

Review Article



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A Systematic Review of the Relationship between Acculturation and Diet among Latinos in the United States: Implications for Future Research

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ABSTRACT

Dietary intake is an important determinant of obesity and numerous chronic health conditions. A healthful diet is an essential component of chronic disease self-management. Researchers have indicated that the healthfulness of the Latino diet deteriorates during the acculturation process. However, given the many operationalizations of acculturation, conclusive evidence regarding this relationship is still lacking. This comprehensive and systematic literature review examines the relationship between acculturation and diet by examining national, quantitative, and qualitative studies involving Latinos living in the United States. Studies of diet included those that examined dietary intake using one of several validated measures (eg, food frequency questionnaire, 24-hour dietary recall, or dietary screener) and/or dietary behaviors (eg, away-from-home-eating and fat avoidance). Articles were identified through two independent searches yielding a final sample of 34 articles. Articles were abstracted by two independent reviewers and inter-rater reliability was assessed. Analyses examined the extent to which various measures of acculturation (ie, acculturation score, years in the United States, birthplace, generational status, and language use) were associated with macronutrient intake, micronutrient intake, and dietary behav-

iors. Several relationships were consistent irrespective of how acculturation was measured: no relationship with intake of dietary fat and percent energy from fat; the less vs more acculturated consumed more fruit, rice, beans, and less sugar and sugar-sweetened beverages. Additional observed relationships depended on the measure of acculturation used in the study. These findings suggest a differential influence of acculturation on diet, requiring greater specificity in our dietary interventions by acculturation status.

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Dietary intake is an important determinant of obesity and numerous chronic health conditions among Latinos living in the United States. A healthful diet is an essential component of chronic disease self-management. Most research concludes that Latinos in the United States consume a less healthful diet compared with other racial/ethnic groups in the United States due, in part, to less access to healthful foods, food insecurity, and low socioeconomic status. One of the social mechanisms that appear to link poor health practices and risk for obesity and certain chronic health conditions are the migration and acculturation processes. The effects of migration are often examined in terms of the individual's country of origin, age of arrival, and years living in the United States. Acculturation is a bidimensional process in which individuals may learn and/or adopt certain aspects of the dominant culture and in some cases retain most or some aspects of their culture of origin (1-3). Previous reviews on the relationship between acculturation and diet concluded that greater acculturation to the way of life in the United States is associated with less healthful dietary intake and dietary behaviors (4-6). However, the published reviews were either not inclusive of all of the studies on this topic or were focused on a specific target population (eg, individuals with type 2 diabetes) (5). In addition, there is research that indicates that being less acculturated is associated with poorer dietary habits (7-9), confirming what previous authors have suggested about the complexity of measuring the process of acculturation and its implications for understanding health and health behaviors (10,11).

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This study represents a comprehensive and systematic literature review of the association between acculturation and diet among Latinos living in the United States. To reflect the varied methods in which migration and acculturation are measured, all operationalizations were examined, including single measures of migration history (eg, number of years living in the United States) to multidimensional and bidirectional measures of acculturation like the Cuellar Acculturation Rating Scale for Mexican-Americans (2). Studies of diet included those that examined dietary intake using one of several validated measures (eg, food frequency questionnaire, 24-hour dietary recall, and dietary screener) and dietary behaviors (eg, away-from-home-eating, food preparation and shopping techniques, and fat avoidance). The literature review focused exclusively on adults but included Latinos of all countries of origin in the Americas (ie, North, Central, and South America) to examine for subgroups differences by level of acculturation. However, studies were limited to populations currently residing in the United States.

Based on previous research with the target population, it was expected that greater acculturation to the US culture would have a negative influence on the Latino diet. The extent to which this was moderated by the operationalization of acculturation and Hispanic subgroup were important components of this literature review, given the inconsistent findings. The discussion provides guidance on how health care practitioners can best encourage traditional healthful dietary practices among the different Latino subgroups in the United States using the principles of the US Department of Agriculture Food Guide Pyramid as a guiding tool without sacrificing flavor, traditional foods, and cultural traditions/preferences.

METHODS

Data Retrieval Process

Using methods developed by Cooper (12), articles were identified for inclusion using three approaches: database literature searches, reviewing the references of articles selected for the review (also known as backward searching), and examining published reviews on the topic. Consistent with the multiple operationalization approach recommended for literature reviews (12), an initial search was conducted by the first author in Medline and PsycInfo using the following key terms for acculturation and diet: acculturation, culture, migration, years in United States, country of origin, generation status, nutrition, dietary intake, dietary behaviors, food frequency, food recall, food habits, food preparation, food preferences, and food shopping. A second search, conducted by the health sciences librarian at San Diego State University, was inclusive of several additional databases: CINAHL, Academic Search Premiere, Sociological Abstracts, and Web of Science. The searches were then limited to studies conducted with Latinos/Hispanics using the following key terms: Latino/a, Hispanic, Spanish-speaking, Chicano/a, Spanish, Mexican American, Puerto Rican, Latin immigrant, Central American, and South American. Literature searches were downloaded into EndNote (version 9.0, 2000, Thomson Scientific, Philadelphia, PA) to eliminate duplicates and to facilitate the review process. Both

literature searches were conducted in June and July 2007 to ensure inclusion of the latest research.

Articles were included in the review if the abstract, title, or key words indicated that the authors examined or were interested in the influence of acculturation on diet. In a few cases, this was not clear. These articles were included to ensure that no possible study was omitted. Articles had to be published in a peer-reviewed journal between 1965 and the present (1980 to the present in Web of Science) and available in Spanish or English. Articles were excluded from the review process if they addressed some aspect of health or health behaviors not specific to diet (eg, obesity or diabetes), if the publication was a dissertation or nonpeer-reviewed publication (eg, newspaper article or report), or did not contain sufficient information for evaluation purposes (eg, conference abstracts).

Data Coding

Using Cooper's Method-Description Approach (12), a data coding sheet was created to capture information pertinent to this review. Reviewers coded all information available in each article pertaining to the study's implementation and evaluation. When discrepancies were observed between information presented in the text vs a table or figure, final coding was based on information provided in the table or figure. Similarly, studies with potential methodologic flaws and/or threats to internal validity were included in the review process to eliminate the need for reviewers to make judgments about study design during the review process. This decision also provided the opportunity to examine the relationship between study design issues and outcomes.

Participant Characteristics. Each study's sample size was noted, and its participants were characterized based on

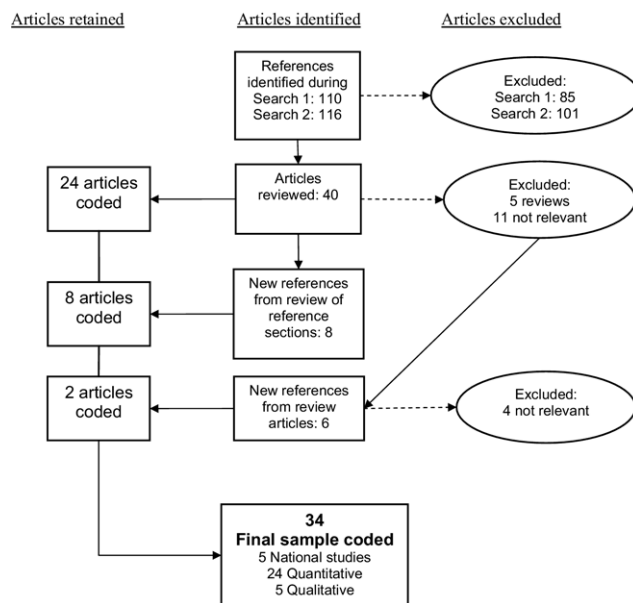


Figure 1. Literature included during the review process to explore the relationship between acculturation and diet among Latinos in the United States.

Table 1. Relationship between US Latinos' acculturation and diet, based on five studies of national samples using Hispanic Health and Nutrition Examination Survey (HHANES) and National Health and Nutrition Examination Survey (NHANES) data

Reference	Study design	N	% Women	Sample characteristics	% Subgroup			Acculturation	Dietary measure	Results
					MA ^a	PR ^b	Other ^c			
Marks and colleagues, 1990 (26)	HHANES	4,665	57	Age range 20-74 y 21% CA male to 45% PR women <\$10,000/y 16% PR to 31% MA women <7 y of education	61	23	CA: 16	Eight of 20-item Cuellar ARSMA ^d scale assessed language and ethnic identity; 4 language items used for CA and PR; higher=more acculturated	Diet index based on past 3-month FFQ ^e ; 0=not balanced/high on junk food to 3=balanced diet/low junk food.	Correlation between diet index and acculturation score - ^f MA men and women + ^g PR men ∅ ^h CAs and PR females
Guendelman and Abrams, 1995 (25)	HHANES	1,373	100	Mean age 29 y 1st generation 27 y 2nd generation Below poverty 38% 1st generation 28% 2nd generation Mean education 7 y 1st generation 11 y 2nd generation	100			Generation status based on birth place of self and parents; 475 1st generation and 898 2nd generation	Single 24-h dietary recall to obtain mean absolute intake and categorize based on nutrient adequacy ratio	2nd generation - 1st generation - ^f Protein - ^f Carbohydrates - ^f Cholesterol - ^f Vitamin A - ^f Vitamin C - ^f Folic acid - ^f Calcium - ^f Nutrient adequacy ratio ^h ∅ Energy, total fat, and vitamin E
Khan and Martorell, 1997 (28)	NHANES II	5,256	57	Mean age 41±15 y Income 2 (±1.4) PIR ⁱ Mean education 10 years (standard deviation=3.9)	61	23	CA: 16	Language preference responses ranged from 1=Spanish only to 5=English only. Generation status based on birth place of self and parents; 1st generation, 2nd generation, and 3rd generation.	Portion score based on consumption of 5 food groups. Each portion (median gram weight)=2 points (grains=1 point), 20-point maximum score.	MEN Generation status - ^f Portion score among MA and PR Language preference ∅ ^h Portion score Generation status and Lang preference ∅ ^h Portion score WOMEN Generation status - ^f Portion score, MA + ^g Portion score, PR Language preference ∅ ^h Portion score Generation status and Lang preference + ^g Portion score and Lang preference among 3rd generation MA only
Dixon and colleagues, 2000 (24)	NHANES III	2,853	51	Age range 37 y (C) to 46 y (A) Below poverty 14% (B) to 51% (C) Mean education 7 y (C) to 12 y (B)	100			Categories using country of origin and primary language spoken at home: A: born in United States and Spanish language dominant; B: born in United States and English language dominant; C or Reference: born in Mexico	Single 24-h dietary recall Past month FFQ to assess consumption of: milk and milk products, meat, egg dishes, fruits and vegetables, grains, and legumes, desserts, and added fats.	MEN language and birthplace - ^f A-C, - ^f B-C Energy ∅ ^h A-C, - ^f B-C Cholesterol ∅ ^h A-C, - ^f B-C Fiber - ^f A-C, ∅ ^h B-C Vitamin A - ^f A-C, - ^f B-C Vitamin C - ^f A-C, ∅ ^h B-C Vitamin E - ^f A-C, - ^f B-C Folate - ^f A-C, - ^f B-C Vitamin B-6 - ^f A-C, - ^f B-C Calcium - ^f A-C, - ^f B-C Potassium - ^f A-C, - ^f B-C Magnesium WOMEN language and birth place ∅ ^h A-C, ∅ ^h B-C Energy ∅ ^h A-C, ∅ ^h B-C Cholesterol ∅ ^h A-C, - ^f B-C Fiber ∅ ^h A-C, - ^f B-C Vitamin A - ^f A-C, - ^f B-C Vitamin C - ^f A-C, ∅ ^h B-C Vitamin E - ^f A-C, - ^f B-C Folate - ^f A-C, - ^f B-C Vitamin B-6 - ^f A-C, - ^f Calcium ∅ ^h A-C, - ^f B-C Potassium ∅ ^h A-C, - ^f B-C Magnesium <i>(continued)</i>

Table 1. Relationship between US Latinos' acculturation and diet, based on five studies of national samples using Hispanic Health and Nutrition Examination Survey (HHANES) and National Health and Nutrition Examination Survey (NHANES) data (continued)

Reference	Study design	N	% Women	Sample characteristics	% Subgroup			Acculturation	Dietary measure	Results
					MA ^a	PR ^b	Other ^c			
Simpson and Urrutia-Rojas, 2007 (27)	NHANES III	16,536	Not reported	Age range 17-90 y	Not reported		<p>Categories using country of origin and language of interview:</p> <p>A: born in United States and Spanish dominant;</p> <p>B: born in United States and English dominant;</p> <p>C or Reference: born in Mexico</p> <p>Years in the United States assessed among foreign born, categorized in 5-y increments and then examined from 1 to 90 y</p>	<p>Five carotenoids examined that were measured continuously as microgram/deciliter. A total serum carotenoids score was computed by summing all:</p> <p>α-Carotene</p> <p>β-Carotene</p> <p>β-Cryptoxanthin</p> <p>Lutein/zeaxanthin</p> <p>Lycopene</p>	<p>Language and birthplace</p> <p>– A-C, – B-C Total carotenoids</p> <p>– A-C, – B-C α-Carotene</p> <p>– A-C, – B-C β-Carotene</p> <p>– A-C, – B-C β-Cryptoxanthin</p> <p>– A-C, – B-C Lutein/zeaxanthin</p> <p>+9 A-C, +9 B-C Lycopene</p> <p>Years in United States (1 y vs 90 y)</p> <p>– Total carotenoids</p> <p>– α-Carotene</p> <p>– β-Carotene</p> <p>– β-Cryptoxanthin</p> <p>– Lutein/zeaxanthin</p> <p>+9 Lycopene</p>	

^aMA = Mexican Americans.
^bPR = Puerto Ricans.
^cOther ethnicities, including Cuban American (CA), Central American (Cent-Am), and Dominican (DR).
^dAFSMA = acculturation rating scale for Mexican-Americans.
^eFFQ = food frequency questionnaire.
^fNegative association (–) indicates that greater acculturation to the US culture is associated with less intake of nutrients assessed.
^gPositive association (+) indicates that greater acculturation is associated with more intake of nutrients assessed.
^h∅ = no significant association.
ⁱPIP = Poverty Index Ratio. PIP is drawn from National Center for Health Statistics and represents a continuous variable based on income plus living expense in the area of residence plus date of the measurement plus family composition. PIP of 1.0 or greater indicates that family should be able to meet their basic needs, including an adequate food plan.

their sex, age and age range, income, employment, education, body mass index (BMI) or weight status, and country of origin/Latino ethnic subgroup.

Study Characteristics. Characteristics of a study included the study objectives, primary outcomes, the study design specific to the acculturation–diet analyses (cross-sectional or longitudinal), the geographic region of the study, and analytic approach.

Migration and Acculturation. Measures of migration and acculturation included generation status, language of assessment, years in the United States, age at arrival to the United States, and acculturation score, the latter inclusive of scales that measured acculturation on a unidimensional/unidirectional scale (eg, language used at home) to multidimensional and bidirectional scales (2).

Diet. Measures of diet included dietary intake assessed using 24-hour dietary recall methodology, a food frequency questionnaire, or a dietary screener; dietary behaviors included but were not limited to away-from-home eating, food preparation and shopping techniques, and fat avoidance; and dietary stages of change.

Review Process

Several strategies were used to ensure accurate coding of information onto the coding sheets. First, two reviewers reached consensus on the appropriate use of the coding sheet. This process involved discussions about each variable; testing the coding sheet with two articles, comparing results, addressing discrepancies, and revising the coding sheet as needed until adequate inter-rater reliability estimates were obtained between the raters. All articles were then double-coded for verification purposes, with discrepancies addressed using a consensus approach (12). Inter-rater reliability on a subsample of the articles yielded results that ranged from 0.70 to 0.99, with more errors observed on coding of the acculturation variable used in primary analyses, and fewer errors observed on demographic variables. All discrepancies were resolved and consensus reached.

RESULTS

Results of the literature search are outlined in Figure 1. Two separate searches and backward searches from identified articles yielded 54 articles describing the acculturation–diet relationship. Five (10%) studies were excluded from the review process because they themselves were review articles (4-6,10,11). The other studies were excluded because they examined the outcomes of a poor diet (eg, obesity, diabetes, or hypertension) rather than on diet itself or they did not systematically measure acculturation (13-23). This yielded a final sample of 34 articles that underwent further examination. Although not included in this review, one study was notable in its examination of the relationship between acculturation, diet, and low birthweight; Cobas and colleagues (23) found that acculturation had a negative effect on dietary intake, and dietary intake had a direct effect on low birthweight status.

Tables 1 and 2 provide detailed information on the relationship between diet and the various operationalization(s) of acculturation. Given our specific interest in the

Table 2. Relationship between US Latinos' acculturation and diet, based on 24 studies using regional samples

Reference	Study design	N	% Women	Sample characteristics	% Subgroup			Acculturation	Dietary measure	Results
					MA ^a	PR ^b	Other ^c			
Elder and colleagues, 1991 (50) California	Cross-sectional	358	63	Mean age Low acculturation=39±14 y High acculturation=34±14 y Between \$1,250-\$1,750: 32% of low and 37% of high acculturation Mean education: Low acculturation=9±4 y; High acculturation=12±3 y			Not reported	Five items from Cuellar's scale (62) used to create a composite score and then a median split: low vs high acculturated	Six-item Knapp Fat avoidance scale; higher score=more fat avoidance. Past year fiber consumption of whole grains/fruit/vegetables/legumes. High-energy items based on weekly intake of whole milk, pastries, ice cream, red meat, sweet snacks, and foods cooked in fats/butter. Low energy based on weekly dark green leafy vegetables, salad or raw vegetables, lean white meat, and whole fruits.	Acculturation + ^d Fat avoidance - ^e Fiber consumption - ^e High energy consumption ∅ ^f Low energy consumption
Winkleby and colleagues, 1994 (49) California	Four cross-sections over 10 y	426	60	Mean age 40±12 y Income Not reported Mean education 6±3 y			Not reported	Primary language spoken at home from Marin's 4-item scale (3); 65% Spanish language dominant (less acculturated)	Past year FFQ ^g identified the major sources of fat and frequency of consumption in the previous day. 40% random subsample completed a 24-hour dietary recall; used to compute energy and nutrient intake.	Language use + ^d Cured meat and red meat + ^d Cheese + ^d Added fat + ^d Whole grains & bread - ^e Whole milk - ^e Rice/corn/noodles/potatoes/tortillas - ^e Cooked dried beans/peas
Gardner and colleagues, 1995 (60) California	Cross-sectional	106	0	Mean age 33±8 y All but two below poverty level for 1991 Mean education 10±5 y	44	Cent Am: 56		Seventeen-item scale (combo of Marin [3] & Cuellar [62]) with a total score of 100 (more acculturated). 44% in United States for ≤2 y; 27% for 2.1-5.0 y; and 28% for 5.1-15.0 y.	206-item past month FFQ. 31 Hispanic foods used to compute % energy derived from traditional foods and % of foods consumed that were traditional. Postmigration changes in intake of: plant, flesh, dairy, and processed foods. Atherogenic foods: total and saturated fat, dietary cholesterol. Antiatherogenic foods: anti-oxidants, unsaturated fat, fiber.	Acculturation + ^d Diet variety + ^d Vitamin C ∅ ^f Atherogenic foods ∅ ^f Antiatherogenic foods Postmigration-Qualitative + ^d Poultry, wheat, high-fat and high-sugar prepared foods, sugar drinks - ^e Pork, poultry, skin, fish, cheese, nonfat milk, lard, margarine
Balcazar and colleagues, 1995 (55) California	Cross-sectional	571	100	Age not reported Income range from \$751 to \$1,500 per month Mean education sixth if educated in Mexico 12th if educated in United States.	91			Five items from General Acculturation Index (split at score of 3.0; modified Cuellar [62]) and educational status used to create four categories: LL=low acc+low educ; LH=low acc+high educ; HL=high acc+low educ; HH=high acc+high educ	Eight dietary behaviors assessed based on times per week	Acculturation and education - ^e Cooking with lard (LL vs LH, HL, HH) - ^e Cooking with veg oil (LH vs HL, HH) - ^e Eat fruit (LL vs LH, HH) - ^e Eat legumes and beans (LL vs HL, HH) - ^e Eat leafy vegetables (LL vs HH; LH vs HL, HH) + ^d Eat lean white meat (HH vs LH) + ^d Eat salad/raw vegetables (HH vs LL, LH)
Otero-Sabogal and colleagues, 1995 (61) California	Cross-sectional	1,650	50	Age range 35-74 y 68% <\$30k 72% <high school	28	Cent Am: 26		Five items from Marin's scale (3) used to create dichotomy: ≤3=less acculturated and >3 more acculturated	Eleven-item dietary behavior scale (based on National Health Interview Survey and Knapp fat avoidance scale) to assess prior day consumption of various foods	Acculturation - ^e Fruit - ^e Rice - ^e Beans - ^e Fried foods - ^e Red meat - ^e Whole milk - ^e Food prepare involving lard/meat fat + ^d Vegetables (subsampling) + ^d Oatmeal/cereal + ^d Olive oil
Polednak, 1997 (52) New York Connecticut	Cross-sectional	665	54	Age range 20-74 y Income and education not reported			Not reported	Four items from Cuellar's scale (62) created a continuous acculturation score	Thirteen-item Block FFQ to assess dietary fat intake	Acculturation ∅ ^f Dietary fat (women only)

(continued)

Table 2. Relationship between US Latinos' acculturation and diet, based on 24 studies using regional samples (continued)

Reference	Study design	N	% Women	Sample characteristics	% Subgroup			Acculturation	Dietary measure	Results
					MA ^a	PR ^b	Other ^c			
Woodruff and colleagues, 1997 (51)	Cross-sectional	132	60	Mean age 29±11 y Median income \$700-\$10,99 Mean education 10±4 y			Not reported	Eleven items from Marin's scale (3) used to create a dichotomy (low vs high acc) via median split	Six-item Knapp Fat avoidance scale; scores range from 0-6; higher score=more fat avoidance	Acculturation + ^d Fat avoidance
Garcia-Maas, 1999 (44) Texas	Cross-sectional	76	100	Mothers' mean age 56±12 y Daughters' mean age 32±10 y 77.6% financial status adequate or more to meet needs 44% ≤high school	88			Five items from Cuellar scale (62) used to create a composite score. 18% Mexico-born and 70% US-born.	Twenty-three of Block's 98-item Fat and Fruit/Vegetable Screening questionnaire used to estimate fat (meats/snacks) and fruit/vegetable/fiber intake.	Acculturation ∅ Total meats/snacks ∅ Fruits/vegetables/fiber
Bermudez and colleagues, 2000 (38) Massachusetts	Cross-sectional	711	DR68 PR59 Other 63	Mean age 69±7 y PR 69±7 y DR 70±7 y Other Poverty 1.0±0.7 PR 0.95±0.4 DR 2.0±1.7 Other Mean education 5±4 y PR 5±4 y DR 8±6 y Other	47	DR: 14 Other 39		Three items from Cuellar scale (62) used to create a dichotomy: less acculturated (1 to 2.99) and more acculturated (>3.00). Years in the United States collapsed into <20 y and ≥20 y of residence in United States.	Single 24-h dietary recall	Acculturation - ^e Complex carbohydrates (root crops and bananas) - ^e Ethnic foods Years in the United States - ^e Complex carbohydrates + ^d Refined sugar
Monroe and colleagues, 2003 (40) California	Cross-sectional	32,255	50	Mean age range 55-64 y Income not reported Mean education 7-12 y	100			Generation status: 1st (C), 2nd (B), and 3rd (A) generation. Furthermore, 1st generation respondents were stratified by years in United States: <15 y (C1), 16-25 y (C2), and 26+y (C3).	180-item past-year FFQ	Generation status and years in the United States - ^e Energy (B-C only) + ^d Percent calories of fat (monounsaturated B-C only) + ^d Cholesterol - ^e β-Carotene - ^e Fiber (legumes, tortillas, fruits and vegetables) + ^d Whole milk (the authors do not report whether these differences are statistically significant.)
Lin and colleagues, 2003 (39) Massachusetts	Cross-sectional	582	53-71	Age range 60 to 72 y 35% to 62% <poverty level Mean education 4 to 10 y		DR: 23	77	Three-item acculturation score ranging from 1=using Spanish only to 5=using English only.	Past 3-mo 118-item food frequency questionnaire captured 32 food groups and used to create five dietary clusters based on nutrient contributions	Acculturation Lowest to highest by cluster Rice=1.8 Starchy veggies=2.0 Sweets=2.0 Whole milk=2.1 Fruit & cereal=2.5
Ayala and colleagues, 2004 (46) California	Cross-sectional	357	100	Mean age 40±10 y Median income \$1,500-\$2,000/mo Median education junior high school	95			Thirty-item ARSMA-II ^h (2) used to create two of four acculturation groups; 64% traditional, 36% bicultural	Three 24-h dietary recalls used to determine energy, % energy from fat, and grams of fiber	Acculturation category ∅ Energy ∅ % energy from fat ∅ Fiber
Neuhouser and colleagues, 2004 (57) Washington	Cross-sectional	726	58	Age not reported Income not reported Education not reported	90			Four-item acculturation scale developed by research team and used to create two categories; 62% low and 38% high acculturation	Six-item fruit and vegetable FFQ (items from BRFSS ⁱ and 5-A-Day questions) Twelve-item previously validated Fat-Related Diet Habits questionnaire	Acculturation - Fruits/vegetables ∅ Fat (+ trend)

(continued)

Table 2. Relationship between US Latinos' acculturation and diet, based on 24 studies using regional samples (continued)

Reference	Study design	N	% Women	Sample characteristics	% Subgroup			Acculturation	Dietary measure	Results
					MA ^a	PR ^b	Other ^c			
Norman and colleagues, 2004 (54) California	Cross-sectional	119	100	Mean age 32±10 y 32% <\$10,000 Mean education 10±3 y	41	Mexican-born, 49 US-born, 8 Central American		Birthplace: US-born vs foreign-born Years in the United States Categories based on country of origin and language preference. 3: US-born and English dominant; 2: US-born and Spanish dominant; 1: foreign born	Twenty-item Eating Patterns Assessment tool used to assess consumption of high- and low-fat foods in past week: lower-fat items (like fruits and vegetables; 10 items) and higher-fat items (10 items)	Birthplace + ^d Higher fat (+ ^d convenience foods, + ^d chocolate) ∅ Lower fat Language ∅ Higher fat ∅ Lower fat except - ^e beans/peas Years in the United States ∅ Higher fat ∅ Lower fat Birthplace and language + ^d Higher fat (+ ^d convenience foods, + ^d salty snacks) ∅ Lower fat
Sharma and colleagues, 2004 (35) Hawaii and California	Cross-sectional	42,951	52	Mean age range 58-61 y Income not reported Education not reported	40	foreign born		Birth place: United States vs foreign-born	FFQ used to calculate usual daily intake of energy, Food Guide Pyramid servings, and adherence to Food Guide Pyramid recommendations	Birthplace - ^e Energy intake - ^e Grains - ^e Vegetables - ^e Fruit - ^e Dairy - ^e Meat (men only)
Ayala and colleagues, 2005 (47) California	Cross-sectional	357	100	Mean age 40±10 y Median income \$1,500-\$2,000/mo 51% <high school	95			Thirty-item ARSMA-II (2) used to create acculturation scores Mean time in the United States 6±11y	Four of 30-item Dietary Behavioral Strategies scale for fat and fiber, pertaining to restaurant eating. Measured on a scale from 1=never/rarely to 4=usually/always Frequency of consuming away-from-home foods at each meal (0=never to 4=5+ d/wk). Preference for fast food vs other restaurants, and grocery stores vs other food stores.	Acculturation + ^d Share high-fat meal with someone + ^d Eat less and save rest ∅ Order regular size vs jumbo ∅ Serve smaller portion at buffet ∅ Eat out for breakfast + ^d Eat out for lunch + ^d Eat out for dinner + ^d Eat more meals from fast-food restaurant ∅ Prefer fast-food restaurants + ^d Prefer supermarkets/grocery stores Years in the United States + ^d Prefer fast-food restaurants ∅ Prefer supermarkets/grocery stores
Himmelgreen and colleagues, 2005 (59) Connecticut	Cross-sectional	174	100	Mean age 25±10 y Income not reported 62% <high school		100		Birth place: United States vs foreign-born Language use based on 3 items from Marin (3). Time in the United States: ≤2y, 2-9.9 y, and ≥10 y	Condensed FFQ used to examine frequency of consumption of various foods and composite foods groups	Birthplace - ^e Fruit juice Language use + ^d Snacks + ^d Artificial drinks Years in the United States + ^d Artificial drinks (eg. soda and fruit drinks)

(continued)

Table 2. Relationship between US Latinos' acculturation and diet, based on 24 studies using regional samples (continued)

Reference	Study design	N	% Women	Sample characteristics	% Subgroup			Acculturation	Dietary measure	Results
					MA ^a	PR ^b	Other ^c			
Harley and colleagues, 2005 (45) California	Cross-sectional	474	100 (pregnant)	Mean age: 26–Mexico-born; 23–US-born; 65% Mexico-born and 53% US-born at or below poverty Mean education: 51% Mexico-born <6th grade; 49% US-born <high school	74			Time in the United States: <5 y, 6–10 y, and ≥11 y	Past 3-mo 72-item FFQ based on 98-item Block Screener; modified to reflect additional Latino foods; examined macro- and micronutrients as well as food groups	Birthplace – ^e Energy ∅ ^f Protein (% of energy) ∅ ^f Fat (% of energy) ∅ ^f Saturated fat (% of energy) ∅ ^f Cholesterol – ^e Fiber – ^e Vitamin A – ^e Vitamin C – ^e Vitamin E – ^e Folate ∅ ^f Iron – ^e Calcium – ^e Zinc – ^e Fruit ∅ ^f Vegetables – ^e Grains – ^e Dairy ∅ ^f Meat Years in the United States (Mexico-born only) – ^e Energy ∅ ^f Protein (% of energy) ∅ ^f Fat (% of energy) ∅ ^f Saturated fat (% of energy) + ^d Fiber ∅ ^f Vitamin A ∅ ^f Vitamin C ∅ ^f Vitamin E – ^e Folate – ^e Iron ∅ ^f Calcium – ^e Zinc
Kasirye and colleagues, 2005 (56) California	Cross-sectional	1,062	100	Mean age 25±6 y Income not reported Mean education 9±3 y	100			Time in the United States; if US-born, used age as indicator. 26% US-born, 74% Mexico-born. Age of immigration estimated based on age of interview and total years in the United States. Used to validate Cuellar. Twelve-item Cuellar ARSMA-II (2) created 3 groups: low (score=1), moderately (score=2/3) and high acculturation (score=4/5).	Past month intake of fruits, vegetables and fast food meals. Categorized based on consumption of 3+ servings of fruits per day, 3+ servings of vegetables per day, and 2+ fast-food meals per week.	Acculturation – ^e Fruit ∅ ^f Vegetables + ^d Fast food
Smith and colleagues, 2005 (58) Texas	Cross-sectional	293	100	Mean age 36 y Income not reported 29% <high school	100			Four-item heritage retention score (possible range 0–12). Scores were collapsed into three categories: weak (0–5 points), moderate (6–8 points), and strong heritage retention (9–12 points).	Modified 137-item FFQ used to estimate mean fiber intake	Heritage retention (higher score=more retention) + ^d Fiber
Fitzgerald and colleagues, 2006 (48) Connecticut	Cross-sectional	200	100	Mean age 29 y Income not reported 62% <high school			100	Language use based on primary language spoken at home and English proficiency. Two groups: low acculturation=Spanish only/not fluent in English vs high acculturation=English or bilingual/fluent in English.	Fourteen-item FFQ used to examine consumption of five food groups.	Language use ∅ ^f Grains ∅ ^f Fruit/vegetable/legume ∅ ^f Meat/egg/fish ∅ ^f Dairy ∅ ^f Soda/sweets/snacks

(continued)

Table 2. Relationship between US Latinos' acculturation and diet, based on 24 studies using regional samples (continued)

Reference	Study design	N	% Women	Sample characteristics	% Subgroup			Acculturation	Dietary measure	Results
					MA ^a	PR ^b	Other ^c			
Gregory-Mercado and colleagues, 2006 (37) Arizona	Cross-sectional	259	100	Mean age 58±5 y 45% <\$10,000/y 58% <high school	100			Five items from ARSMA-I (62); median split to create two categories: less acculturated (<1.62) and more acculturated (≥1.62).	Three 24-h dietary recalls (1 weekend and 2 weekdays); computed total daily servings of fruits and vegetables, and then dichotomized: meets guidelines vs does not meet guidelines.	Acculturation – ^e Fruit and vegetables – ^e Met dietary guidelines for fruit and vegetables
Harley and Eskenazi, 2006 (53) California	Cross-sectional	568	100 (pregnant)	Mean age 25 y 63% live at or below poverty 83% <high school		89 foreign-born		Age of arrival (childhood, adolescents, adulthood) Time in the United States categorized as: ≤5 y, 6-10 y, and ≥11 y	Past 3-mo 72-item FFQ based on 98-item Block Screener; modified to reflect additional Latino foods. Diet Quality Index for Pregnancy score categorized into three groups: low (16-40), medium (40-49), and high (49-67).	Age of arrival – ^e Diet quality Years in the United States – ^e Diet quality
Gregory-Mercado and colleagues 2007 (36) Arizona	Cross-sectional	260	100	Mean age 58±3 y Mean annual income \$9,807±\$344 Mean education 8±0.2 y	100			Five items from ARSMA-I(62); median split to create two categories: less acculturated (<1.62) and more acculturated (≥1.62).	Three 24-h dietary recalls (1 weekend and 2 weekdays)	Acculturation – ^e Vitamin E – ^e Folate ∅ ^f Energy ∅ ^f Protein ∅ ^f Carbohydrates ∅ ^f Total fat ∅ ^f Cholesterol ∅ ^f Fiber ∅ ^f Micronutrients (Vitamins A, C, B-6, B12, thiamin, riboflavin, and niacin; phosphorus; magnesium; iron; copper; zinc; calcium; potassium; and sodium).

^aMA=Mexican Americans.
^bPR=Puerto Ricans.
^cOther=other ethnicities, including Cuban Americans (CA), Central Americans (Cent-Am), Dominican (DR).
^dNegative association (–) indicates that greater acculturation to the US culture is associated with less intake of nutrients assessed.
^ePositive association (+) indicates that greater acculturation is associated with more intake of nutrients assessed.
^f∅=no significant association.
^gFFQ=food frequency questionnaire.
^hARSMA=acculturation rating scale for Mexican-Americans.
ⁱBRFSS=Behavioral Risk Factor Surveillance System.

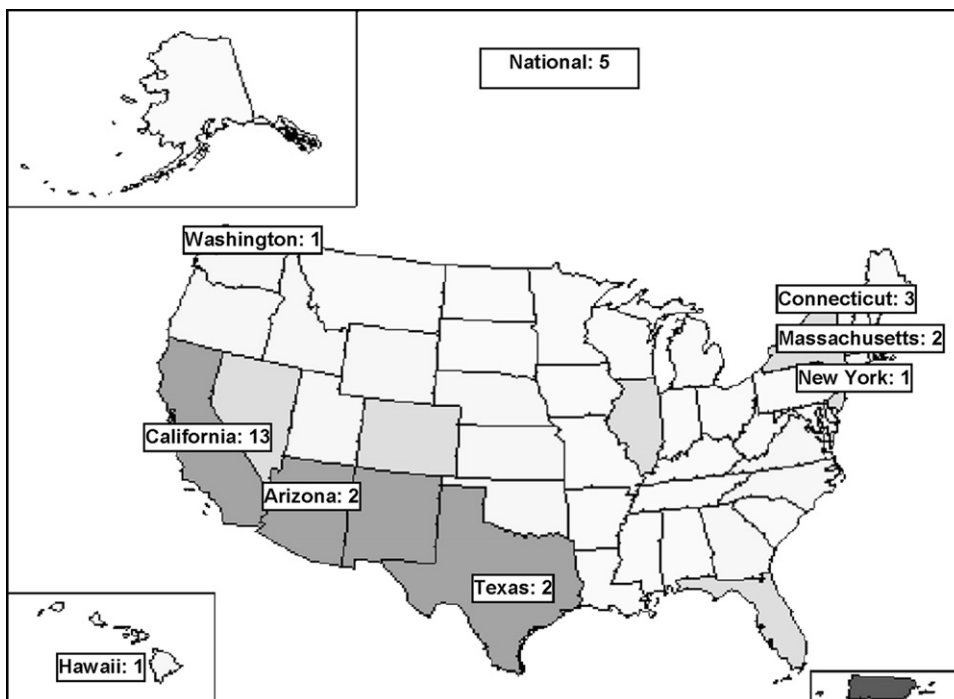


Figure 2. Geographic distribution of studies by density of the Latino population in the United States. Darker shading represents a higher concentration of Latinos living in this region of the United States.

relationship between diet and acculturation among Latinos, non-Latino subsamples were excluded. The following information is presented in the tables: sample characteristics (eg, number, sex, age, income, and education); ethnicity, acculturation, and final acculturation score(s) used in primary analyses (eg, ethnic subgroup, generation status, language of assessment, years in the United States, age at first arrival, and acculturation); operationalization(s) of diet; and results. Information on employment status and BMI were abstracted but excluded from the Tables given that <50% of studies reported these characteristics. Information in the Tables is organized first by year of publication and then alphabetically by first author, the former to show progression in the science.

National Studies

Table 1 presents the results based on five studies using Hispanic Health and Nutrition Examination Survey and National Health and Nutrition Examination Survey data, representing the most generalizable findings available (24-28). Irrespective of the samples included and the operationalization of acculturation used, being less acculturated was associated with more healthful levels of nutrient consumption. For example, Dixon and colleagues (24) found that a higher percentage of Mexican-born men and women, compared with US-born English and Spanish-speaking Mexican/Mexican-American men and women, were more likely to meet dietary guidelines for total fat, saturated fat, fiber, and potassium, as well as consume the recommended dietary allowance of vitamin C, vitamin B-6, folate, calcium, and magnesium. Based on re-

ported consumption in the past month, Mexican-born men and women consumed more fruit, vegetables, fruit juice, grains and legumes, as well as fewer salty snacks, desserts, and added fats than US-born Mexican/Mexican-American men and women. The only exception was observed among Cuban Americans where no relationships were observed between acculturation and diet (24,26). Two studies also demonstrated no relationship between acculturation and total energy among women (25,27).

Quantitative Studies

An examination of the 24 site-specific quantitative studies identified several important findings related to the study design, Latino subgroup, measurement of acculturation and diet, and their relationship.

Geography. Most studies (71%) were conducted in the Southwest region of the United States, including 13 in California (see Figure 2). As such, it is difficult to draw generalizable conclusions about the relationship between acculturation and diet given that acculturation is influenced, in part, by contextual factors (eg, density of the Latino population in a given neighborhood, history of migration into the region, and influence of social network members who are also Latino) (29-31), as is diet (32-34).

Participant Characteristics. Fifty percent of the studies collected data from both men and women. This is a much larger percentage of studies than anticipated given the perceived dearth of studies on Latino men's lifestyle behaviors. All but six studies (35-40) involved primarily a young adult to middle-age population, consistent with the age distribution of the Latino population in the United

States (41). However, this also points to the lack research among Hispanic elders, a concern given the continued growth of this population (42), and the fact that they are more likely to be living in poverty (43). Markers of socioeconomic status suggest that researchers have primarily focused their efforts on a lower socioeconomic population. For example, among studies that reported education based on the percentage of sample who did not complete high school, the lowest number was 29% (58) and the highest number was 83% (53). Although not included in the tables given the limited findings, seven studies reported that the mean BMI ranged from 27 to 29.7, indicating that the average BMI was in the overweight range (35,36,40,46-49). In addition, two studies reported percent overweight/obese at 59% (45) to 77% (37).

Latino Subgroups. Four studies did not report the percent of individuals representing different Latino subgroups, although three of these studies involved residents of California who are, according to US census data, primarily Mexican/Mexican American (49-51) and one involved residents of New York and Connecticut who are predominantly Puerto Rican (52). Three studies reported country of origin in global terms (foreign- vs US-born) (35,53,54). Eleven studies involved primarily Mexicans/Mexican Americans (36,37,40,44-47,55-58) or Puerto Ricans (48,59), precluding the possibility of examining Latino subgroup differences. Of the four remaining studies that included multiple Latino subgroups, analyses did not examine the relationship between acculturation and diet by subgroup (38,39,60,61).

Measurement of Acculturation. All studies published in the 1990s used either the Cuellar and colleagues (62) or the Marin and Gamba (3) scales to measure acculturation. By the year 2000, studies began to examine several dimensions of acculturation including birthplace, years in the United States and age of arrival to the United States. However, a less desirable trend during this era was the use of project-specific scales to measure acculturation, limiting our ability to draw comparisons across studies.

Measurement of Diet. A strength of this review is the finding related to dietary assessment method used. In 18 of 24 (75%) studies, dietary intake was measured using a food frequency questionnaire or a 24-hour dietary recall. The remaining studies examined dietary behaviors, including fat avoidance (50,51,61) and fat/fiber-related behaviors (47,54,55).

Relationship between Acculturation and Diet. Table 3 summarizes the results regarding the relationship between acculturation and diet. Across several studies, the evidence is fairly conclusive that dietary fat and percent energy from fat are not associated with any measure of acculturation. The one exception observed was in a study by Monroe and colleagues (40), which found that second-generation respondents consumed more monounsaturated fat than first-generation Mexican immigrants. This may be explained by the additional pattern of findings: more acculturated individuals consume more fast food, fatty snacks, and added fats than less acculturated individuals; however, they were also more likely to engage in fat avoidance behaviors. Compounding this is evidence that less acculturated individuals were more likely to consume whole milk and more likely to fry food with

lard and other meat fat than their more acculturated counterparts. There is also strong evidence that acculturation is not associated with dietary cholesterol intake. One study provides striking evidence that contradicts the rest of the literature (40). The relationship between acculturation and dairy and meat depend on the measure of acculturation.

The evidence regarding fiber intake and acculturation is equally mixed. Fruit, rice, and beans are negatively associated with acculturation (less acculturated eat more fruit/rice/beans than more acculturated individuals), as are reports of total fruit and vegetable consumption. However, there is mixed evidence on the relationship between acculturation and fiber, and this relationship varies by measurement of acculturation.

One's acculturation score was not associated with total energy consumed; however, being born in the United States and living more years in the United States were associated with less energy intake. Nevertheless, those who spoke English and had lived in the United States for more years consumed more sugar, including sugar-sweetened beverages. For the most part, acculturation was not associated with micronutrient intake. The only variable that seemed to differentiate individuals was generation status/birthplace; foreign-born individuals consumed more vitamins A, C, and E; folate; calcium; and zinc compared with their counterparts.

Three studies are not included in Table 3 because they do not contain acculturation and/or dietary variables that are comparable with other studies (39,47,53). However, the results are consistent with those contained in Table 3. For example, diet quality was negatively associated with age of arrival and years in the United States (53); pregnant women who arrived to live in the United States at an earlier age and who lived in the United States for fewer years had a better quality diet than their counterparts. Lin and colleagues (39) determined that people who consumed fruit and cereal were more acculturated than those who consumed rice in the past 3 months. In a study conducted with Mexican/Mexican-American women in San Diego (47), more acculturated women were more likely to engage in several healthful dietary behaviors; however, they also were more likely to eat out for lunch and dinner, and to eat at fast-food restaurants than the less acculturated individuals.

Qualitative Studies

Five qualitative studies were identified that provided support for the findings in this systematic review (63-67). Most of these studies were conducted within the past 6 years and involved focus groups and interviews with members of the target population. In a study involving 18 middle-aged Latina women originating from Mexico, Central America, and South America and now living in Mississippi, Gray and colleagues (65) found that 61% of women who completed the interview said that they generally ate more healthfully in their country of origin. Since arriving in the United States reductions were reported in fish, seafood, bread, and corn. Increases were reported in vegetables, pork, chicken, hamburgers, and pizza. No changes were reported in milk, beef, rice, potatoes, beans, and eggs. In a second study involving 23 Honduran women living in Louisiana (63) and a third

Table 3. Relationship between acculturation and diet by type of nutrient and measurement of acculturation for Latinos living in the United States, based on the literature

Nutrient/food	Acculturation	Language	Years in United States	Generation status/birthplace	Generation status and years in United States
	←————— reference no. —————→				
Fat					
Dietary fat	60 ^a , 52 ^a , 57 ^a , 36 ^a	54 ^a	54 ^a		
% Energy from fat	46 ^a		45 ^a	45 ^a	40 ^b
Fast food, snacks, added fats	56 ^b	59 ^b , 49 ^b		54 ^b	54 ^b
Fat avoidance	50 ^b , 51 ^b				
Whole milk	61 ^c	49 ^c			40 ^b
Fried foods, food prepared with lard	61 ^c , 61 ^c , 55 ^c				
Cholesterol	60 ^a , 36 ^a			45 ^a	40 ^b
Dairy, cheese		49 ^b , 48 ^a		35 ^c , 45 ^c	
Meat	61 ^c , 44 ^a	49 ^b , 49 ^b , 48 ^a		35 ^c , 45 ^a	
Fiber					
Fiber	58 ^b , 50 ^c , 60 ^a , 44 ^a , 46 ^a , 36 ^a		45 ^b	45 ^c	40 ^c
Fruit and vegetables	57 ^c , 37 ^c	48 ^a			
Fruit	61 ^c , 56 ^c , 55 ^c			35 ^c , 59 ^c , 45 ^c	
Veggies	61 ^b , 56 ^a , 55 ^b			35 ^c , 45 ^a	
Rice	61 ^c	49 ^c			
Beans	61 ^c , 55 ^c	49 ^c			
Whole grains/bread/oats/cereal	61 ^b	49 ^b , 48 ^a		35 ^c , 45 ^c	
Macronutrients					
Total energy	46 ^a , 36 ^a		45 ^c	35 ^c , 45 ^c	40 ^c
Sugar beverages		59 ^b , 48 ^a	38 ^b , 59 ^b		
Carbohydrates	38 ^c , 36 ^a		38 ^c		
Micronutrients					
Vitamin A	36 ^a		45 ^a	45 ^c	
Vitamin C	60 ^b , 36 ^a		45 ^a	45 ^c	
Vitamin E	36 ^c		45 ^a	45 ^c	
β-Carotene					40 ^c
Folate	36 ^c		45 ^c	45 ^c	
Iron	36 ^a		45 ^c	45 ^a	
Calcium	36 ^a		45 ^a	45 ^c	
Zinc	36 ^a		45 ^c	45 ^c	
Protein	36 ^a		45 ^a	45 ^a	

^aNo significant association.

^bPositive association indicating that greater acculturation to the US culture is associated with more intake of nutrients assessed.

^cNegative association indicating that greater acculturation to the US culture is associated with less intake of nutrients assessed.

NOTE: Information from this table is available online at www.adajournal.org as part of a PowerPoint presentation.

study involving 117 Hispanic migrant workers in Pennsylvania (67), increases were noted in consumption of hamburger meat and vegetables.

The five qualitative studies also shed light on possible mechanism for the diet–acculturation relationship. Purchasing of fast food occurred more frequently in the United States (63,65,67) despite reports that fast-food restaurants were perceived to be equally accessible in their home countries (65). In Honduras, 52% of the women reported never eating fast food, whereas 100% reported consuming fast food, including nearly 50% who reported consuming fast food every weekend (63). Lack of time due to work obligations explained these findings (63). Three quotes illustrate these findings:

“When one works outside the home, yes, you go to eat hamburgers, fried chicken, and fast food” (63).

“In Mexico, (women) did not have to work, but here you

have to work. Because of this, sometimes you have to buy easy things to give to the children. You arrive from work tired. In Mexico, you attended to your kids more. Here there is not time” (65).

“If we’re somewhere and they’re hungry . . . how can I not? You know, we can stop off at [fast-food restaurant] and get a cheeseburger and french fries. It’s like a dollar” (66).

Whether an immigrant consumes fewer fruits and vegetables after emigrating to the United States appears to depend, in part, on availability in their home countries and changes in income status following immigration. Fresh foods were perceived as more readily available in their home countries than in the United States (67). For example, Gray and colleagues (65) found that 67% (n=12) of women said they bought at least some of their fresh food from street markets and 61% (n=11) said that food was fresher and more natural in their home country

compared with the United States. These fresh foods also were perceived as tastier in their home countries than in the United States (65-67). However, availability appears to vary by country of origin. In Honduras, women reported that there was little access to fresh vegetables (63). Compounding this issue was access to familiar products in the United States. Changes were attributed to the unavailability of familiar food products in United States (65,67), and increases in the availability of unfamiliar food products, specifically fresh fruits and vegetables (64). In focus groups with 79 Latina women living in Arizona, the women "saw an assortment of vegetables and fruits in their grocery stores but did not know how to prepare them" (64). They were less likely to purchase unfamiliar products because they were concerned about wasting money. Finally, the dietary acculturation process of their children appears to be a major source of influence in the parents' dietary behaviors and intake. Family dietary choices are affected by the children's desire to eat out and requests for "Americanized" food (64-67).

DISCUSSION

This review sought to examine the relationship between acculturation and diet among Latinos living in the United States. Researchers are growing increasingly interested in understanding the influence of acculturation on health behaviors and health outcomes (11,68). Some researchers are trying to disentangle which acculturation variable is most relevant to health (54); others argue that acculturation may not be the most appropriate variable to consider in understanding Latino health disparities (31). This review attempted to bring some clarity to the issue by examining the relationship between acculturation and diet using multiple operationalizations of acculturation and rigorous methods for capturing diet.

Several relationships were consistent irrespective of how acculturation was measured. First, there was no relationship between acculturation and dietary fat intake or percent energy from fat, despite evidence that fat-related behaviors seem to differ between those who are less or more acculturated. Those who are less acculturated consume more whole milk and use fat in food preparation, whereas the more acculturated consume more fast food, snacks, and added fats. Second, less vs more acculturated individuals consumed more fruit, rice, and beans. Third, less acculturated individuals consumed less sugar and sugar-sweetened beverages than more acculturated individuals. Some of our findings support the conclusions drawn by Perez-Escamilla and Putnik (5), whereas other findings are directly opposed. They indicated that "The process of acculturation among Latinos is associated with suboptimal dietary choices, including lack of breast-feeding, low intake of fruits and vegetables, and a higher consumption of fats and artificial drinks containing high levels of refined sugar" (p 867). Our conclusions also differ somewhat from the conclusions drawn by Satia-Abouta and colleagues (6) who wrote that "Overall, most of the studies found some statistically significant associations of levels of acculturation with diet. Unfortunately there was no consistent direction of effect between level of acculturation and dietary intake" (p 1116). The latter review involved only nine articles making it difficult to tease out this complicated relationship.

In a more general review on the topic, Lara and colleagues (11) noted that "More acculturated Latinos (those who are highly acculturated) are more likely to engage in substance abuse and undesirable dietary behaviors and experience worse birth outcomes compared with their less acculturated counterparts." (p 374). When one considers behaviors such as fast-food consumption, sugar-sweetened beverage consumption, and fruit consumption, our findings support those of Lara's; however, the less acculturated individuals also used meat fat to prepare foods. Overall these findings suggest a differential influence of acculturation on diet, requiring greater specificity in our dietary interventions by acculturation status.

The results of this review must be considered in light of its limitations. Although some studies examined multiple cohorts to assess the relationship over time, none of the studies were longitudinal in design severely limiting conclusions that can be drawn about the relationship between acculturation and diet. Second, Lara and colleagues (11) indicated the need to examine whether the relationship between acculturation and diet differs by Latino subgroup. Unfortunately, few studies provided sufficient information to draw any meaningful conclusions. A current research initiative, led by the National Heart, Lung, and Blood Institute, addresses these two concerns. The Hispanic Community Health Study (<http://www.csc.unc.edu/hchs/>) will collect data from 16,000 Latinos living in the United States, including their dietary intake using rigorous methods of dietary data collection (ie, 24-hour dietary recalls, a food propensity questionnaire, and biomarkers); it is longitudinal in nature. Selected measures of acculturation and migration history are being collected, although limited given concern for participant burden. All Latino subgroups will be represented with the study sites located in San Diego, Chicago, Miami, and the Bronx. The four groupings of Latinos are Cubans (mostly in Miami), Puerto Ricans and Dominicans (mostly in the Bronx), Mexican Americans (mostly in San Diego and Chicago) and Central/South Americans (mostly in Chicago and Miami).

The strength of this review is that it is more comprehensive (eg, studies range from national studies using National Health and Nutrition Examination Survey data to qualitative studies involving small samples) and focused (adults only; dietary intake or behaviors and not attitudes and beliefs; and within-group analysis vs non-Hispanic whites as a healthy reference group) than previous reviews given the study's inclusion and exclusion criteria. For example, Perez-Escamilla and Putnik (5) reviewed 16 studies; 11 of their studies were included in this review (duplicates), four were excluded because they involved an adolescent population, and one was excluded because the focus was on breastfeeding. Satia-Abouta and colleagues (6) identified nine studies involving Hispanics, all of which were duplicates in this review. In their comprehensive review of acculturation and a variety of health behaviors, Lara and colleagues (11) reviewed 10 studies on diet; eight were duplicates, one involved adolescents, and one was new (11). The Benavides-Vaello review (4) provided the greatest number of previously unidentified studies: five of the 11 studies were new, three were duplicates, and three involved adolescents.

Directions for Future Research and Practice

Future studies should examine this relationship in other geographic regions of the United States and with a more socioeconomically diverse Latino population. The fact that most of these studies took place in California is striking. Given the growing body of evidence of the influence of the neighborhood environment on the acculturation process and dietary intake, more research is clearer needed in emerging Latino communities (eg, Georgia and North Carolina). Second, acculturation is associated with improvements in socioeconomic status, including more education, better jobs, and more income. Although the poor are at significantly greater health risk due to disparities in the environment (69,70), access to quality care, and lower incomes, this review highlights the need for more research on the health of middle-class Latinos. The food marketing industry is aware of this subpopulation. Our public health efforts should not be far behind.

Culturally competent care targeting healthful lifestyles, whether for prevention or management of a chronic condition like diabetes, needs to recognize the commonalities across Latino subgroups, as well as those aspects that set them apart. Consistent with other collectivistic societies, Mexicans, Puerto Ricans, and Cubans alike emphasize the family to a greater extent than non-Hispanics in the United States. This does not seem to change with the acculturation process, although social networks may become less dense over time and generations. Families influence our food environment and what we eat (32). Second, by definition, Latinos share a fairly common language, a bond that extends from interpersonal to mass media communication. It affects the ability to communicate and receive information from health care providers. Initiatives to develop linguistically appropriate interventions, as well as improve the language skills of health care providers, have the potential to affect positive changes in health. Messages to less acculturated Latinos may need to stress maintenance of healthful lifestyle behaviors such as eating recommended quantities of vegetables, portion control to reduce energy intake, and changes to food preparation practices; the more acculturated may benefit from messages that stress moderation of fast food, sugar-sweetened beverages, and other away-from-home foods. In the United States, the common language shared by all Latino subgroups helps to bridge two cultures—the one that is retained and built upon in the United States based on one's country of origin and the dominant culture of the individual's community. Practitioners need to build into this common language the need for healthful eating habits.

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References

1. Berry J. Conceptual approaches to acculturation. In: Chun K, Organista PB, Marin G, eds. *Acculturation: Advances in Theory, Measurement, and Applied Research*. Washington, DC: American Psychological Association; 2003.
2. Cuéllar I, Arnold B, Maldonado R. Acculturation rating scale for

- Mexican Americans-II: A revision of the original ARSMA scale. *Hisp J Behav Sci*. 1995;17:275-304.
3. Marin G, Gamba RJ. A new measurement of acculturation for Hispanics: The bidimensional acculturation scale for Hispanics (BAS). *Hisp J Behav Sci*. 1996;18:297-316.
4. Benavides-Vaello S. Cultural influences on the dietary practices of Mexican Americans: A review of the literature. *Hisp Health Care Int*. 2005;3:27-35.
5. Perez-Escamilla R, Putnik P. The role of acculturation in nutrition, lifestyle, and incidence of type 2 diabetes among Latinos. *J Nutr*. 2007;137:860-870.
6. Satia-Abouta J, Patterson RE, Neuhouser ML, Elder JP. Dietary acculturation: Applications to nutrition research and dietetics. *J Am Diet Assoc*. 2002;102:1105-1118.
7. DiSogra L, Abrams B, Hudes M. Low prevalence of healthful dietary behaviors in a California agricultural county: Emphasis on white and Mexican-American adults. *J Am Diet Assoc*. 1994;94:544-546.
8. Elder J, Woodruff SI, Candelaria J, Golbect AL, Alvarez JL, Criqui MH, Norquist CD, Rupp JW. Socioeconomic indicators related to cardiovascular disease risk factors in Hispanics. *Am J Health Behav*. 1998;22:172-185.
9. Harris M, Koehler KM. Eating and exercise behaviors and attitudes of Southwestern Anglos and Hispanics. *Psychol Health*. 1992;7:165-174.
10. Hunt LM, Schneider S, Comer B. Should "acculturation" be a variable in health research? A critical review of research on US Hispanics. *Soc Sci Med*. 2004;59:973-986.
11. Lara M, Gamboa C, Kahramanian MI, Morales LS, Bautista DE. Acculturation and Latino health in the United States: A review of the literature and its sociopolitical context. *Annu Rev Public Health*. 2005;26:367-397.
12. Cooper H. *Synthesizing Research: A guide for literature reviews*. Thousand Oaks, CA: Sage; 1998.
13. Espino DV. Hypertension and acculturation in elderly Mexican Americans: Results from 1982-84 Hispanic HANES. *J Gerontol*. 1990;45:209-213.
14. Zambrana RE, Scrimshaw SC, Collins N, Dunkel-Schetter C. Prenatal health behaviors and psychosocial risk factors in pregnant women of Mexican origin: the role of acculturation. *Am J Public Health*. 1997;87:1022-1026.
15. Aldrich L, Variyam JN. Acculturation erodes the diet quality of US Hispanics. *Food Rev*. 2000;23:51-56.
16. Arredondo EM, Elder JP, Ayala GX, Slymen D, Campbell NR. Association of a traditional vs shared meal decision-making and preparation style with eating behavior of Hispanic women in San Diego County. *J Am Diet Assoc*. 2006;106:38-45.
17. Bermudez OI, Ribaya-Mercado JD, Talegawkar SA, Tucker KL. Hispanic and Non-Hispanic white elders from Massachusetts have different patterns of carotenoid intake and plasma concentrations. *J Nutr*. 2005;135:1496-1502.
18. Duerksen SC, Elder JP, Arredondo EM, Ayala GX, Baquero B, Elder JP. Family restaurant choices are associated with child and adult overweight status in Mexican-American families. *J Am Diet Assoc*. 2007;107:849-853.
19. Gans K, Burkholder G, Risica P, Lasater T. Baseline fat-related dietary behaviors of white, Hispanic, and black participants in a cholesterol screening and education project in New England. *J Am Diet Assoc*. 2003;103:699-706.
20. Goslar PW, Macera CA, Castellanos LG, Hussey JR, Sy FS, Sharpe PA. Blood pressure in Hispanic women: The role of diet, acculturation, and physical activity. *Ethn Dis*. 1997;7:106-113.
21. Hubert HB, Snider J, Winkleby MA. Health status, health behaviors, and acculturation factors associated with overweight and obesity in Latinos from a community and agricultural labor camp survey. *Prev Med*. 2005;40:642-651.
22. Sundquist J, Winkleby M. Country of birth, acculturation status, and abdominal obesity in a national sample of Mexican-American women and men. *Int J Epidemiol*. 2000;29:470-477.
23. Cobas JA, Balcazar H, Benin MB, Keith VM, Chong Y. Acculturation and low-birthweight infants among Latino women: A reanalysis of HHANES data with structural equation models. *Am J Public Health*. 1996;86:394-396.
24. Dixon LB, Sundquist J, Winkleby M. Differences in energy, nutrient, and food intakes in a US sample of Mexican-American women and men: Findings from the Third National Health and Nutrition Examination Survey, 1988-1994. *Am J Epidemiol*. 2000;152:548-557.
25. Guendelman S, Abrams B. Dietary intake among Mexican-American women: Generational differences and a comparison with white non-Hispanic women. *Am J Public Health*. 1995;85:20-25.
26. Marks G, Garcia M, Solis JM. Health risk behaviors of Hispanics in

- the United States: Findings from HHANES, 1982-84. *Am J Public Health*. 1990;80(suppl):20-26.
27. Stimpson JP, Urrutia-Rojas X. Acculturation in the United States is associated with lower serum carotenoid levels: Third National Health and Nutrition Examination Survey. *J Am Diet Assoc*. 2007;107:1218-1223.
 28. Khan LK, Martorell R. Diet diversity in Mexican Americans, Cuban Americans, and Puerto Ricans. *Ecol Food Nutr*. 1997;36:401-415.
 29. Van Hook J, Glick JE. Immigrant and living arrangements: Moving beyond economic need versus acculturation. *Demography*. 2007;44:225-249.
 30. Ellis M, Wright R. Spatial demography special feature: Assimilation and differences between the settlement patterns of individual immigrants and immigrant households. *Proc Natl Acad Sci*. 2005;102:15325-15330.
 31. Viruell-Fuentes EA. Beyond acculturation: Immigration, discrimination, and health research among Mexicans in the United States. *Soc Sci Med*. 2007;65:1524-1535.
 32. Ayala GX, Rogers M, Arredondo E, Campbell N, Baquero B, Duerksen S, Elder JP. Away-from-home food intake and risk for obesity: Examining the influence of context. *Obesity*. 2008. In press.
 33. Powell LM, Slater S, Mirtcheva D, Bao Y, Chaloupka FJ. Food store availability and neighborhood characteristics in the United States. *Prev Med*. 2007;44:189-195.
 34. Kamphuis CBM, Giskes K, de Bruijn G-J, Wendel-Vos W, Brug J, van Lenthe FJ. Environmental determinants of fruit and vegetable consumption among adults: A systematic review. *Br J Nutr*. 2006;96:620-635.
 35. Sharma S, Murphy SP, Wilkens LR, Shen L, Hankin JH, Monroe KR, Henderson B, Kolonel LN. Adherence to the food guide pyramid recommendations among African Americans and Latinos: Results from the multiethnic cohort. *J Am Diet Assoc*. 2004;104:1873-1877.
 36. Gregory-Mercado KY, Staten LK, Gillespie C, Ranger-Moore J, Thomson CA, Guiliano AR, Will JC, Ford ES, Marshall J. Ethnicity and nutrient intake among Arizona WISEWOMAN participants. *J Womens Health (Larchmt)*. 2007;16:379-389.
 37. Gregory-Mercado KY, Staten LK, Ranger-Moore J, Thomson CA, Will JC, Ford ES, Guillen J, Larkey LK, Guiliano AR, Marshall J. Fruit and vegetable consumption of older Mexican-American women is associated with their acculturation level. *Ethn Dis*. 2006;16:89-95.
 38. Bermudez OI, Falcon LM, Tucker KL. Intake and food sources of macronutrients among older Hispanic adults: Association with ethnicity, acculturation, and length of residence in the United States. *J Am Diet Assoc*. 2000;100:665-673.
 39. Lin H, Bermudez OI, Tucker KL. Dietary patterns of Hispanic elders are associated with acculturation and obesity. *J Nutr*. 2003;133:3651-3657.
 40. Monroe KR, Hankin JH, Pike MC, Henderson BE, Stram DO, Park S, Nomura AM, Wilkens LR, Kolonel LN. Correlation of dietary intake and colorectal cancer incidence among Mexican-American migrants: The multiethnic cohort study. *Nutr Cancer*. 2003;45:133-147.
 41. Census 2000 summary file 3 (SF 3)—Sample data. US Census Bureau Web site. <http://factfinder.census.gov/servlet/DatasetMainPageServlet>. Accessed May 14, 2008.
 42. Therrien M, Ramirez RR. *The Hispanic Population in the United States: March 2000*. Washington, DC: US Census Bureau; 2000.
 43. Bassford TL. Health status of Hispanic elders. *Clinics in geriatric medicine*. 1995;11:25-38.
 44. Garcia-Maas LD. Intergenerational analysis of dietary practices and health perceptions of Hispanic women and their adult daughters. *J Transcult Nurs*. 1999;10:213-219.
 45. Harley K, Eskenazi B, Block G. The association of time in the US and diet during pregnancy in low-income women of Mexican descent. *Paediatr Perinat Epidemiol*. 2005;19:125-134.
 46. Ayala GX, Elder JP, Campbell NR, Roy N, Slymen DJ, Engelberg M, Ganiats T. Correlates of body mass index and waist-to-hip ratio among Mexican women in the United States: Implications for intervention development. *Womens Health Issues*. 2004;14:155-164.
 47. Ayala GX, Mueller K, Lopez-Madurga E, Campbell NR, Elder JP. Restaurant and food shopping selections among Latino women in Southern California. *J Am Diet Assoc*. 2005;105:38-45.
 48. Fitzgerald N, Himmelgreen D, Damio G, Segura-Perez S, Peng YK, Pérez-Escamilla R. Acculturation, socioeconomic status, obesity and lifestyle factors among low-income Puerto Rican women in Connecticut, US, 1998-1999. *Rev Panam Salud Publica*. 2006;19:306-313.
 49. Winkleby MA, Albright CL, Howard-Pitney B, Lin J, Fortmann SP. Hispanic/white differences in dietary fat intake among low educated adults and children. *Prev Med*. 1994;23:465-473.
 50. Elder JP, Castro FG, de Moor C, Mayer J, Candelaria JI, Campbell N, Talavera G, Ware LM. Differences in cancer-risk-related behaviors in Latino and Anglo adults. *Prev Med*. 1991;20:751-763.
 51. Woodruff SI, Zaslow KA, Candelaria J, Elder JP. Effects of gender and acculturation on nutrition-related factors among limited-English proficient Hispanic adults. *Ethn Dis*. 1997;7:121-126.
 52. Polednak AP. Use of selected high-fat foods by Hispanic adults in the northeastern US. *Ethn Health*. 1997;2:71-76.
 53. Harley K, Eskenazi B. Time in the United States, social support, and health behaviors during pregnancy among women of Mexican descent. *Soc Sci Med*. 2006;62:3048-3061.
 54. Norman S, Castro C, Albright C, King A. Comparing acculturation models in evaluating dietary habits among low-income Hispanic women. *Ethn Dis*. 2004;14:399-404.
 55. Balcazar H, Castro FG, Krull JL. Cancer risk reduction in Mexican American women: The role of acculturation, education, and health risk factors. *Health Educ Q*. 1995;22:61-84.
 56. Kasirye OC, Walsh JA, Romano PS, Beckett LA, Garcia JA, Elvine-Kries B, Bethel JW, Schenker MB. Acculturation and its association with health-risk behaviors in a rural Latina population. *Ethn Dis*. 2005;15:733-739.
 57. Neuhouser ML, Thompson B, Coronado GD, Solomon CC. Higher fat intake and lower fruit and vegetables intakes are associated with greater acculturation among Mexicans living in Washington State. *J Am Diet Assoc*. 2004;104:51-57.
 58. Smith WE, Day RS, Brown LB. Heritage retention and bean intake correlates to dietary fiber intakes in Hispanic mothers—Que Sabrosa Vida. *J Am Diet Assoc*. 2005;105:404-411.
 59. Himmelgreen DA, Brettnall A, Perez-Escamilla R, Peng Y, Bermudez A. Birthplace, length of time in the US, and language are associated with diet among inner-city Puerto Rican women. *Ecol Food Nutr*. 2005;44:105-122.
 60. Gardner C, Winkleby MA, Viteri FE. Dietary intake patterns and acculturation levels of Hispanic immigrant men: A pilot study. *Hisp J Behav Sci*. 1995;17:347-361.
 61. Otero-Sabogal R, Sabogal F, Perez-Stable EJ, Hiatt RA. Dietary practices, alcohol consumption, and smoking behavior: Ethnic, sex, and acculturation differences. *J Natl Cancer Inst Monogr*. 1995;18:73-82.
 62. Cuellar I, Harris LC, Jasso R. An acculturation scale for Mexican American normal and clinical populations. *Hisp J Beh Sci*. 1980;2:199-217.
 63. Edmonds VM. The nutritional patterns of recently immigrated Honduran women. *J Transcult Nurs*. 2005;16:226-235.
 64. Hampl JS, Sass S. Focus groups indicate that vegetable and fruit consumption by food stamp-eligible Hispanics is affected by children and unfamiliarity with non-traditional foods. *J Am Diet Assoc*. 2001;101:685-687.
 65. Gray VB, Cossman JS, Dodson WL, Byrd SH. Dietary acculturation of Hispanic immigrants in Mississippi. *Salud Publica Mex*. 2005;47:351-360.
 66. Dubowitz T, Acevedo-Garcia D, Salkeld J, Lindsay AC, Subramanian SV, Peterson KE. Lifecourse, immigrant status and acculturation in food purchasing and preparation among low-income mothers. *Public Health Nutr*. 2007;10:396-404.
 67. Cason K, Nieto-Montenegro S, Chavez-Martinez A. Food choices, food sufficiency practices, and nutrition education needs of Hispanic migrant workers in Pennsylvania. *Top Clin Nutr*. 2006;21:144-158.
 68. Clark L, Hofess L. Acculturation. In: Loue S, ed. *Handbook of Immigrant Health*. Springer; 1998:37-60.
 69. Moore LV, Diez Roux AV. Associations of neighborhood characteristics with the location and type of food stores. *Am J Public Health*. 2006;96:325-331.
 70. Morland K, Diez Roux AV, Wing S. Supermarkets, other food stores, and obesity: The atherosclerosis risk in communities study. *Am J Prev Med*. 2006;30:333-339.