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Authors
Ramírez, A Susana
Wilson, Machelle D
Miller, Lisa M Soederberg

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Segmented assimilation as a mechanism to explain the dietary acculturation paradox

A. Susana Ramírez, PhD, MPH[a,*], **Machelle D. Wilson, PhD**[b], **Lisa M. Soederberg Miller, PhD**[c]

[a]Department of Public Health, University of California, 5200 North Lake Road, Merced, CA, 95340, USA.

[b]Department of Public Health Sciences, University of California, One Shields Avenue, Davis, CA, 95616, USA.

[c]Department of Human Ecology, University of California, One Shields Avenue, Davis, CA, 95616, USA.

Abstract

U.S. Latinos have disproportionately high rates of diet-related diseases which are associated with acculturation to the US. This negative shift in dietary quality is paradoxical in light of gains in income and education that would be expected to lead to better diet. We examined the extent to which the dietary acculturation paradox among Mexican Americans can be explained by segmented assimilation, a theory that considers how immigrants' and their descendants' trajectories of integration are influenced by a complex interplay of individual, social, and structural factors. First, we performed confirmatory cluster analysis to identify three assimilation segments (classic, underclass, and selective) based on education, income, and an acculturation proxy derived from language, nativity, and time in the U.S. among Mexican-origin participants (N=4,475) of the 2007–2016 National Health and Nutrition Examination Survey (NHANES). These segments were then used as independent variables in linear regression models to estimate the relationship between cluster and dietary quality (assessed by the Health Eating Index (HEI)) and the interaction between cluster and gender, controlling for marital status. There were strong effects of cluster on dietary quality, consistent with hypotheses per segmented assimilation theory. The classic assimilation segment had the poorest diet, despite having higher income and education than the underclass segment. The selective segment had higher or similar dietary quality to the underclass segment. Consistent with expectations, this difference was driven by the relatively higher consumption of greens and beans and whole grains of those in the selective and underclass segments. Overall, women had better diets than men; however, the strongest contrast was in the underclass segment. This study advances understanding of dietary acculturation and potential disparities in diet-related health outcomes.

*Corresponding author: sramirez37@ucmerced.edu.

Keywords

acculturation; dietary acculturation paradox; Healthy Eating Index; Hispanic; obesity

1. INTRODUCTION

Latinos in the United States – the largest ethnic group in the country, numbering 60.6 million[1] – have disproportionately high rates of diet-related conditions and diseases, including obesity and diabetes[2,3]. Risk for poor diet and obesity may be a function of economic and culturally-based dietary patterns: for example, Latinos have lower incomes and double the rates of food insecurity of non-Latino Whites[4]. In addition, studies of dietary patterns have found that while immigrants initially eat a diet considered healthful – rich in fruits and vegetables, high in fiber, and low in saturated fat, as they become more acculturated to mainstream US culture, they adopt a less healthful, Standard American Diet, characterized by fewer fruits and vegetables, less fiber, and more saturated fat[5–10]. Other studies have shown that increasing acculturation is associated with decreasing consumption of ethnic foods and increasing consumption of fats and sugars or other unhealthful nutrients[11–13]. Bicultural second- and third-generation Latinos are more likely to suffer from obesity and diet-related disease compared with their immigrant parents and grandparents[14,15]. Yet immigrant, first-generation Latinas are at higher risk of poverty than either second-generation Latinas or White non-Latina women. Thus, the negative shift in dietary quality is paradoxical in light of gains in income and education, which, among other populations, typically increase diet quality[9,16–18]. This paradoxical pattern is most consistently seen in Mexican American populations, who also suffer from higher rates of obesity and diabetes compared with other ethnic groups including other Latino subgroups[19].

1.1 Dietary Acculturation Paradox

Dubbed the acculturation paradox, this phenomenon has been the subject of debate. On the one hand, numerous researchers have questioned the existence of such a paradox on the basis of inconsistent findings across health behaviors and health outcomes[16,20–23]. Evidence for the paradox has been documented in diet-related health outcomes as well as in mortality and birthing outcomes[22,24–26]. Yet some have noted methodological problems with epidemiological studies reporting such a so-called paradox, with arguments that the findings are attributable to poor measurement of the underlying construct of acculturation[27]. Another critique is that the mortality paradox observed among immigrants may be partially explained by the “salmon bias hypothesis,” suggesting that the longer-than-expected lifespans for immigrants to the U.S. is due to the immigrants representing the healthiest, fittest members of the sending countries[24,28–30].

Nevertheless, recent studies employing diverse methods and samples have suggested that cultural understanding of food and dietary behaviors – and how these behaviors evolve through the process of acculturation, and throughout the life course – may help to explain the observed (paradoxical) epidemiological findings with respect to dietary behaviors. For example, in one study, second- and third-generation Mexican American women perceived “American” foods as generally more healthful than traditional Mexican foods[31]; this

misperception could account at least in part for the negative dietary shift observed across immigrant generations. Other work suggests that structural factors that facilitate or impede integration into mainstream society are responsible for immigrants' worse health[32]. In a qualitative study with Dominican immigrant women in New York City, for example, researchers found that dietary behaviors such as consuming non-traditional foods are due to modest material conditions or lack of access to traditional foods in their new environment[33]. These findings raise questions about what it means to integrate, as well as what dietary acculturation is, and how dietary acculturation might differ across Latino subgroups.

1.2 Segmented Assimilation

An approach to clarifying the confusing pattern of studies observing a dietary acculturation paradox may be segmented assimilation, a sociological framework that examines how immigrants' and their descendants' trajectories of integration are influenced by a complex interplay of individual, social, and structural factors. Segmented assimilation theory[34] identifies three distinct patterns of integration: classic assimilation (the adoption of mainstream values and behaviors and rejection of original culture); underclass acculturation (poverty, low educational attainment, maintenance of original culture); and selective acculturation (retention of ethnic values along with economic and educational advancement). In the case of diet, income and education are negatively associated with dietary quality in the general population[35–37]. Because Latinos in the US are both more likely to live in poverty[38] and to have low educational attainment[39] compared with non-Latino whites, we would expect that they should have poorer dietary quality as well. Yet these patterns have been inconsistently observed, leading to the "dietary paradox". But if we consider the distinct trajectories of cultural integration, we may observe more consistency in the relationship between dietary quality and acculturation. Those who "make it"—achieve a college education or a middle-class income by completely assimilating to mainstream U.S. culture—may also lose what could be considered the protective component of their culture of origin. In dietary terms, that would be indicated by the adoption of the poor-quality Standard American Diet[10]. But those who achieve a cultural balance (e.g., accepting some parts of U.S. mainstream culture while retaining cultural traditions and a strong sense of ethnic identity and pride) may be protected from adopting the Standard American Diet by retaining more of the dietary patterns from that culture of origin.

Although there is a large literature on segmented assimilation in the context of educational, economic, and political trajectories, relatively few studies to date have used the theory to examine health-related outcomes. One study using data from the National Latino and Asian American Survey found partial support for the pattern of segmented assimilation and this was associated with obesity among Latinos[40]. Another study found that children of Mexican immigrants demonstrate more dietary assimilation outside the home (i.e., schools and restaurants), but the relative healthfulness of the food depended on the location[41]. Recently, researchers seeking to move beyond culture-based explanations for the high rates of obesity among Latinos compared with white Americans argued that acculturation and socioeconomic status operate as dual streams of influence on the risk of obesity[42]. Using a conceptual framework that includes both socioeconomic status and an acculturation index, the researchers found that higher socioeconomic status was negatively associated with

weight gain while acculturation was positively associated with weight gain. Further, they found that gender is an important modifier of acculturation effects, such that acculturation was a greater risk for obesity among men. Although this study informs a more complex understanding of acculturation and diet-related outcomes, the mechanisms through which acculturation influenced weight gain were not tested. Thus, the specific dietary changes that might reflect dietary acculturation differentially across assimilation groups remain unclear.

Other studies have not explicitly examined segmented assimilation but have tested or found evidence that can be considered preliminary support for components of the theory. For example, one study in South Texas found evidence that less-acculturated Mexican Americans had healthier diets compared with more-acculturated (bilingual and English-monolingual) Mexican Americans; this pattern was true across two proxy indicators of acculturation, language preference and generation[43]. In a study with Hispanic/Latino youth[44], researchers distinguished between those with a bicultural orientation – equally preferring US and culture of origin – were considered “integrated”; those with a high US and low Latino orientation, “assimilated”; and those with a low US and high Latino orientation, “separated”. While there was no consistent pattern between dietary quality and acculturative category, less-acculturated youth – as defined by two distinct proxies, generation and language preference – had better dietary quality than more-acculturated youth[44]. That study controlled for family income but did not examine how income might moderate the effects of acculturation on diet, or how income (as a proxy for the greater construct of socioeconomic incorporation) might factor into assimilation trajectory.

Similarly, in a study conducted in a US-Mexico border city, female Mexican migrants with low socioeconomic position were more likely to adopt the low-quality Standard American Diet than those with higher levels of income and education[45]. The women with low socioeconomic position migrated having already developed poor dietary habits as a function of their social position and associated access to healthier foods and ways of eating both in Mexico and in the United States[45]. Such findings would reject the “salmon bias” hypothesis for the acculturation paradox. In another study examining Latinos’ use of nutrition labels using population-based data from the National Health and Nutrition Examination Survey, results suggested some evidence for segmented assimilation: Having a low income had a negative effect on English-speaking Latinos’ nutrition label use, whereas less-acculturated (Spanish-speaking) Latinos’ label use did not significantly decrease (from the relatively high use rate of about 80%) with poverty[46]. This pattern of effects was replicated with dietary quality as the outcome[46]. These results suggest that having low income is detrimental for those with behavioral acculturation (*i.e.*, acquisition of English language), but less significant for those who do not acculturate (*i.e.*, retain native language).

Together, these studies are consistent with the notion that the segmented assimilation framework can shed light on the seemingly paradoxical findings in the relationship between acculturation and dietary behaviors. Missing from the literature, however, is an explicit test of the theory in the context of dietary quality. Thus, we sought to understand the relationships between socioeconomic, acculturation factors, and dietary quality.

1.3 Present Study

The present study examined the extent to which the dietary acculturation paradox among Mexican Americans can be explained by segmented assimilation. Consistent with Florez and Abraído-Lanza's[40] approach to examine segmented assimilation and obesity, we used cluster analysis to characterize three clusters of participants in terms of acculturation and socioeconomic status as predicted by segmented assimilation theory: *classic assimilation* (adoption of mainstream values and rejection of original culture, indicated by English dominance and relatively high levels of income and education); *selective acculturation* (retention of ethnic values along with economic and educational advancement, indicated by Spanish and English bilingualism and high levels of income and education); and *underclass acculturation* (retention of ethnic values and behaviors and lack of socioeconomic advancement, indicated by relatively high poverty, low educational attainment, and Spanish-language preference). Critically, segmented assimilation theory speaks to both inter- and intra-generational trajectories. That is, individuals who arrive to the United States from other countries may adapt to U.S. customs and culture over their lifetimes, and examination of the changes in their behaviors and would be consider their individual assimilation trajectory. Yet studying individual trajectories is impractical for most researchers, as it would require multiple data collection efforts over individuals' lifetimes. Thus, assimilation research typically examines groups of individuals and compares changes in group-level attributes[47]. Consistent with that approach, in this study, we aggregate individual level data to create clusters of individuals who have similar patterns of assimilation. We hypothesized that those following the classic assimilation path would have the worst diet – this is the group who, in moving away from the presumed healthier dietary customs of their origin cultures, adopt the Standard American Diet. Those in the selective acculturation group were expected to have the best diets, as they benefit from the protective effects of high incomes, education, as well as maintenance of some cultural behaviors including adherence to traditional Mexican diets high in the foods recommended to achieve nutrient adequacy (*i.e.*, greens, beans, whole grains). Those who appear to have the least integration to U.S. society –the underclass pattern – were expected to have good diets, somewhat protected by their adherence to traditional Mexican diets, but with some residual negative effects of poverty that are not completely ameliorated by low acculturation.

A secondary goal was to explore gender differences in cluster effects on dietary quality. Research suggests that Latinas are more likely to consumer a healthier diet than Latinos. The positive effects of marriage and caregiving responsibilities on women's dietary behaviors may be explained in part by cultural norms, for example, having to eat less in order to ensure their family members have enough, or not having access to animal protein to the same extent as men—behaviors that nutritionists define as healthier, even if they are experienced as deprivations[48]. However, there is also evidence suggesting that the family context – specifically, the presence of a male figure in the household – is positively associated with weight gain behaviors[48]. However, men in the selective acculturation cluster may be more inclined to adopt less traditional gender-constrained roles in the household and therefore take a more active role in the family diet. Yet existing work has examined only main effects of gender, making it unclear whether the combined effects of assimilation path would show a similar or varying pattern with gender. Thus, we hypothesized that gender would moderate

the effects of acculturation on diet such that gender differences would be more pronounced in the classic assimilation and underclass clusters and less pronounced in the selective. Specifically, we expected that the negative effects of classic and underclass assimilation on dietary quality would be more pronounced for men than for women.

2. METHODS

2.1 Sample Design and Data Collection

We used data from five National Health and Nutrition Examination Survey (NHANES) waves between 2007 and 2016. NHANES is a nationally representative study of the civilian, non-institutionalized U.S. population conducted by the National Center for Health Statistics. Given the diversity of cultures subsumed within the panethnic labels “Hispanic” and “Latino”[49], the centrality of foods and dietary patterns in cultural identity-making[31], and evidence of increased dietary health risks among Mexican-origin Latinos[49], we limited the sample to Mexican Americans. The final sample thus consisted of self-identified Mexican origin adults, ages 20–80 (N=4475; see Table 1). The complex, multistage, probability sampling scheme and estimation procedures are described in CDC publications[50,51]; analyses were adjusted using the provided weights and strata.

2.2 Measures

The methods and measures are described in greater detail by the Centers for Disease Control and Prevention[52].

2.2.1 Segmented Assimilation Cluster Components—

The following measures of acculturation, income, and education were used in a confirmatory cluster analysis, where cluster assignment was then used as an independent variable in models examining dietary quality.

Acculturation.: To construct the measure of acculturation we first created a measure of the individual’s immigration status based on the NHANES variable *dmdyrsus*, which is an ordinal variable indicating how many years a foreign-born individual has lived in the US. This variable ranges from 1, indicating that the individual has lived in the US less than 1 year, to 9, indicating that the individual has lived in the US for 50 or more years. We adjusted this variable for age by dividing by age and multiplying by 100 to obtain a scalar variable that functions as a proxy to the percentage of an individual’s life that they have lived in the US. For example, the lowest observed value of the scalar variable (1.25) was for an 80-year-old individual who had lived in the US for less than 1 year (dmdyrsus = 1). The highest value observed (28.57) was a 21-year-old individual who had lived in the US for at least 20 years (dmdyrsus = 6). This scalar variable was then discretized as 0 (a value less than or equal to 7; 29.16% of sample), 1 (a value greater than 7 and less than or equal to 12; 23.06% of sample), or 2 (a value greater than 12; 25.79% of sample). Individuals born in the US (NHANES variable dmdborn4 = 1) were given the value 3 (21.99% of sample). This final ordinal variable, ranging from 0 to 3, was then added to the NHANES variable *acd040*, which is a 5-category ordinal variable ranging from 1 to 5 indicating increasing use of English at home (value 1 for those speaking only Spanish at home and 5 for those speaking

only English). The final acculturation variable ranged in value from 1 to 8, where 1 indicates low acculturation (speaking only Spanish and living a small proportion of one's life in the US) and where 8 indicates high acculturation (speaking only English and living a large proportion of one's life in the US). No other language-based proxy measure is available in NHANES.

Income.: We used the Poverty to Income Ratio (PIR), an index for the ratio of family income to poverty that ranges from 0 to 5. This measure is based on the U.S. Department of Health and Human Services' (HHS) poverty guidelines, which are issued each year and determine financial eligibility for federal assistance programs including Head Start, Supplemental Nutrition Assistance Program (SNAP), Supplemental Nutrition Program for Women, Infants, and Children (WIC), and the National School Lunch Program. A value of 1.3 or lower determines eligibility for SNAP. PIR was calculated by dividing family income by the poverty level specified by HHS guidelines, adjusted for family size, as well as the appropriate year and state.

Education.: We used the highest grade or level of education completed by adults 20 years and older. The five response categories were: less than 9th grade education, 9–11th grade education (included some 12th grade and no diploma), High school graduate/GED, some college or associates (AA) degree, and college graduate or higher.

2.2.2 Cluster Analysis and Assignment—

We performed confirmatory cluster analysis on the variables acculturation, education, and income, as described above. In accord with segmented assimilation theory (SAT), we sought to confirm 3 clusters that were consistent with conceptual framework proposed by SAT in their education, income, and acculturation values. We used a k-means cluster procedure, which involved a disjoint cluster analysis based on Euclidean distances, with least squares estimation. Once each individual was assigned to a cluster, we used the cluster assignment as an independent variable in the linear models described below in section 2.3.

2.2.3 Participant Demographics

Gender.: We used a binary variable where 1 indicates male and 2 indicates female.

Marital Status.: We controlled for marital status, dichotomized as married (1) or non-married (0), because prior research has shown that marriage is negatively associated with diet[48].

2.2.4 Dietary Quality—

The Healthy Eating Index (HEI)-2010 is an overall measure of dietary quality, specifically assessing adherence to the Dietary Guidelines for Americans[53]. The HEI incorporates foods and nutrients that should be consumed to ensure a nutrient-adequate diet, and those that should be limited or consumed in moderation for chronic disease prevention. Dietary intake data were taken from two 24-hour dietary recalls. Dietary quality was assessed using an average of the two dietary recalls for each individual to calculate HEI scores.

HEI Total Score.: The HEI score is calculated as a summary of 12 components, 9 of which assess *adequacy* of the diet, including 1) total fruit; 2) whole fruit; 3) total vegetables; 4) greens and beans; 5) whole grains; 6) dairy; 7) total protein foods; 8) seafood and plant proteins; and 9) fatty acids. The remaining 3 components – refined grains, sodium, and empty calories (i.e., energy from solid fats, alcohol, and added sugars (SOFAAS)) – assess dietary components that are recommended to be consumed in *moderation*. Higher scores reflect better diet quality for all components and for the total because lower intakes are scored higher for the moderation components. The scores of the 12 components are summed to yield a total score with a maximum value of 100.

HEI and Adequacy and Moderation Components.: In addition to the overall HEI score, we examined adequacy and moderation components. Specifically, we were interested in whether differences in overall dietary quality were more attributable to lower consumption of healthier foods – those whose consumption is encouraged, including fruit, vegetables, whole grains, dairy, protein, and fatty acids – or to higher consumption of less-healthy foods – those whose consumption is discouraged, including refined grains, sodium, and empty calories (solid fats, alcohol, and added sugars). The adequacy score was calculated by summing the nine individual adequacy component scores (maximum 60), and the moderation score was calculated by summing the three moderation component scores (maximum 40). Further details and examples of the subcomponents can be found at the National Cancer Institute HEI website[54].

2.3 Statistical Analysis

All statistical analyses were performed using SAS® version 9.4 for Windows®. The SAS macro provided by the National Cancer Institute was used to create the HEI scores from the dietary recall data[55]. The FASTCLUS procedure was used for the confirmatory cluster analysis. The Wilcoxon rank sum test, ANOVA, and chi square tests were used to examine differences between the clusters for ordinal, continuous, and categorical variables, respectively. The SURVEYREG procedure was used to fit linear models to test for cluster effects and their interaction with gender on dietary quality as measured by the HEI scores, while controlling for marital status, using the strata and weights provided in the NHANES data set to adjust for the complex sampling design. Normality was assessed using histograms, as well as diagnostic plots from the linear regressions and ANOVA models. A p-value of less than 0.05 was considered significant in all analyses. Multiple comparisons within a linear model were adjusted using the Tukey-Kramer adjustment.

3. RESULTS

The identified clusters conformed well to segmented assimilation theory in terms of average education level, income, and acculturation score, and there were significant differences in total HEI, the adequacy component, and the moderation component across clusters (see Table 2). Women had better diets than men overall, and gender by segment interactions were significant for the total HEI and the adequacy scores but not for the moderation scores. Marital status had significant effects in all models.

3.1 Cluster Analysis

Cluster analysis yielded three clusters that were well-separated and well-defined. The clusters conformed to segmented assimilation theory, consisting of a classic assimilation pattern, an underclass pattern, and a selective pattern as hypothesized. As expected, the selective segment was characterized by having higher education and income levels compared with the classic segment. Table 2 shows the medians and interquartile range for the 3 cluster variables and percentages for gender and marital status for each cluster.

3.2 Associations between clusters and diet quality

Healthy Eating Index (HEI) Total—When considering only the main effects, the classic segment had significantly lower diet quality (mean=49.1 (standard error=0.37)) than both the selective (52.8 (0.39), p<.001) and the underclass (52.5 (0.36), p<.001) segments, but selective and underclass segments were similar (p=.85). In general, women eat better diets than men (53.4 (0.31) vs 49.5 (0.5931), p<.001) Data are shown in Appendix.

After adjusting for sex, marital status, and the interactions between sex and cluster, the effect of assimilation pattern on dietary quality differed by sex (interaction p-value=.002) (Tables 3, 4). Underclass females had better diet (55.2 (0.42)) than underclass males (49.9 (0.40), p<.001), as did women in the classic segment (51.5 (0.47) vs 47.0 (0.48), p<.001). In the selective assimilation segment, women and men had similar diets (53.9 (0.52) vs 51.7 (0.59), p=0.07). Men in the classic assimilation segment had the lowest HEI scores (47.04 (0.48)) while underclass women had the highest (55.20 (.42), p-value<.001). Being married was associated with better diet quality (52.2 (0.34) vs 50.8 (0.27), p<.001).

3.2.1 HEI Adequacy and Moderation Components

3.2.1.1 Adequacy Scores: For the unadjusted effects of cluster for the adequacy component, the selective cluster had the highest mean adequacy score (30.3 (0.35)), but was similar (p-value=.41) to underclass (29.9 (0.20)), with both being significantly better than classic (27.4 (0.35), p-values both <.001)). Results shown in the Appendix.

In the adjusted model accounting for interaction effects, consistent with overall HEI results and as hypothesized, there were significant gender by cluster interactions (p-value=.0087, Table 4), with the highest mean adequacy scores observed in the underclass female group and the worst mean scores in the classic male group (p-value < .001). Females scored higher than males in all clusters (all p-values < .01). In the selective cluster, males and females were not significantly different from their counterparts in underclass cluster (p-values = .11 and .75, respectively).

3.2.1.2 Moderation Scores: In unadjusted analyses, the Underclass (22.6 (0.21)) and Selective clusters (22.5 (0.24)) had similar moderation scores (p-value=.98), and both had better dietary quality than the classic (21.7 (0.25)), p-values =.024, .032, respectively). In the adjusted model, gender did not modify the association between cluster and moderation score (p-value=.07). Marital status did not affect moderation scores (p=0.86). Full results shown in the Appendix.

3.2.2 HEI Adequacy and Moderation Sub-Scores

3.2.2.1 Adequacy Sub-scores: To better understand what might be driving the observed effects in the adequacy component, we examined greens and beans and whole grains adequacy sub-scores (Table 4). We selected these components specifically because they account for significant portion of what is considered the traditional healthful Mexican diet[56]. The strongest moderation effects of sex on assimilation cluster appeared to occur for the greens and beans and whole grain sub-scores (p-values .014 and <.001, respectively). Men and women differed significantly in classic and selective clusters but were similar in the underclass for greens and beans. For whole grain, in the selective cluster men and women were similar while differing significantly in the classic and underclass.

3.2.2.2 Moderation Sub-Scores: To test what might be driving the differences in the moderation score between the clusters, we further examined the SOFAAS component of the moderation sub-score (Table 4). There were significant differences between all clusters in dietary intake of SOFAAS. The underclass cluster had the highest score of 14.43 (0.21), with the selective next (13.43 (0.19)), and the classic having the lowest (12.80 (0.15)). Women had a higher average score than men (13.83 (0.12) vs 13.27 (0.17), p-value<.001) and married had higher scores than single (13.87 (0.15) vs 13.24 (0.13), p-value<.001). Gender significantly moderated the effect of cluster (p-value = .006), with underclass women having significantly higher SOFAAS score than men (15.00 (0.21) vs 13.87 (0.25), p-value <.001), with the classic and selective segments showing no significant gender differences (deltas=0.61 and −0.052; p-values = 0.12 and >.99, respectively). Complete results are shown in the Appendix.

4. DISCUSSION

The main study findings provide support for the hypothesized assimilation clusters and a segmented assimilation approach to understand the paradoxical literature on dietary quality and acculturation among Mexican Americans. As hypothesized, Mexican Americans who follow the classic assimilation path, gaining education and income by shedding their ethnic identity, had the worst diets. In contrast, both groups who retained aspects of their ethnic identity – the selective and underclass assimilation clusters – had better quality diets. In addition to the total HEI and the adequacy and moderation sub-scores reported in Section 3.2, we also examined specific sub-components and found a few cases that help to explain our results (Appendix). For example, those in the classic assimilation cluster have generally worse dietary quality due to their higher consumption of empty calories and lower consumption of greens and beans, fatty acids, and whole fruits. This pattern is consistent with expectations that those following the classic path to assimilation reject traditional dietary patterns and adopt the Standard American Diet. These results are consistent with prior studies of dietary behavior or diet-related outcomes and components of segmented assimilation [40,43–45,57], which in general have demonstrated that having low income is detrimental for those with behavioral (*i.e.*, English-language acquisition) acculturation, while for those who do not acculturate, the strength of their culture (*i.e.*, the retention of their native language) is a more powerful—and protective—force than economics. By formally identifying and testing distinct assimilation clusters as per segmented assimilation

theory, this study advances understanding of how adaptations to new cultures necessarily implicates structural and social mechanisms and are not simply individual behavioral choices. In this way, results for this study of dietary behaviors are also consistent with studies employing segmented assimilation in other health contexts[18,58,59].

We found strong gender effects on dietary quality: Latinas in the US, without regard to acculturation status, are more likely to consume a healthier diet than Latinos, perhaps because women in general tend to assume responsibility for caregiving and feeding in the family. Moreover, consistent with our hypotheses, we found a strong effect modification by gender, such that men in the underclass segment had the lowest quality diet of all groups, while the dietary quality of women and men in the selective cluster was not significantly different (HEI-2010 53.9 versus 51.7, p=.07).

This study thus advances theoretical understanding of mechanisms to explain changes in dietary behaviors in Mexican Americans, specifically providing evidence for segmented assimilation as a mechanism to partially explain prior paradoxical research results. But perhaps the greatest concern highlighted by our findings is that despite significant differences in dietary quality observed across assimilation and gender subgroups (HEI 47.0–55.2), no group achieved what is objectively considered a “healthy diet”: A diet meeting the Healthy People 2020 goals would require HEI of 74; while a score of 100 is the definition of achieving the Daily Guidelines for Americans[60]. And even the subgroup with the healthiest diets, Mexican American women in the Underclass segment, had worse dietary quality than the mean HEI for American adults (HEI 55.2 versus 58.3). Krebs-Smith and colleagues[61] recommend “grading” HEI scores as a way of interpreting overall dietary quality; using their rubric, neither the general American population nor Mexican Americans specifically would earn a passing grade (>59). Even so, using Kirkpatrick and colleagues’[62] guidelines to compare subgroup dietary quality scores, we observed meaningfully significant differences across Mexican American assimilation clusters, and between most clusters and the general American population mean. There is thus opportunity to decrease both disparities in dietary quality and to improve overall dietary quality in Americans across ethnicities.

4.1 Strengths and Limitations

A strength of this study is the use of one model for examining how the intersection of multiple sources of inequality contribute to health disparities[32,63,64]. Nonetheless, our conclusions are limited by the nature of the measures available. For example, consistent with prior studies including those relying on NHANES data, in this study we assumed that acculturation could be approximated by a set of proxy indicators. Additionally, the measure of income fails to account for geographic location, despite wide variation in cost-of-living. This particular limitation may have resulted in an underestimation of observed effects, since Latinos are concentrated in higher-cost-of-living regions[65]. While our study’s outcome measure, dietary quality, was assessed using the gold standard in measurement, the HEI based on 24-hour dietary recall, additional measures of dietary behavior available NHANES may further illuminate the complex relationships between acculturation and dietary quality. For example, future research might consider acculturation group differences in consumption of meals prepared outside of the home. As with all cross-sectional studies non-response

bias is a potential problem and cause and effect cannot be inferred; hence associations may be spurious or confounded. The cross-sectional nature of this study also precludes the study of individual assimilation trajectories; studying individuals over time would allow for deeper and more nuanced understandings of the nature of assimilation and the ways in which these observed patterns influence dietary behaviors. Our focus in this study was the Mexican American population, for theoretical and practical reasons: We sought to constrain the cultural and dietary variability subsumed in the panethnic label “Latino” in order to test a theoretical model of segmented assimilation. Practically, Mexican Americans are the largest Latino subgroup in the United States, accounting for two-thirds of the Latino population, the “acculturation paradox” is most consistently seen in this group, and they consistently have the highest rates of obesity, diabetes, and other diet-related disease[19]. Nonetheless, it is critical to point out that Mexican Americans may not illustrate patterns for other Latino subgroups, and as such, future studies should examine the extent to which the segmented assimilation framework may explain observed disparities and paradoxical patterns in other Latino subgroups. Finally, we note that while some recent data suggest that diet quality is not improving for Mexican Americans and that income disparities in diet quality are worsening[66], the notion of the “dietary acculturation paradox” may soon cease to be relevant: As Mexico and other Latin American countries experience the global nutrition transition[67], risk of poor diet and related health outcomes affect those countries as much as U.S. Latinos[68,69].

4.2 Conclusions

This study advances understanding of the complexities of dietary acculturation, shedding some light on the paradoxical findings in the literature on diet and diet-related outcomes among immigrants and their descendants. We find support for the sociological framework of segmented assimilation and call on future researchers to consider ways of integrating more complex measurements of acculturation into health behavior and outcomes research.

Future work may benefit from differentiating between more or less modifiable potential drivers of food choice and how these may differ across subgroups of Latinos (or other immigrant groups). For example, barriers such as misperceptions surrounding the healthfulness of foods with the Standard American Diet versus issues related to access to and cost of cultural ingredients may pose barriers that are specific to one segment more than another. This information would provide important information for future interventions designed to improve diet quality[70]. For example, Latinos who can be characterized along the underclass pattern may lack access to culturally relevant foods in their neighborhoods. On the other hand, they may be able to overcome physical access barriers but find the foods unaffordable. Both of these barriers to healthier diets are structural and thus implicate policy solutions.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1:

Sample demographics of Mexican American participants in the National Health and Nutrition Examination Survey (NHANES), 2007–2016, adjusted for sampling cluster and strata.

	N	Mean or Percent	SE
Female	2775	47.85	0.73
Age, *mean years*	5366	40.77	0.43
Married	2967	53.82	1.46
Poverty Income Ratio	4673	1.84	0.05
Educational Attainment			
< 9th grade	1833	28.18	1.00
9–11th grade	1075	21.47	0.79
High school graduate or equivalent	1029	20.80	0.78
Some college	1011	21.04	0.97
College graduate	408	8.51	0.61
Country of Birth			
US	3199	58.12	1.94
Mexico	2154	41.88	1.94
Language Spoken at Home			
Spanish only	2267	39.86	1.42
Mostly Spanish	817	15.58	0.98
Equal Spanish/English	765	14.18	0.84
Mostly English	742	14.66	1.20
English only	767	15.73	1.17
Assimilation Cluster			
Underclass	2465	55.08	
Selective	969	21.65	
Classic	1041	23.26	
Healthy Eating Index			
Total Score	3465	51.42	0.53
Adequacy Subscore	3465	29.31	0.30
Moderation Subscore	3465	22.11	0.25

Table 2:

Cluster Variables and Demographics. Data are reported as medians and IQRs, unless otherwise noted as percent (%).

	Underclass (N=2465)	Selective (N=969)	Classic (N=1041)	p-value
Education [1]	1.0 (1.0)	4.0 (2.0)	3.0 (2.0)	<.001[a]
Poverty to Income Ratio [2]	1.1 (0.9)	3.7 (2.4)	1.3 (1.3)	<.001[b]
Acculturation	2.0 (2.0)	5.0 (1.0)	7.0 (3.0)	<.001[a]
Female %	50.1	51.2	54.8	.041[c]
Married %	43.4	37.4	53.2	<.001[c]

[a] Wilcoxon rank sum test

[b] ANOVA

[c] Chi square test

[1] Education was a 5-category variable, where 1 is less than ninth grade, 3 is high school or GED or equivalent, and 4 two-year college degree.

[2] Poverty to Income Ratio: Ratio of family income to poverty level. 1.1 means 10% above poverty level. 3.7 is 370% of poverty level.

[3] Acculturation ranges from 1–8 and is a combination of country of birth, time in the US, and language spoken.

Table 3:

Diet quality as assessed by Healthy Eating Index (HEI), overall and by gender and assimilation cluster adjusted means (standard errors) and p-values for comparison between genders within assimilation cluster

	Overall		Women		Men		P-value
	N	HEI Mean (SE)	N	HEI Mean (SE)	N	HEI Mean (SE)	
Selective	969	52.8 (0.39)	496	53.9 (0.52)	473	51.7 (.59)	0.07
Classic	1041	49.1 (0.37)	570	51.3 (0.48)	471	47.0 (0.48)	<.001
Underclass	2465	52.5 (0.36)	1235	55.2 (0.42)	1230	49.9 (0.40)	<.001
Overall	4475	52.3 (0.20)	2301	53.4 (0.31)	2174	49.5 (0.31)	<.001

All pairwise comparisons with p-values are shown in the appendix.

Table 4:

Selected components of the Healthy Eating Index (HEI) Adequacy and Moderation Sub-Scale, by assimilation cluster and gender, adjusted means (standard errors)

		Men	Women	P-value
Adequacy Sub-Scale		27.58 (0.28)	30.81 (0.22)	<.001
	Classic	25.6 (0.42)	29.3 (0.37)	<.001
	Selective	29.2 (0.52)	31.3 (0.27)	.007
	Underclass	27.9 (0.23)	31.9 (0.27)	<.001
Greens and Beans				
	Classic	1.51 (0.07)	1.84 (0.07)	<.001
	Selective	1.87 (0.07)	2.2 (0.07)	<.001
	Underclass	2.20 (0.05)	2.23 (0.05)	0.99
	Interaction			0.002
Whole Grain				
	Classic	1.92 (0.08)	2.56 (0.09)	<.001
	Selective	2.29 (0.08)	2.45 (0.09)	0.45
	Underclass	1.13 (0.04)	2.05 (0.06)	<.001
	Interaction			<.001
Moderation Sub-Scale		21.95 (0.21)	22.62 (0.18)	0.013
	Classic	21.4 (0.34)	22.0 (0.33)	0.784
	Selective	22.5 (0.38)	22.6 (0.30)	>.99
	Underclass	22.0 (0.24)	23.3 (0.22)	<.001
Solid fats, alcohol, and added sugars (SOFAAS)		13.27 (0.17)	13.83 (0.12)	<.001
	Classic	12.5 (0.20)	13.11 (0.19)	0.11
	Selective	13.46 (0.30)	13.40 (0.17)	1.000
	Underclass	13.87 (0.25)	15.00 (0.21)	<.001
	Interaction			0.006