the sample was limited to 172 women with complete data on all six questions, and when we quantified level of acculturation based only on English proficiency among the 241 women with complete responses for those three questions.

Dietary intake was assessed using a FFQ designed for the target population (24). Women reported their frequency of intake over the last year of 88 foods and beverages, including Chinese as well as American items, and selected a usual portion size from four choices. A nutrient database was compiled by Health Technomics, Inc. (Annandale, VA) (25), derived from the US Department of Agriculture's (USDA) database used in the 1994–96 Continuing Survey of Food Intakes by Individuals (26) and Release 12 of the USDA Nutrient Database for Standard Reference (27), both updated using USDA provisional carotenoid tables (28). Nutrient intake was estimated as the product of each food's consumption frequency and amount (in specified units), grams per unit, and nutrient content per 100 g, summed over all food items. All questionnaires were administered by a single, trained interviewer, who also reviewed them for completeness and accuracy upon their completion or receipt.

Assessment of diet quality

The DQI-I (29) captures four facets of diet quality related to under- as well as overnutrition: (1) dietary variety within protein sources (meat, poultry, fish, dairy, beans, eggs) and across food groups (meat/poultry/fish/eggs, dairy/beans, grains, fruits, vegetables); (2) adequacy of intake of eight key food groups and nutrients (vegetables, fruits, grains, fiber, protein, iron, calcium, and vitamin C) relative to recommended intakes; (3) moderation of intake of five factors (total fat, saturated fat, cholesterol, sodium, and empty calorie foods) related to chronic disease development; and (4) overall balance with respect to macronutrients and fatty acid composition (29). Servings per day reported on the FFQ were adjusted to match the US Food Guide Pyramid serving size definitions (30). Details on components of the DQI-I and scoring criteria are given in the Appendix.

Statistical methods

Analyses included 243 women with information on acculturation, education, and dietary intake. Overall DQI-I score and its four components were examined as outcome variables using SAS (version 8.01, 1999, SAS Institute, Cary, NC). Acculturation score was dichotomized at the approximate median (≤ 9 or >9) to represent lower and higher levels of acculturation. Level of education was categorized into three groups (<high school (HS), HS completion, and college degree or higher), which were subsequently collapsed (<HS, ≥HS) to insure adequate numbers for stratified analyses. In bivariate analyses demographic characteristics were compared across acculturation categories using Cochran-Mantel-Haenszel test statistics for categorical data (expressed as percent in each category), and t-tests for continuous variables (expressed as mean (standard deviation (SD)). Polytomous logistic regression for ordinal, categorical outcome variables (31) was then used to allow for estimation of age-adjusted odds ratios (OR), with corresponding 95% confidence intervals (CI), for falling into a higher DQI-I (or component) quartile. P-values for interaction were estimated by including an acculturation × education term in a model that also included both acculturation and education as dichotomous variables.

Results and Discussion

Mean (SD) age of the sample was 53.2 (10.5) years (Table 1). Most women (80%) were born in China or Hong Kong, with the rest from Southeast Asia or Taiwan. Mean length of US

residence was 11.7 (8.5) years (range <1–45 years), and mean age at migration was 41.4 (13.1) years (range 11–69 years). Level of acculturation was generally low (mean (SD) 9.5 (2.8), range 6–20). Educational attainment showed greater variability, with 40% having less than a high school education but 23% having at least a college degree.

In bivariate analyses, more acculturated women were more likely to have been born in Southeast Asia or Taiwan, had longer US residence, migrated at a younger age, and were better educated compared with less acculturated women (Table 1). With respect to diet quality, more acculturated women had higher mean scores for dietary variety and adequacy and a lower mean score for dietary moderation. Balance and overall DQI-I score were not significantly different by level of acculturation. In age-adjusted logistic regression analyses (Table 2), more acculturated women were over twice as likely to have a higher dietary variety score relative to less acculturated women (OR=2.4, 95% CI 1.5–3.8) (Table 2). Level of acculturation also remained significantly associated with dietary adequacy, inversely associated with moderation, and not associated with overall balance or overall DQI-I score.

Other studies of Chinese Americans examined various indicators of acculturation in relation to other dietary measures. Among Chinese women in Seattle and Vancouver (14), higher western dietary acculturation scores corresponded with increased high-fat dietary behavior, but also increased fruit and vegetable intake. A small sample of foreign-born Asian American students reported a significant increase in fats/sweets and a decrease in vegetable consumption after immigration, but also increased dairy and fruit intake and lower meat intake (13). In a study of Chinese in Pennsylvania (15), overall consumption and dietary variety increased after immigration. Length of US residence and English proficiency were associated with greater consumption of fats/sweets and meat/meat alternatives, as well as vegetables, grains, and fruits.

In their comparison of DQI-I scores between China and the US, Kim et al. (29) suggested that higher variety scores in the US were due to greater economic prosperity and food availability. In the present sample of US Chinese women, higher variety scores among the more acculturated women may similarly be due to a generally higher level of food intake in those women, possibly because greater acculturation brings new food preferences as well as greater access, opportunity, and/or resources to obtain a wider variety and greater volume of foods. These may translate into greater dietary variety, improved dietary adequacy, but less moderation.

Effects of acculturation and education are difficult to disentangle because the two factors are often correlated. Nevertheless, stratified analyses in this sample showed an effect of acculturation that persisted, at least among women with less than a high school education (Table 2). Higher level of acculturation was associated with improved dietary adequacy (OR=3.1, 95% CI 1.2–7.7) and less moderation (OR=0.4, 95% CI 0.1–0.9) only among less educated women (p's for interaction 0.01 and 0.03, respectively). A similar but non-significant pattern of effect modification was also evident for dietary variety, with higher level of acculturation associated with greater dietary variety only among less educated women (OR=3.3, 95% CI 1.3–8.3). Associations were stronger still among women with <8 years of education (results not shown), but confidence intervals were wider because of the smaller sample size (n=53). That level of acculturation was not associated with variety, adequacy, or moderation scores among women with at least a high school education may suggest a maximum consumption amount such that more educated/more acculturated women are not eating more than (and diet quality component scores are not different from) more educated/less acculturated women.

Study limitations include the potential for general FFQ measurement error; the use of a unidirectional acculturation measure that did not capture a bicultural state (32–34); and eligibility and exclusion criteria that may have biased results or may limit generalizability. The sample's generally low level of acculturation may also limit generalizability, although the fact

that associations were apparent even with this limited range of acculturation has its own implications, indicating that changes in diet quality can occur even early in the acculturation process.

Conclusions

The present study is among the first to examine acculturation in relation to specific components of diet quality in an immigrant group (35–38). The use of the DQI-I provides an effective means of elucidating the particular aspects of diet quality that change with acculturation and sheds light on the complexity of migration-related dietary changes in an immigrant population. Associations were not observed for overall DQI-I score but for specific components of diet quality – namely, improvements in dietary variety and adequacy of intake, and a reduction in moderation – indicating that acculturation has both positive and negative effects on diet quality. The finding with respect to less moderation is consistent with the increase in incidence of many chronic conditions (1–9) and highlights the importance of acculturation-related dietary change to health risks in this immigrant population. These findings also echo a recommendation by Ayala et al. (39) in favor of greater specificity in dietary interventions by acculturation status; interventions among immigrant populations should be sufficiently flexible to discourage the adoption of some new dietary habits while encouraging the retention of other, traditional ones.

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Table 1

Descriptive characteristics of convenience sample of Chinese women in the Philadelphia region (n=243) by level of acculturation[a].

	Acculturation score			
	All women (n=243)	**≤9 (n=140)**	**>9 (n=103)**	**p-value[b]**
Age (years)	53.2 (10.5)	53.9 (10.6)	52.3 (10.2)	0.22
Birthplace (%)				0.002
China/Hong Kong	80	88	70	
Southeast Asia	12	8	17	
Taiwan	8	4	14	
Length of United States residence (years)[c]	11.7 (8.5)	9.6 (7.4)	14.5 (9.0)	<0.0001
Age at migration (years)	41.4 (13.1)	44.0 (12.7)	37.8 (12.8)	0.0003
Level of education (%)				<0.0001
<high school	40	56	19	
high school - <college	37	34	41	
≥college	23	10	40	
Body mass index (kg/m^2)	24.1 (3.5)	24.3 (3.4)	23.9 (3.6)	0.37
Diet Quality Index (DQI) -International score[d]				
Overall	65.8 (8.6)	65.5 (9.0)	66.3 (8.2)	0.47
Components				
Variety	15.3 (4.2)	14.5 (4.3)	16.4 (3.7)	0.0003
Adequacy	32.9 (5.4)	32.2 (5.2)	33.8 (4.5)	0.03
Moderation	15.0 (6.4)	16.1 (6.7)	13.5 (5.6)	0.002
Overall balance	2.6 (2.2)	2.6 (2.3)	2.6 (2.2)	0.78

[a] Level of acculturation quantified based on six questions assessing adult English proficiency and level of interaction with members of mainstream society, with possible range from 6–24 (22).

[b] P-values comparing women with acculturation scores ≤9 vs. >9, determined using Cochran-Mantel-Haenszel test statistic for categorical variables and t-test for continuous variables.

[c] Due to missing values, n=239 for length of United States residence, age at migration, and body mass index.

[d] Diet Quality Index (DQI) - International used to quantify overall and four specific components of diet quality – variety, adequacy, moderation, and balance (29). See Appendix for detailed description of scoring criteria.

Table 2

Age-adjusted odds ratios (95% confidence intervals) from polytomous logistic regression models for higher diet quality score comparing women with higher (>9) vs. lower (≤9) acculturation scores[a], in all women and stratified on level of education (<high school (HS), ≥HS).

	Level of education			
Diet Quality Index (DQI) – International score[b]	**All women (n=243)**	**<HS (n=98)**	**≥HS (n=145)**	**P for interaction[c]**
Overall	1.2 (0.8–2.0)	1.4 (0.6–3.4)	1.1 (0.6–2.1)	0.63
Components				
Variety	2.4 (1.5–3.8)	3.3 (1.3–8.3)	1.5 (0.8–2.7)	0.14
Adequacy	1.6 (1.0–2.6)	3.1 (1.2–7.7)	0.8 (0.5–1.5)	0.01
Moderation	0.6 (0.4–0.9)	0.4 (0.1–0.9)	1.1 (0.6–2.0)	0.03
Overall balance	1.0 (0.6–1.5)	0.6 (0.2–1.5)	1.3 (0.7–2.3)	0.16

[a] Level of acculturation quantified based on six questions assessing adult English proficiency and level of interaction with members of mainstream society, with possible range from 6–24 (22)

[b] Diet Quality Index (DQI) - International used to quantify overall and four specific components of diet quality – variety, adequacy, moderation, and balance (29). See Appendix for detailed description of scoring criteria.

[c] Estimated for acculturation × education interaction term in polytomous logistic regression model also including age (years), acculturation (≤9, >9), and education (<HS, ≥HS).

Appendix

Components and scoring criteria for the Diet Quality Index – International (DQI-I)[a], adapted from Kim et al. (29).

Component	Maximum score	Scoring criteria
Variety		
Overall food group variety (meat/poultry/fish/eggs; dairy/beans; grain; fruit; vegetable)	15	15: ≥1 serving/day from each food group 12: Any 1 food group missing 9: Any 2 food groups missing 6: Any 3 food groups missing 3: ≥4 food groups missing 0: None from any food groups
Within-group variety for protein source (meat, poultry, fish, dairy, beans, eggs)	5	5: Meaningful consumption (≥0.5 serving/day) from ≥3 different sources 3: 2 different sources 1: 1 source 0: None
Maximum score	**20**	
Adequacy[b]		
Vegetable group	5	5: ≥3–5 servings/day 0: 0 servings/day
Fruit group	5	5: ≥2–4 servings/day 0: 0 servings/day
Grain group	5	5: ≥6–11 servings/day 0: 0 servings/day
Fiber	5	5: ≥20–30 g/day 0: 0 g/day
Protein	5	5: ≥10% of energy 0: 0% of energy
Iron	5	5: ≥100% RDA 0: 0% RDA
Calcium	5	5: ≥100% AI 0: 0% AI
Vitamin C	5	5: ≥100% RDA 0: 0% RDA
Maximum score	**40**	
Moderation		
Total fat	6	6: ≤20% of total energy 3: >20–30% of total energy 0: >30% of total energy
Saturated fat	6	6: ≤7% of total energy 3: >7–10% of total energy 0: >10% of total energy
Cholesterol	6	6: ≤300 mg/day 3: >300–400 mg/day 0: >400 mg/day
Sodium	6	6: ≤2400 mg/day 3: >2400–3400 mg/day 0: >3400 mg/day
Empty calorie foods[c]	6	6: ≤3% of total energy 3: >3–10% of total energy 0: >10% of total energy
Maximum score	**30**	
Overall balance		
Macronutrient ratio (carbohydrate: protein: fat)	6	6: 55–65: 10–15: 15–25 4: 52–<55 or >65–68: 9–<10 or >15–16: 13–<15 or >25–27

Component	Maximum score	Scoring criteria
		2: 50–<52 or >68–70: 8–<9 or >16–17: 12–<13 or >27–30 0: Otherwise
Fatty acid ratio	4	4: P:S 1–1.5 and M:S 1–1.5 2: P:S 0.8–<1 or >1.5–1.7 and M:S 0.8–<1 or >1.5–1.7 0: Otherwise
Maximum score	**10**	

[a] DQI-I, Diet Quality Index-International; RDA, Recommended Dietary Allowance; AI, Adequate Intake; P:S, ratio of polyunsaturated to saturated fatty acid intake; M:S, ratio of monounsaturated to saturated fatty acid intake.

[b] All sub-scores coded as continuous. Recommended intake of food groups depending on three levels of energy intake (≤1900 kcal, 1900–2500 kcal, and > 2500 kcal). Nutrients evaluated by percentage attainment of dietary recommended intakes (40–43).

[c] Defined as foods for which sum of nutrient densities across 15 nutrients (protein, vitamin A, thiamin, riboflavin, vitamin B-6, vitamin B-12, niacin, folate, vitamin C, vitamin E, calcium, phosphorus, iron, magnesium, and zinc) is <1. Nutrient density calculated as (nutrient content/recommended nutrient intake)/(energy content/recommended energy intake) (29). Recommended nutrient intake levels varied by age. Recommended energy intake was based on level of physical activity reported by participant.