Published in final edited form as:
J Am Diet Assoc. 2009 November ; 109(11): 1878–1885. doi:10.1016/j.jada.2009.08.015.

Differences in fruit and vegetable intake among Hispanic subgroups in California - Results from the 2005 California Health Interview Survey

Uriyoán Colón-Ramos, ScD., MPA,
Formerly, CRTA post-doc fellow, Health Promotion Research Branch, Behavioral Research Program, Division of Cancer Control and Population Sciences, National Cancer Institute, 6130 Executive Blvd / EPN 4074 MSC 7335, Bethesda, MD 20892-7335, Currently: uc13@cornell.edu

Frances E. Thompson, Ph.D., MPH,
Epidemiologist, Risk Factor Monitoring and Methods Branch, Applied Research Program, Division of Cancer Control and Population Sciences, National Cancer Institute, 6130 Executive Blvd / EPN 4095A MSC 7344, Bethesda, MD 20892-7344, Phone: 301-435-4410, Fax: 301-435-3710, thompsof@mail.nih.gov

Amy Lazarus Yaroch, Ph.D.,
Formerly, Behavioral Scientist, Program Director, Health Promotion Research Branch, Behavioral Research Program, Division of Cancer Control and Population Sciences, National Cancer Institute, 6130 Executive Blvd / EPN 4074 MSC 7335, Bethesda, MD 20892-7335, Currently: Director, Center for Human Nutrition, Rm. 1024, 505 Durham Research Plaza, Omaha, NE 68105-1313, Phone: 402-559-5500, Fax: 402-559-7302, ayaroch@unmc.edu

Richard P. Moser, Ph.D.,
Research Psychologist, Office of the Associate Director, Behavioral Research Program, Division of Cancer Control and Population Sciences, National Cancer Institute, 6130 Executive Blvd., MSC 7326, Executive Plaza North, Room 4052, Bethesda, MD 20892-7326, Phone: 301-496-0273, Fax: 301- 435-7547, moserr@mail.nih.gov

Timothy S. McNeel, B.A.,
Information Management Services, Inc., 12501 Prosperity Dr., Suite 200, Silver Spring, MD 20904, Phone: 301-680-9770, Fax: 301-680-8304, mcneelt@imsweb.com

Kevin W. Dodd, Ph.D.,
Biometry Research Group, Division of Cancer Prevention, National Cancer Institute, National Institutes of Health, Department of Health and Human Services, 6130 Executive Blvd Room 3129 MSC 7362, Bethesda, MD 20892-7362, Phone: 301-496-7461, Fax: 301-402-0816, doddk@mail.nih.gov

Audie A. Atienza, Ph.D.,
National Cancer Institute, Division of Cancer Control and Population Sciences, Behavioral Research Program, Health Promotion, Research Branch, 6130 Executive Blvd, EPN 4082, Bethesda, MD 20892-7335, Phone: 301-402-8426, Fax: 301-480-2087, atienzaa@mail.nih.gov

Correspondence to: Frances E. Thompson.

Sharon B. Sugerman, MS, RD, FADA, and
Research Scientist II, California Department of Public Health Cancer Prevention and Nutrition Section Research and Evaluation Unit, MS-7204, PO Box 997377, Sacramento, CA 95899-7377, Phone: 916- 449-5406, Fax: 916- 449-5415, Sharon.Sugerman@cdph.ca.gov

Linda Nebeling, Ph.D., M.P.H. RD, FADA
Chief, Health Promotion Research Branch, Behavioral Research Program, Division of Cancer Control and Population Sciences, National Cancer Institute, 6130 Executive Blvd, EPN 4060, Bethesda, MD 20892-7326, Phone: 301- 435-2841, Fax: 301- 435-7547, nebelinl@mail.nih.gov

Abstract

Objective—To compare total fruit and vegetable intake in cup equivalents (FVC) and its individual components among Hispanic subgroups in California.

Methods—Data are from the adult portion of the 2005 California Health Interview Survey. Hispanic/Latino subjects (n = 7954) were grouped into six subcategories (Mexican, Central American, Caribbean, Spanish American, South American, > 1 group). FVC was estimated from frequency responses about seven food categories. T-test and chi-squares were estimated to assess differences in sociodemographic characteristics across Hispanic subgroups. Multivariate linear regressions using SUDAAN were conducted to obtain means of FVC and its components by Hispanic subgroups controlling for confounders.

Results—Hispanic subgroups did not differ in their intake of total FVC (mean cups = 3.4 and 2.9 for men and women, respectively). Small but significant differences ($p<0.01$) were found across Hispanic subgroups in individual FVC components (green salad (women only), cooked dried beans and non-fried white potatoes) after adjusting for potential sociodemographic and acculturation confounders.

Conclusion—Hispanic FVC intake did not meet the national recommendation, although their reported intake is higher compared to other race/ethnicity groups. The public health message remains the same: to increase FVC. Examination of intake for subgroups of Hispanics may enhance the utility of dietary information for surveillance, program and message design, and intervention and evaluation.

INTRODUCTION

Hispanics as a group is the fastest growing demographic group in the United States (US); it is estimated that by 2050, 25% of the population in the US will be Hispanic (1). The Office of Management and Budget uses the terms ‘Hispanic’, ‘Latino’ or ‘of Spanish Origin’ interchangeably; the classification is composed of any person of Cuban, Mexican, Puerto Rican, South or Central American or other Spanish culture or origin (2). This group, however, is not a homogeneous one; it includes people from different racial and socioeconomic backgrounds and cultural influences. Health behavior practices and morbidity and mortality incidences are also different (3–11). Furthermore, Hispanic subgroups may differ in immigration history and rate of acculturation to the US diet (12,13). However, data about dietary intake for Hispanic subgroups in the US are scarce; only a few studies have compared dietary intake among some Hispanic subgroups (6,12,14–17).

Prior research has noted that consuming a diet high in fruits and vegetables is associated with lower risk of chronic diseases including cardiovascular disease, diabetes and certain types of cancers (18). In previous surveys, Hispanics have reported higher intake of fruits and vegetables than other ethnic groups (19,20). However, none have examined potential differences in fruit and vegetable consumption across subgroups of Hispanics. This study uses data from the 2005 California Health Interview Survey (CHIS 2005) to examine potential differences in total and individual components of fruit and vegetable intake among Hispanic

subgroups. The results will broaden our understanding of common and distinct dietary patterns, and inform design of public health nutrition programs for specific subpopulations within this heterogeneous group.

METHODS

Data are from the adult portion of the CHIS 2005, a biennial, population-based random digit dial telephone survey of California's population conducted between July 2005 and April 2006. The CHIS is based at the University of California at Los Angeles' (UCLA) Center for Health Policy Research; it is conducted in collaboration with the California Department of Public Health, the California Department of Health Care Services and the Public Health Institute. The CHIS was designed to produce reliable estimates of various health parameters, including diet (questions on diet were partially funded by the National Cancer Institute (NCI)). The CHIS study protocols were approved by the UCLA and the NCI Institutional Review Boards.

The CHIS surveys are the largest health surveys ever conducted in any state. The total number of completed interviews among adults for the CHIS 2005 was 43,020; a response rate of 26.9% (49.8% screener completion rate times 54.0% adult interview completion) is comparable to other surveys conducted in California in the 2005–2006 time frame (21). CHIS 2005 methodology and sample design are described in detail elsewhere (22) (http://www.ucla.chis.edu).

Study population

One of the advantages of the CHIS 2005 is its ability to capture the rich diversity of the California population, including a large sample of Hispanic respondents (n=8036 in total). In order to recruit English and non-English speakers, the interviews were conducted in five different languages. About 10% of adult interviews were conducted in languages other than English. Of those self-identified as Hispanics/Latinos, 38.9% of the interviews were conducted in Spanish.

Country of origin

The CHIS asked respondents about their racial and ethnic background. Those who self-reported being Latino or Hispanic were then asked about their specific country of origin. For the purposes of this study, the authors grouped countries of origin by geographic regions as follows: Mexican (Mexican, Mexican American, Chicano), Central American (Salvadoran, Guatemalan, Costa Rican, Honduran, Nicaraguan, Panamanian), Caribbean (Puerto Rican, Cuban, other Caribbean origin), Spanish-American (from Spain or Spanish origin), South American (Colombian, Argentinean, Peruvian and other South American origin); and more than one of the other five Hispanic or Latino origin groups. Eighty-two Hispanic respondents who could not be categorized into one of the six groups were excluded from Hispanic subtype analyses (Hispanic group n=7954). Geographic regions tend to share similar socio-political history and cultures. Some social scientists may argue that Hispanics should be categorized by their immigration status and not by geographic region of origin (i.e. Cubans and Mexicans share immigration status, so they should be grouped together, and Puerto Ricans should be grouped with other American citizens such as Mexican American and Chicano) (23). In the CHIS, the authors found no statistical differences between the groups of Puerto Ricans and Cubans, and the groups of Mexicans, Mexican-Americans and Chicanos in sociodemographic variables of interest (education, income, BMI, percentage of smokers). Therefore, Puerto Ricans and Cubans were grouped together, as were Mexicans, Mexican-Americans and Chicanos.

Fruit and vegetable assessment

Fruit and vegetable intake in cup equivalents (FVC) was estimated from responses about frequency of consumption of seven categories of fruits and vegetables (fruit; 100% fruit juice; green leafy or lettuce salad; cooked dried beans; French fries, home fries or hash browns; other potatoes; and other vegetables), using the following procedures. The reported frequency category for each individual food was converted to mean daily number of times consumed. Because portion size was not asked, external estimates of median portions (in cup equivalents) by gender and 10-year age group were applied. Generally, a cup equivalent of fruits is defined as 1 cup of fruit or 100% fruit juice or ½ cup of dried fruit; a cup equivalent of vegetables is defined as 1 cup of raw or cooked vegetables or vegetable juice or 2 cups of raw leafy greens (24). For each component, frequency of intake was multiplied by age-sex specific portion size. In order to estimate total FVC, these component estimates were summed, and regression coefficients (developed externally to reflect the relationship between the screener and 24-hour dietary recall), were applied (25). Estimates of intake for individual components and total fruits and vegetables are given in cup equivalents.

Sociodemographic and other characteristics

were included in the analyses either as categorical or as continuous variables. These included: age; gender; marital status (married, never married or other); annual household income; hours worked per week for those working outside the home; food security status (high food security, marginal food security, low food security, very low food security); percentage at or under 300% federal poverty level; years of education completed; smoking status (current smoker vs. not current smoker); body mass index (BMI = self-reported weight (kg)/self-reported height (m^2)); days in poor health per month; physical activity (self-reported vigorous leisure activity for at least 3 days per week and 20 minutes per day or moderate leisure activity for at least 5 days per week and 30 minutes per day; moderate and vigorous activities were defined respectively as activities that make you breathe somewhat harder or much harder than normal); and number of children in household, as well as self-reported history of high cholesterol, heart disease, hypertension, diabetes and colo-rectal cancer. Variables indicating receipt of social services (i.e. Food Stamps, Social Security, Temporary Assistance to Needy Families and California Work Opportunity and Responsibility to Kids (TANF/CALWORKS), and Women, Infants, Children (WIC) Supplemental Nutrition Program) were also included, as well as information regarding acculturation (born in U.S. vs. not; number of years living in the US; language of interview (Spanish, English); and English proficiency (speak only English; speak English very well/well; do not speak English well or at all)).

Statistical analyses

Descriptive statistics were estimated to assess differences in socio-demographic characteristics and dietary intake across race/ethnicity and by Hispanic subgroup. SUDAAN (Survey Data Analysis, Research Triangle Institute, Research Park Triangle, NC) was used with jackknife replicate weights to account for the complex sampling design in computing variance estimates. For comparisons with national data, the authors also analyzed mean total FVC from the National Health and Nutrition Examination Survey which used 24-hour dietary recalls rather than a screener (NHANES 2003–2004 presented in Table 1). These data were also analyzed in SUDAAN using jackknife replicate weights. All analyses were weighted to obtain California (CHIS) or national (NHANES) estimates. Table 1 shows age-adjusted means of total FVC from NHANES 03–04 and CHIS by race/ethnicity. P-values were obtained using pair-wise comparisons between Hispanics and other ethnic groups.

Sociodemographic and health characteristics among the Hispanic subgroups are presented in Table 2. Because FVC consumption is related to both gender and age, further analyses tested for significant differences in selected characteristics (those that are continuous rather than

categorical in scaling) among the groups after adjusting for gender and age. All variables that remained statistically significantly different across Hispanic subgroups were tested one by one in their association with FVC or its components. Variables that showed a significant association ($p<0.05$) with FVC and ethnic subgroups were included in the final multivariate regression models to obtain mean FVC and its components.

FVC was examined in the original scale as well as the transformed scale (using the square root in order to approximate normality); no notable differences were seen in the means of FVC, so cup equivalents on the original scale are presented in the tables for easier interpretation. Overall p-values for Hispanic groups were obtained and significant differences noted ($p<0.05$). Individual fruit and vegetable components that varied significantly across Hispanic subgroups ($p<0.05$) were further examined in pair-wise comparisons. Because of multiple comparisons, the Bonferroni correction was used to detect statistically significant differences ($p<0.005$).

RESULTS

Table 1 shows the means of total FVC from CHIS 2005. For comparisons with national data, Table 1 also presents results from NHANES 2003–2004. Due to sampling design, the Hispanic group of NHANES is predominantly Mexican-Americans, while Hispanics in CHIS included all Hispanic groups. Results from both surveys are generally consistent: Among women in both surveys, Hispanics reported higher mean total FVC than non-Hispanic Whites (CHIS $p<0.001$; NHANES $p<0.01$) or Blacks (CHIS $p<0.05$; NHANES $p<0.001$). Among men, in CHIS, there were no significant differences by race/ethnicity. Among men in NHANES, while there were no differences in reported intakes between non-Hispanic Whites and Blacks, and between non-Hispanic Whites and Mexican Americans, Mexican-American men reported higher ($p<0.01$) FVC consumption than non-Hispanic Black men.

Using CHIS 2005 data, there were significant differences ($p<0.05$) in demographic characteristics (education, income, below federal poverty level, high food security, number of hours worked per week, number of children in household, born outside the US, number of years living in the US for those foreign-born, and English proficiency); behavioral characteristics (smoking, BMI); use of income assistance programs (Food Stamps, WIC); and self-reported health conditions (days of poor physical health, diabetes) among Hispanic subgroups (Table 2). These relationships in ratio scaled variables remained after gender and age adjustment. Respondents of Mexican and Central American origins had lower education and income, as compared to the other groups; the subgroup of Mexican origin had the largest number of children in the household and the highest BMI. South American and Central American reported longer working hours per week. Caribbean respondents reported the most days in poor physical health and the largest number of years living in the US (not surprising, since the majority of respondents in this group were Puerto Rican, and Puerto Rico is considered as part of the US). Groups also differed ($p<0.05$) in prevalence of smoking and reported history of diabetes. Those of Mexican and Central American origins were more likely to be at or under the 300% federal poverty level, and report receiving WIC benefits. Respondents of Mexican and Central American origins were more likely ($p<0.05$) to have been born outside the US and report that they did not speak English well or at all.

Final models for analysis of differences in FVC among Hispanic subgroups were stratified by gender and controlled for potential confounders (age, income, education, BMI, smoking, born in the US). Further adjustment for English proficiency, language of interview or number of years lived in the US did not alter the results (Tables 3A and Table 3B). There were no differences in total FVC among Hispanic subgroups ($p=0.86$ for females and $p=0.24$ for males) (Table 3A and 3B). However, an examination of the components of FVC suggests differences by gender and across these subgroups, even after adjusting for potential confounders (age,

income, education, BMI, smoking and born in the US). South American women reported higher intake of other white potatoes (significant differences among all subgroups) and green salad (significant difference compared to Mexican and Central Americans) and a lower intake of cooked dried beans (significant differences among all subgroups). Among men, only two components of total fruit and vegetables remained significantly different across subgroups after adjusting for potential confounders: Mexican men reported higher consumption of cooked dried beans than all other groups except respondents of multiple origin; and South American men reported higher intake of other white potatoes than did Mexican, Spanish, and multiple origin men.

DISCUSSION

Consuming a diet high in fruits and vegetables is associated with lower risk of chronic diseases including cardiovascular disease, diabetes and certain types of cancers (18). Results from this study found higher intake of total fruit and vegetable cup equivalents for Hispanic men and women, as compared to non-Hispanic Whites and Blacks. These findings are consistent with national results from NHANES 2003–2004 using 24-hour dietary recalls. Previous data from the 2000 National Health Interview Survey (NHIS) also found that Latino men and women reported significantly higher servings of fruits and vegetables than non-Hispanic White and Black counterparts (20). Although total fruit and vegetable consumption for Hispanic subjects is somewhat higher than other race/ethnicity groups in the US population, it is lower than the recommended intake of fruits and vegetables for Americans (a total of 4.5 cups of fruit and vegetables per day for a 2,000-calorie intake) (26). Identifying differences in intake across the Hispanic subgroups may help public health programs mold nutrition education messages to increase fruit and vegetable intake in this population.

Even though all people of Hispanic or Latino descent are often grouped together in surveys, the Hispanic population is heterogeneous, composed of persons of Hispanic, Latino and Spanish origin (2). Previous studies that have compared dietary intake by ethnicity have focused mostly on Mexican-Americans (13,19,27–30), and do not represent well over one-third of the US Hispanic population of other countries of origin (1). To date, there are only a few studies that have examined dietary intake among Hispanic subgroups and compared differences. Studies that have looked at particular dietary intakes between selected Hispanic groups, suggest different eating behaviors by country of origin (3,6,12,15,16).

The current study is the first to compare fruit and vegetable intake among five Hispanic subgroups in a representative sample. Although no differences were found in total FVC across Californian Hispanic subgroups, there were significant differences in the estimated intake of the individual fruit and vegetable components (beans and other potatoes for both genders, and salad for women), even after considering potential sociodemographic and acculturation confounders. These findings suggest that among different Hispanic subgroups, there are preferences for certain types of fruits and vegetables that go beyond sociodemographic predictors or acculturation factors. However, with the very short food questionnaire, it was not possible to examine potential differences in individual type of fruit and vegetable in detail.

The Hispanic population in the US varies widely by region of origin and, thereby, by race, culture and health behavior practices, among others (4,5,23,31,32). Previous studies have examined how subpopulations of this heterogeneous group differ in their sociodemographic characteristics, and determinants and predictors of disease and mortality (4,6,9–11,13,33,34). The various Hispanic subgroups may also differ in their level of acculturation (English proficiency, years lived in the US, language of interview, etc). In separate studies, Gordon-Larsen et al.(12), and Lin et al. (35) reported different effects of acculturation on dietary patterns by Hispanic subgroups, specifically, adolescent Puerto Ricans, Cubans and Mexicans,

and elderly Dominicans and Puerto Ricans respectively. The present study found that Hispanic subgroups differed in sociodemographic variables and various characteristics that suggest acculturation; however, these differences did not explain all of the variation found in fruit and vegetable intake within certain subgroups. A plausible explanation is that food is still related to culture from the country of origin among certain groups. In a careful examination of cultural diversity of diet among Hispanics, Sanjur noted that dietary patterns are bound to the local cultures and sociopolitical histories. Foods that remain more 'static' in diets tend to be staple foods, such as maize in Central America, and corn and beans among Mexicans and Mexican-American diets (17). However, it is still not well understood which factors foster dietary change away from traditional dietary patterns (17,35), whether this change may lead to healthier or unhealthier outcomes, and how that may differ by Hispanic subgroup. The current study identified small, but significant differences in intake of various components of total fruit and vegetable consumption. Although the main public health message is still that all race/ethnicity groups should increase intake of total fruit and vegetables, this information on small but significant differences among Hispanic subgroups may be useful to local public health programs in California that want to target the fruit and vegetable consumption through the food culture of specific Hispanic subgroups in their communities.

There are several limitations to this study, including that all measures of health behavior and sociodemographic variables were self-reported, which may lead to some misclassification and bias. In addition, the overall response rate for CHIS 2005 suggests a low response; however, it is comparable to the response rates in other national telephone surveys (36). An important limitation of this study is the use of a short dietary assessment instrument, instead of a more detailed measure, such as multiple 24-hour dietary recalls, to estimate fruit and vegetable intake. The screener only asked about frequency of consumption of seven items; portion sizes were estimated using external data. An analytical procedure which calibrated screener-type responses against 24-hour recalls was used to provide a better approximation of fruit and vegetable intake. However, race/ethnicity was not incorporated in the calibration. Despite this limitation, screener estimates of differences among Hispanics, non-Hispanic whites and non-Hispanic blacks in CHIS 2005 were generally consistent with national estimates (NHANES 2003–2004) that used multiple 24-hour recalls to collect dietary data. Another limitation of the screener is the lack of information on specific fruits and vegetables that would allow the authors to examine consumption in accordance to the Dietary Guidelines' specific recommendations (26). For example, the USDA Food Guide recommends consumption of 2 cups per week of orange vegetables; 3 cups per week of dark green vegetables and 3 cups per week of dry beans; the screener does not ask about orange and dark green vegetables separately.

The CHIS dataset is unique in that it is able to capture the rich diversity of the California Hispanic population, providing a major strength to this study. The large number of Hispanic respondents in the CHIS adult dataset allowed the authors to estimate differences in fruit and vegetable intake among Hispanic subgroups with considerable confidence. This is the first such study in this growing segment of the US population. The results are generalizable to the state of California but also suggest patterns that may pertain to other regions of the US.

The main public health message remains to increase FVC among all ethnic and Hispanic subgroups, but the small differences in FVC found among Hispanic subgroups can have valuable implications for the design and implementation of this public health message. Results can be particularly useful in the design of culturally-sensitive public health programs that promote fruit and vegetable consumption among local Hispanic subgroups. The findings can be relevant to identify barriers among various subgroups to increase intake of fruits and vegetables and to identify how different groups respond to various public health messages. Future epidemiologic studies that wish to examine disease outcomes on dietary data about specific fruits and vegetables among various Hispanic groups could also find these results

useful. Recognition of the heterogeneity of Hispanics also implies the need for surveillance of the diet among Hispanic subgroups.

CONCLUSIONS

In California, Hispanics reported higher consumption of fruits and vegetables than non-Hispanic Whites and Blacks, although their intake still does not meet the national recommendation. There were no significant differences in total fruit and vegetable intake among different Hispanic subgroups. However, different Hispanic subgroups reported differences in intake of specific fruits and vegetables. As Hispanics are the largest minority in the US, it is increasingly important to examine the health behaviors of this heterogeneous group more carefully. Future research of Hispanics should consider design and adequate sample size in order to capture any potential diversity in health behaviors. Also, public health programs that wish to promote fruit and vegetable consumption among Hispanics should consider the heterogeneous nature of this population.

Acknowledgments

The authors would like to thank Susan Foerster, MPH, RD, from the Network for a Healthy California, who provided assistance and support during this project.

References

1. U.S. Census Bureau. Hispanic population in the United States: 1970 to 2050. U.S. Census Bureau Web site. [Accessed February 17, 2008]. http://www.census.gov/population/www/socdemo/hispanic/hispanic_pop_presentation.html
2. Office of Management and Budget. Revisions to the standards for the classification of Federal data on race and ethnicity. Office of Management and Budget Web site. [Accessed February 3, 2008]. http://www.whitehouse.gov/omb/fedreg/ombdir15.html
3. Bermudez OI, Velez-Carrasco W, Schaefer EJ, Tucker KL. Dietary and plasma lipid, lipoprotein, and apolipoprotein profiles among elderly Hispanics and non-Hispanics and their association with diabetes. Am J Clin Nutr 2002;76:1214–1221. [PubMed: 12450885]
4. Borak J, Fiellin M, Chemerynski S. Who is Hispanic? Implications for epidemiologic research in the United States. Epidemiology 2004;15:240–244. [PubMed: 15127918]
5. Bowie JV, Juon HS, Cho J, Rodriguez EM. Factors associated with overweight and obesity among Mexican Americans and Central Americans: results from the 2001 California Health Interview Survey. Prev Chronic Dis 2007;4:A10. [PubMed: 17173718]
6. Gans KM, Burkholder GJ, Upegui DI, Risica PM, Lasater TM, Fortunet R. Comparison of baseline fat-related eating behaviors of Puerto Rican, Dominican, Colombian, and Guatemalan participants who joined a cholesterol education project. J Nutr Educ Behav 2002;34:202–210. [PubMed: 12217263]
7. Gao X, Martin A, Lin H, Bermudez OI, Tucker KL. alpha-Tocopherol intake and plasma concentration of Hispanic and non-Hispanic white elders is associated with dietary intake pattern. J Nutr 2006;136:2574–2579. [PubMed: 16988129]
8. Hajat A, Lucas JB, Kington R. Health outcomes among Hispanic subgroups: data from the National Health Interview Survey, 1992-95. Adv Data 2000:1–14. [PubMed: 10977762]
9. Khan LK, Sobal J, Martorell R. Acculturation, socioeconomic status, and obesity in Mexican Americans, Cuban Americans, and Puerto Ricans. Int J Obes Relat Metab Disord 1997;21:91–96. [PubMed: 9043961]
10. Mendoza FS, Ventura SJ, Valdez B, Castillo RO, Saldivar LE, Baisden K, Martorell R. Selected measures of health status for Mexican-American, mainland Puerto Rican, and Cuban-American children. JAMA 1991;265:227–232. [PubMed: 1984152]

11. Smith CA, Barnett E. Diabetes-related mortality among Mexican Americans, Puerto Ricans, and Cuban Americans in the United States. Rev Panam Salud Publica 2005;18:381–387. [PubMed: 16536924]
12. Gordon-Larsen P, Harris KM, Ward DS, Popkin BM. Acculturation and overweight-related behaviors among Hispanic immigrants to the US: the National Longitudinal Study of Adolescent Health. Soc Sci Med 2003;57:2023–2034. [PubMed: 14512234]
13. 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. [PubMed: 17374645]
14. 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. [PubMed: 10863569]
15. Loria CM, Bush TL, Carroll MD, Looker AC, McDowell MA, Johnson CL, Sempos CT. Macronutrient intakes among adult Hispanics: a comparison of Mexican Americans, Cuban Americans, and mainland Puerto Ricans. Am J Public Health 1995;85:684–689. [PubMed: 7733429]
16. Polednak AP. Use of selected high-fat foods by Hispanic adults in the northeastern US. Ethn Health 1997;2:71–76. [PubMed: 9395590]
17. Sanjur, D. Hispanic Foodways, Nutrition & Health. Boston: Allyn and Bacon; 1995.
18. Food, Nutrition, Physical Activity, and the Prevention of Cancer: a Global Perspective. Washington, DC: American Institute for Cancer Research; 2007. World Cancer Research Fund, American Institute for Cancer Research. Vegetables, fruits, pulses (legumes), nuts, seeds, herbs, spices. Section. 4.2.
19. Casagrande SS, Wang Y, Anderson C, Gary TL. Have Americans increased their fruit and vegetable intake? The trends between 1988 and 2002. Am J Prev Med 2007;32:257–263. [PubMed: 17383556]
20. Thompson FE, Midthune D, Subar AF, McNeel T, Berrigan D, Kipnis V. Dietary intake estimates in the National Health Interview Survey, 2000: methodology, results, and interpretation. J Am Diet Assoc 2005;105:352–363. [PubMed: 15746822]
21. California Health Interview Survey. CHIS 2005 methodology series report 4: response rates. UCLA Center for Health Policy Research Web site. [Accessed April 23, 2008]. http://www.chis.ucla.edu/pdf/CHIS2005_method4.pdf
22. California Health Interview Survey. CHIS 2005 methodology series report 1: sample design. UCLA Center for Health Policy Research Web site. [Accessed April 23, 2008]. http://www.chis.ucla.edu/pdf/CHIS2005_method1.pdf
23. Gimenez ME. Latino/"Hispanic"--who needs a name? The case against a standardized terminology. Int J Health Serv 1989;19:557–571. [PubMed: 2753584]
24. U.S. Department of Agriculture. Inside the pyramid. U.S. Department of Agriculture Web site. [Accessed April 23, 2008]. http://www.mypyramid.gov/pyramid/
25. National Cancer Institute. Diet screener in the 2005 CHIS: scoring procedures. National Cancer Institute Web site. [Accessed February 14, 2008]. http://appliedresearch.cancer.gov/surveys/chis/dietscreener/scoring.html
26. U.S. Department of Agriculture. Dietary guidelines for Americans 2005. U.S. Department of Agriculture Web site. [Accessed April 27, 2008]. http://www.health.gov/dietaryguidelines/dga2005/document/pdf/DGA2005.pdf
27. Block G, Norris JC, Mandel RM, DiSogra C. Sources of energy and six nutrients in diets of low-income Hispanic-American women and their children: quantitative data from HHANES, 1982–1984. J Am Diet Assoc 1995;95:195–208. [PubMed: 7852686]
28. Carrera PM, Gao X, Tucker KL. A study of dietary patterns in the Mexican-American population and their association with obesity. J Am Diet Assoc 2007;107:1735–1742. [PubMed: 17904933]
29. 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. [PubMed: 10997545]
30. Kruger J, Yore MM, Solera M, Moeti R. Prevalence of fruit and vegetable consumption and physical activity by race/ethnicity--United States, 2005. MMWR Morb Mortal Wkly Rep 2007;56:301–304. [PubMed: 17410082]
31. Jones Syracuse, C. Cultural diversity: eating in America - Puerto Rican. The Ohio State University Web site. [Accessed February 14, 2008]. http://ohioline.osu.edu/hyg-fact/5000/5257.html

32. Warrix, M. Cultural diversity: eating in America - Mexican-American. The Ohio State University Web site. [Accessed February 14, 2008]. http://ohioline.osu.edu/hyg-fact/5000/5255.html

33. Aldrich L, Variyam JN. Acculturation erodes the diet quality of U.S. Hispanics. Food Rev 2000;23:51–55.

34. Kuczmarski M, Kuczmarski R, Najjar M. Food usage among Mexican-American, Cuban and Puerto Rican adults. Nutr Today 1995;30:30–37.

35. Lin H, Bermudez OI, Tucker KL. Dietary patterns of Hispanic elders are associated with acculturation and obesity. J Nutr 2003;133:3651–3657. [PubMed: 14608089]

36. Nelson DE, Powell-Griner E, Town M, Kovar MG. A comparison of national estimates from the National Health Interview Survey and the Behavioral Risk Factor Surveillance System. Am J Public Health 2003;93:1335–1341. [PubMed: 12893624]

Table 1

Age-adjusted mean (95% Confidence Intervals) daily intake of total fruit and vegetable cup equivalents: California Health Interview Survey 2005 and National Health and Nutrition Examination Survey 2003–2004

	Women			Men		
California Health Interview Survey 2005 (from screener)	**Hispanic (n=4760)**	**Non-Hispanic White*** (n=16267)**	**Non-Hispanic Black* (n=1124)**	**Hispanic (n=3219)**	**Non-Hispanic White (n=11141)**	**Non-Hispanic Black (n=681)**
	2.94 (2.90, 2.98)	2.85 (2.83, 2.88)	2.83 (2.74, 2.91)	3.38 (3.32, 3.44)	3.36 (3.32, 3.40)	3.25 (3.08, 3.42)
National Health and Nutrition Examination Survey 2003–2004 (from 24HR)	**Mexican-American (n=536)**	**Non-Hispanic White** (n=1338)**	**Non-Hispanic Black*** (n=559)**	**Mexican-American (n=501)**	**Non-Hispanic White (n=1249)**	**Non-Hispanic Black** (n=508)**
	3.03 (2.87, 3.20)	2.58 (2.39, 2.97)	2.46 (2.31, 2.60)	3.26 (2.81, 3.71)	3.04 (2.85, 3.22)	2.49 (2.35, 2.62)

* $p<0.05$ compared to Hispanic (California Health Interview Survey).

** $p<0.01$ compared to Mexican-American (National Health and Nutrition Examination Survey).

*** $p<0.001$ compared to Hispanic (California Health Interview Survey) or Mexican-American (National Health and Nutrition Examination Survey).

J Am Diet Assoc. Author manuscript; available in PMC 2010 November 1.

Table 2

Weighted mean or percentage (standard error) distribution of sociodemographic and health characteristics by Hispanic subgroup[a] : California Health Interview Survey, 2005 (n= 7954)

Variables (*type*[b])	Mexican (n=6115)	Central American (n=692)	Caribbean (n=215)	Spanish (n=323)	South American (n=247)	> 1 Origin (n=362)	Total (n=7954)
Age, y *	37.6	39.3	43.0	47. 5	41.7	37.3	38.2
(R)	(0.15)	(0.66)	(1.48)	(1.33)	(1.32)	(1.02)	(0.12)
Women, %	49.0	48.6	46.3	50.1	54.7	47.4	49.0
(C)	(0.46)	(2.59)	(4.01)	(3.44)	(3.80)	(3.46)	(0.06)
Education completed, y *	10.7	10.0	13.5	14.1	14.6	13.2	11.0
(R)	(0.05)	(0.24)	(0.29)	(0.26)	(0.22)	(0.18)	(0.04)
Annual household income, $ *	40798	38305	66358	64241	68185	87492	44395
(R)	(633.1)	(1706.7)	(7562.3)	(4075.5)	(7337.8)	(11624.0)	(799.8)
Hours worked per week *	28.9	32.5	27.3	27.8	33.9	27.6	29.3
(R)	(0.36)	(1.00)	(1.79)	(2.20)	(1.37)	(1.59)	(0.30)
Married, %	53.9	53.5	50.1	52.2	52.8	45.6	53.4
(C)	(0.77)	(2.61)	(4.30)	(3.70)	(4.32)	(3.43)	(0.66)
Number of children aged 0–11 in household *	1.0	0.8	0.6	0.4	0.6	0.7	1.0
(R)	(0.02)	(0.06)	(0.08)	(0.07)	(0.06)	(0.09)	(0.02)
Current smokers, % *	13.9	9.4	26.1	17.0	15.1	14.7	13.8
(C)	(0.61)	(1.66)	(4.39)	(2.79)	(2.85)	(2.66)	(0.54)
Body mass index, kg/m^2 *	28.0	27.6	27.1	27.1	25.9	26.7	27.8
(R)	(0.12)	(0.30)	(0.48)	(0.37)	(0.45)	(0.42)	(0.10)
Body weight status (BMI)							
Overweight/obese (≥25.0), % *	67.4	61.8	61.0	69.4	48.9	59.6	65.9
(C)	(0.83)	(2.35)	(4.17)	(3.89)	(4.56)	(3.49)	(0.72)
Poor physical health, *d in past month* *	3.6	4.1	6.9	4.8	3.3	4.4	3.8
(R)	(0.13)	(0.45)	(0.98)	(0.63)	(0.63)	(0.62)	(0.12)
Vigorous physical activity, %	12.5	9.4	13.9	13.9	16.9	14.9	12.4

Variables (*type*[b])	Mexican (n=6115)	Central American (n=692)	Caribbean (n=215)	Spanish (n=323)	South American (n=247)	> 1 Origin (n=362)	Total (n=7954)
(C)	(0.55)	(1.61)	(2.89)	(2.30)	(3.37)	(2.50)	(0.51)
Moderate physical activity, %	24.0	20.9	21.1	24.5	29.7	24.0	23.8
(C)	(0.72)	(1.65)	(3.61)	(3.39)	(4.88)	(3.31)	(0.60)
Medical history, %:							
High cholesterol	17.9	20.7	20.8	20.9	18.3	13.4	18.1
(C)	(0.68)	(2.01)	(3.44)	(2.48)	(3.35)	(1.98)	(0.59)
Heart disease	3.3	4.1	7.6	5.4	5.3	7.0	3.7
(C)	(0.27)	(1.12)	(2.20)	(1.56)	(2.28)	(1.87)	(0.29)
High blood pressure	18.4	18.0	23.7	25.1	17.2	21.3	18.8
(C)	(0.64)	(1.92)	(3.99)	(2.76)	(3.21)	(2.85)	(0.55)
Diabetes*	9.0	9.2	12.7	9.8	3.8	8.9	9.0
(C)	(0.36)	(1.64)	(3.04)	(2.25)	(1.16)	(1.98)	(0.37)
Colo-rectal cancer	0.2	0.1	0.8	0.0	0.5	0.0	0.2
(C)	(0.07)	(0.06)	(0.08)	(0.0)	(0.53)	(0.0)	(0.06)
≤300% Federal Poverty Level, %*	73.1	74.7	50.9	37.0	45.1	46.4	69.9
(C)	(0.68)	(2.00)	(4.71)	(4.07)	(4.16)	(4.12)	(0.64)
Of those ≤300% Federal Poverty Level (n=5237):							
Food stamp recipient, %*	7.5	4.1	9.9	6.1	2.1	4.2	7.0
(C)	(0.52)	(1.12)	(3.59)	(2.80)	(1.78)	(1.48)	(0.42)
Social security recipient, %	3.7	4.9	7.4	13.0	2.2	6.2	4.1
(C)	(0.35)	(1.16)	(2.59)	(3.24)	(1.35)	(2.25)	(0.33)
TANF/CALWORKS, %	2.8	1.7	3.2	4.1	2.0	3.1	2.7
(C)	(0.29)	(0.49)	(1.78)	(2.03)	(1.78)	(1.27)	(0.25)
Of those with child < 7 and/or pregnant: n=1244):							
WIC recipient, %*	55.2	48.3	8.9	44.4	25.9	37.3	53.3
(C)	(1.79)	(7.66)	(5.57)	(18.53)	(10.83)	(13.10)	(1.67)
Of those with ≤200% of federal poverty level: n=4137):							
High food security, %*	51.6	47.6	54.5	65.3	52.5	57.8	51.5

Variables (*type*[b])	Mexican (n=6115)	Central American (n=692)	Caribbean (n=215)	Spanish (n=323)	South American (n=247)	> 1 Origin (n=362)	Total (n=7954)
(C)	(1.08)	(3.30)	(7.95)	(6.91)	(6.41)	(6.58)	(1.05)
Born outside US, %*	58.7	86.6	11.6	10.0	76.4	16.7	57.9
(C)	(0.68)	(1.64)	(2.76)	(2.29)	(3.07)	(2.74)	(0.59)
Of those born outside US (n=3835):							
Time living in US, y*	17.5	17.5	35.8	30.9	18.7	24.6	17.4
(R)	(0.24)	(0.53)	(4.14)	(2.69)	(1.21)	(2.20)	(0.22)
Language of interview*:							
Spanish, %	47.9	61.2	4.9	1.3	21.1	3.5	44.5
(C)	(0.63)	(2.39)	(1.51)	(0.67)	(3.0)	(1.14)	(0.59)
Doesn't speak English well or at all, %*	41.8	49.2	4.3	0.6	19.7	3.4	38.4
(C)	(0.67)	(2.47)	(1.51)	(0.34)	(3.49)	(1.04)	(0.60)

[a]Definition of Hispanic subgroups is as follows: Mexican origin (Mexican, Mexican American, Chicano); Central American (Salvadoran, Guatemalan, Costa Rican, Honduran, Nicaraguan, Panamanian); Caribbean (Puerto Rican, Cuban and other Caribbean); Spanish American (from Spain); South American (Colombian, Argentinean, Peruvian, other South American origin); > 1 origin (respondent identifies with more than one Hispanic group from above).

[b]Type of variable: R = ratio; C= categorical

*At least two of the Hispanic subgroup means or percentages are significantly different from each other ($p<0.05$).

Table 3

Table 3A. Adjusted[a] mean (standard error) daily intake of total and individual[b] fruit and vegetable cup equivalents : California Health Interview Survey 2005, adult women (n=4711)

	Mexican (n=3608)	Central American (n=415)	Caribbean (n=125)	Spanish (n=186)	South American (n=160)	> 1 Origin (n=217)	p-Value[c]
			Cup Equivalents per Day				
Total fruits and vegetables	2.93	3.01	2.97	3.00	3.00	2.98	0.86
	(0.02)	(0.08)	(0.15)	(0.09)	(0.12)	(0.10)	
Fruit	0.97	0.95	0.94	1.02	0.95	0.97	0.97
	(0.02)	(0.05)	(0.09)	(0.07)	(0.08)	(0.07)	
100% fruit juice	0.51	0.63	0.66	0.54	0.54	0.55	0.07
	(0.02)	(0.05)	(0.09)	(0.06)	(0.06)	(0.05)	
Green salad*	0.22 **sa**	0.21 **sa**	0.24	0.25 **ca**	0.28 **ca, mx**	0.23	**0.04**
	(0.00)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	
Cooked dried beans*	0.18 **cb, sp, sa**	0.16 **sa**	0.14 **mx, sa**	0.13 **mx, sa, ca, 2o**	0.08 **mx, ca, cb, sp, 2o**	0.16 **sp, sa**	**<0.001**
	(0.00)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	
Fried potatoes	0.06	0.06	0.04	0.06	0.06	0.06	0.68
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	
Other white potatoes*	0.10 sa, cb	0.09 **sa**	0.08 **sa**, mx	0.08 **sa**	0.16 mx, **ca, cb, sp, 2o**	0.11	**0.01**
	(0.00)	(0.01)	(0.02)	(0.01)	(0.02)	(0.02)	
Other vegetables	0.48	0.49	0.48	0.52	0.51	0.50	0.20
	(0.01)	(0.01)	(0.03)	(0.03)	(0.03)	(0.02)	

Table 3B. Adjusted[a] mean (standard error) daily intake of total and individual [b] fruit and vegetable cup equivalents: California Health Interview Survey 2005, adult men (n=3188)

	Mexican (n=2465)	Central American (n=272)	Caribbean (n=89)	Spanish (n=136)	South American (n=86)	> 1 Origin (n=140)	p-Value[c]
			Cup Equivalents per Day				
Total fruits and vegetables	3.43	3.33	3.51	3.19	3.53	3.69	0.24
	(0.03)	(0.10)	(0.17)	(0.13)	(0.18)	(0.24)	
Fruit	0.88	0.85	0.91	0.75	0.89	0.89	0.60
	(0.02	(0.07)	(0.12)	(0.07)	(0.12)	(0.12)	
100% fruit juice	0.61	0.63	0.70	0.57	0.72	0.74	0.40

Table 3B. Adjusted[a] mean (standard error) daily intake of total and individual [b] fruit and vegetable cup equivalents: California Health Interview Survey 2005, adult men (n=3188)

	Mexican (n=2465)	Central American (n=272)	Caribbean (n=89)	Spanish (n=136)	South American (n=86)	> 1 Origin (n=140)	p-Value[c]
	(0.02)	(0.06)	(0.08)	(0.10)	(0.09)	(0.12)	
Green salad	0.16	0.15	0.14	0.15	0.20	0.19	0.29
	(0.00)	(0.01)	(0.02)	(0.02)	(0.03)	(0.03)	
Cooked dried beans*	0.29 **ca,cb, sa, sp**	0.23 **mx**	0.22**mx**	0.23 **mx**, sa	0.17 **mx**, sp	0.32	**<0.001**
	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.07)	
Fried potatoes	0.12	0.11	0.10	0.15	0.14	0.10	0.41
	(0.00)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	
Other white potatoes*	0.13 sa	0.13	0.16 sp	0.10 **sa**	0.19 mx, **sp**, 2o	0.17 sa	**0.05**
	(0.00)	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)	
Other vegetables	0.45	0.44	0.47	0.42	0.42	0.53	0.16
	(0.01)	(0.02)	(0.04)	(0.03)	(0.04)	(0.03)	

[a] Adjusted for age, household income, education, BMI, current smoking and born in the US.

[b] Values are a product of frequency and estimated portion size.

[c] p-value for overall differences across Hispanic subgroups.

* Significant differences (using Bonferroni correction, bolded values are P<0.005; unbolded values are P<0.01) in pair-wise comparisons: mx (Mexican), ca (Central American), cb (Caribbean), sp (Spanish), sa (South American), 2o (>1 origin).