Dietary Assimilation and Immigrant Health

Ilana Redstone Akresh*
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University of Illinois at Urbana-Champaign
Department of Sociology
redstone@uiuc.edu

This paper uses New Immigrant Survey data to examine immigrants' adaptation of their diets after coming to the U.S. and the subsequent relationship between those changes and the individual's BMI and health status. Results indicate that the degree of change immigrants make in their diets increases with time in the U.S. and with various measures of acculturation. The most commonly reported dietary changes are an increased consumption of meat and junk food. More dramatic levels of dietary change are associated with a higher BMI. The extent to which respondents change their diets is also associated with higher probabilities of divergent health outcomes, with individuals experiencing either significantly worse or significantly improved health status. Two possible explanations are offered. First, this suggests two trajectories resulting from dietary change, depending on the changes that are made. Choosing to eat the readily available junk food in the U.S. will lead to worsened health, while choosing to take advantage of the year round availability of fruits and vegetables leads to improved health. Second, the results are consistent with the idea that certain changes (for instance, an increase in meat consumption) might be experienced as positive in the short run and negative in the long run.

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On every dimension available to researchers for study, time in the U.S. has been shown to influence immigrants' behaviors, habits, and associations. The longer immigrants remain in the United States, the higher their earnings and wages, the lower their rates of residential segregation, the better their English ability, and the more likely they are to intermarry (Akresh 2005; Chiswick 1978; Duncan and Lieberson 1959; Kahn 1988, 1994; Li 1982; Massey 1981; Stevens 1985).[1] The current analysis extends this literature to the previously unexplored area of dietary assimilation.

Research on immigrants and assimilation has been motivated in part by an empirical interest in understanding individuals' experiences as they transition from their home country to a new environment. Several major studies also seek to define whether immigrants are 'better off' in the U.S. and whether assimilation is 'good' in some absolute sense (see Rumbaut 1997 for a discussion). Economic outcomes in particular have been of interest due to public and policy concerns over whether the immigrant population poses a financial burden on the native population. If time in the U.S. is associated with changes in diet in the same way it is associated with other behavioral adaptations, this may have important, and perhaps costly, health consequences. This will particularly be the case if those changes are linked to worsened health. The focus of the current analysis, understanding the correlates of dietary change and the subsequent health outcomes for the immigrant population, is motivated by these concerns.

Healthy Immigrant Effect

A consideration of health outcomes for immigrants first requires discussion of the 'healthy immigrant effect'. This describes immigrants as healthier on average than the native

[1] These changes have generally been referred to either as assimilation or acculturation. In his seminal work, "Assimilation in American Life", Milton Gordon specified acculturation as the subset of assimilation that refers to cultural or behavioral assimilation (Gordon 1964 p. 71). This is contrasted with other types defined by Gordon, such as: marital assimilation, structural assimilation, and identificational assimilation (1964).

population when they arrive in the host country and that, over time, their health worsens (Chen et al. 1996; McDonald and Kennedy 2004; Newbold 2005). If the distribution of health among the immigrant population is, at baseline, more skewed towards good health than the distribution for natives, then immigrants' health must worsen to some degree over time in order for the two patterns to converge.[2] One possibility, as described by Jasso et al. (2004), is that the mere process of immigration has a direct effect on health, via its tendency to increase stress levels.

Several explanations for the change in immigrants' health are discussed in a recent paper by Antecol and Bedard (2005). They include the idea that the change in immigrant health may be driven by a difference in access to health care, such that over time immigrants' access becomes more limited. The authors concede that this scenario is highly improbable, given that access to care likely increases rather than decreases over time (LeClere et al. 1994). Alternatively, health care access might exert its influence by bringing previously undiagnosed conditions to light, thereby leading individuals to report worsened health (Antecol and Bedard 2005). The authors also explore the role of increasing BMI in explaining the convergence of health statuses. In the current analysis, I argue that the pathway by which BMI matters for the changing health outcomes of immigrants is dietary assimilation.

Time in the U.S. and Health

Although no previous work exists looking at patterns of dietary change, several researchers have looked at the relationship between time in the host country and health. Studies have demonstrated a positive relationship between time in the U.S. and other negative health outcomes including low birthweight (Balcazar and Krull 1999; Scribner and Dwyer 1989), psychological distress (Kaplan and Marks 1990), and activity limitations (Cho et al. 2004;

[2] There is stronger theoretical justification supporting the idea that it is the health of immigrants that worsens, rather than the health of natives improving, driving the convergence between the two distributions.

Frisbie et al. 2001). Prior work has also shown that the prevalence of obesity and overweight are positively associated with time in the U.S. (Goel et al. 2004; Gordon-Larsen et al. 2003; Himmelgreen et al. 2003) and in Canada (Cairney and Ostbye 1999). In the Goel et al. study, the authors used the 2000 National Health Interview Survey and found an increase in the prevalence of obesity among immigrants who had been in the U.S. for 10 years or more (2004).

These studies provide key insights into the changes observed among the immigrant population after several years in their new environments (the U.S. and Canada). However, they also raise additional questions. What is responsible for the observed increases in excess weight and obesity? Can a worsened health status since coming to the U.S. be partly attributed to a change in diet? The current analysis takes advantage of a unique newly available data set, the New Immigrant Survey (NIS), to explore these patterns.

THEORETICAL FRAMEWORK

Factors Influencing the Degree of Change

There are several reasons one might expect immigrants to alter their diets after coming to the U.S. In addition to dietary change being part of a larger process of adaptation that occurs after living in the U.S. for a substantial period (reflected by years of U.S. experience), hours supplied to the labor market, the individual's social environment, household factors, residential setting, and self-selection may all be influential factors.

Labor Supply

It may be that they are working more hours, a schedule which detracts from time available to prepare meals. The majority of immigrants come to the U.S. to improve their economic situation regardless of the visa category through which they attain permanent residency, suggesting that many may be working long hours. Although the number of hours they

supply to the labor market may not differ significantly from natives (as shown for Hispanic men by Borjas 1983), these hours may be more than in their home country. If this is true, working a greater number of hours per week would be associated with a higher degree of dietary change.

Of course, the above hypothesis necessitates that individuals are preparing their own meals. One way that hours worked could affect male respondents' report of dietary change is through the labor supply of their wives. If immigrant households are more likely to have a traditional division of labor and their diet prior to moving to the U.S. was labor intensive, then the wife's labor supply is expected to affect the husband's diet.

Social Environment

It may be that as immigrants solidify relationships with people other than co-ethnics, they are exposed to various types of food. The friends and relationships they form in the U.S. with people of different ethnic backgrounds may influence their tastes and consumption patterns. This type of change does not specify that tastes morph into something generically 'American'; it only requires that through exposure and contact, they change from what they were prior to immigrating. English ability, speaking only English with friends or at work, and speaking English at home suggest a greater degree of acculturation and are expected to be associated with a report of more dramatic dietary changes. Marrying someone who was born in the U.S. is also expected to result in more changes in diet. Conversely, marrying someone from one's own country is thought to be associated with maintaining a diet more similar to that prior to coming to the U.S.

Household Characteristics

Household characteristics may play a role in the extent and pace of dietary change. For instance, a preponderance of young people or a higher overall number of mouths to feed may

make maintaining the diet from the home country difficult, particularly if some of the necessary items are more costly in the U.S. Additionally, more young people in the household may mean having more processed, pre-prepared food available, items which may also be associated with weight gain or worsened health.

Residential Setting

Another possible factor influencing dietary change is simple availability. Depending on where in the U.S. they live, it may be harder for immigrants to find the foods they are used to using for meal preparation. The extent to which this presents a challenge likely depends on the region of the country the individual is living in and whether he or she is living in an urban or rural area. It may further depend on whether the individual resides in an ethnically concentrated neighborhood with other immigrants from the same country or region.

Selection

Additionally, changing diets may be indicative of the selective nature of the immigration process in that individuals who are more adventurous and interested in new experiences are more likely to leave their home country and are also more likely to be open to trying new foods.

In this paper, I address the first three of the hypotheses presented here.[3] I am unable to address the fourth hypothesis due to the absence of residential information and the fifth due to a lack of measured characteristics. I then extend the analysis to look at the link between dietary change and Body Mass Index (BMI) and the link between dietary change and the self-reported comparison between pre- and post- migration health status.[4]

[3] A more in depth exploration of the specific dietary changes that are occurring among the immigrant population and how these changes relate to one another (i.e., the types of foods immigrants are giving up and the types they are replacing them with), in addition to how patterns of dietary assimilation vary by region and country of origin is the subject of another paper.

[4] BMI is measured as weight (kg) divided by height^2 (meters). Less than 18.5 is considered underweight, 18.5-24.9 is considered healthy, 25-29.9 is overweight, and 30 or greater is considered obese.

Dietary Changes and Health

The direction of the relationship between the degree of dietary assimilation and health is likely determined by the types of changes that are made. On the one hand, American diets often contain more processed foods and more junk food than those in other countries. Both groups tend to be high in sodium and to contain high levels of fat. If part of what immigrants are assimilating into is the consumption of these items, this may lead to weight gain and a decline in health. On the other hand, many grocery stores in the U.S. offer a year round selection of fruits and vegetables that is unparalleled in other countries. If the dietary changes involve taking advantage of this variety, an improvement in health or maintenance of good health may be experienced.

DATA AND METHODS

Data

The data used for this study come from the New Immigrant Survey (NIS). The study is based on a probability sample of immigrants who were granted permanent residency between May and November of 2003. The survey methodology for the adult sample involved four strata: spouses of U.S. citizens, employment principals, diversity principals, and other immigrants (Jasso et al. *forthcoming*).[5] This analysis uses the adult sample, which was restricted to individuals who were at least 18 years old at the time of admission. Unique to the NIS is that the interview was conducted in the language of the respondent's choice (see Jasso et al. *forthcoming* for a full description). For the current analysis, sample size is restricted to individuals who had valid responses for all of the variables of interest, yielding 6,637 out of the available 8,575 observations for the majority of the analysis. Approximately 84 percent of the cases that are excluded are attributable to missing values on one or more of the following: the report of dietary

[5] All descriptive characteristics presented are weighted with sampling weights.

similarity, English ability, and BMI, with about half of the 84 percent due to the BMI. The vast majority (92%) of missing BMI values are missing data on both height and weight, with only 14 percent portion missing weight data only, suggesting that the bias is not attributable to overweight individuals who are unwilling to report their weight. For this reason, it is difficult to anticipate the direction of a bias resulting from missing data on BMI or on the report of dietary similarity.

Dependent variables

This analysis takes advantage of several unique questions in the NIS. The dependent variable for the first part of the multivariate analysis comes from the following question:

> "Using a scale from one to ten where 10 indicates exactly the same and 1 means completely different, how would you compare the similarity in the diet in the food you now normally eat in the United States with the food you normally ate in your home country?"[6]

The subsequent questions allow for a deeper understanding of individuals' replies. The following two questions:

> "Please tell me the most important thing that you eat a lot now that you rarely ate before you came to the United States?" and,
>
> "Please tell me the most important thing that you ate regularly before coming to the United States that you rarely eat now?"

were both posed to individuals who said that there was an item that they eat now that they did not used to eat or who said that there was something they used to eat regularly that they do not eat now. Thirty-nine percent of respondents (n=2561) reported at least one of the dietary changes that were coded. Respondents were permitted to list more than one item and responses

[6] The direction of the coding was reversed for ease of interpretation in the empirical work.

were recorded verbatim. Responses to this question were coded into categories representing whether more or less meat, vegetables, fish and seafood, rice and beans, fruit, and junk food were consumed in the U.S. Because junk food is to some degree subjectively defined, it was coded in two ways. The first, labeled 'current measure' in Table 1, is the indicator used in the multivariate analyses. This is a more conservative measure that is coded a 1 for individuals who reported eating more "junk food, "fast food', or who named a fast food restaurant. The second measure, labeled 'broad measure', adds to the previous measure individuals who responded "pizza" or "fried food".[7]

The health outcomes considered are twofold. The first is BMI, measured continuously using self-reported height and weight data. This is used in place of an indicator for obesity because the current research question pertains to changes in the individual's perception of his relative health status and changes in BMI at any level may be relevant.[8] The second measure is a categorical response to the question:

> "Compared with your health right before you most recently came to the United States to live, would you say that your health is better now, about the same, or worse?"

Independent Variables

The analysis includes controls for the following demographic and background characteristics: age, gender, marital status, and years of completed education. Years of U.S. experience is an important covariate and one of the proxy measures for assimilation. The current

[7] Repeating the analyses with the broad measure yields results qualitatively similar to those using the conservative measure. The latter is used in the multivariate analyses shown because it is a conceptually cleaner definition of junk food.

[8] Table 5 has also been estimated as a logistic regression with the dependent variable coded as 1 for a BMI >=30 and 0 otherwise. While there are subtle differences in the results, they are qualitatively robust. The one substantive difference is that the indicator for female loses statistical significance when predicting obesity. Table available upon request.

measure captures the cumulative total years the individual has been in the U.S. and is anticipated to be associated with a greater degree of dietary change and a higher BMI. This measure of U.S. experience is thought to be more accurate than that obtained from the question used on the decennial census and Current Population Survey, "When did you come to the U.S. to stay?" (Redstone and Massey 2004).

Household characteristics are measured as the total number of individuals in the household and their average age. Following the hypothesis described previously, the expectation is that having more household members will be associated with a greater degree of dietary change. We expect that members of older households will experience a lesser degree of change in diet and that members of younger households will dominate in the consumption of junk food.

To capture the level of assimilation, I include three indicators in addition to the direct measure of time spent in the U.S. The first is an indicator of English ability. This is a self-reported measure which takes a one for those reporting the ability to speak English well or very well and a zero otherwise. The second is an indicator for whether the respondent's spouse, if married, was born in the U.S. and the third, conversely, is an indicator for whether the respondent's spouse was born in the same country as the respondent. If acculturation is associated with more dramatic changes in diet and increasing average BMI, then the first and second indicators will have positive signs on the coefficients predicting the level of dietary similarity. Being married to a co-ethnic is then expected to have a negative sign on the coefficient when predicting dietary change.

Methods

Tables 1, 2a, 2b, and 3 present sample characteristics and conditional means describing the data. Tables 4a, 4b, and 5 use ordinary least squares regression to predict the level of dietary

change. Tables 4a and 4b have also been estimated using an ordered logit, yielding similar qualitative results. Results using the OLS are presented for ease of interpretation. Table 6 uses a multinomial logistic regression to predicted relative health status.

RESULTS

Understanding the level of dietary change begins with understanding the types of changes being reported. Table 1 shows some of the most salient patterns reported in the survey. The most commonly reported changes are an increased consumption of meat and junk food, broadly measured, in the U.S. Figure 1 provides a clearer description of how the changes in Table 1 correspond to respondents' report of their level of dietary change. The x-axis contains the individual's report of the similarity in his or her diet compared to before they came to the U.S. The further the point is to the left, the more similar the diet, the further to the right, the more different. The height of the line represents the proportion reporting the dietary change described in the legend for the particular line.

Of those who indicate the greatest dietary change, the highest proportion reports an increased consumption of junk food, using the broad definition. The prevalence of reports of an increase in junk food ranges from about 12.5-17 percent at the highest levels of dietary change (values of 6-10). The next most commonly reported change is an increase in meat consumption. The prevalence of these two changes suggests that the possibility of health implications.

Table 2a examines differences between respondents who report an increased consumption of meat and those who do not. Results indicate that demographic and background characteristics differ strongly between the two groups. Immigrants who eat more meat in the U.S. have been in the U.S. longer, have more children, and live in younger households. They also have fewer years of education, a lower proportion able to speak English well, and lower

rates of English language use with friends and at work than those who do not report an increased consumption of meat. Individuals reporting increased meat consumption also have higher household incomes and higher average BMI. This pattern depicts immigrants who are perhaps less integrated, yet are doing well enough financially to afford meat. They may not have the nutrition information necessary to accurately assess the value of increased meat consumption or they may chose to ignore this information.

Table 2b explores differences in descriptive characteristics between individuals who report eating more junk food in the U.S. with those who do not. One of the most salient characteristics is the overall number of significant differences that exist between the two groups. The indicators of acculturation or assimilation differ in the expected directions indicating that consuming more junk food is associated with acculturation. Specifically, those who report consuming more junk food in the U.S. have more U.S. experience, are more likely to have a spouse from the U.S., and are less likely to have a spouse from the same country. They are also more likely to speak English as one of multiple languages at home and are more likely to speak exclusively English at work and with friends. Further, those who report eating more junk food have a significantly higher average BMI than those who do not, although the difference (0.771 points) is not as great as that shown in Table 2a (1.278).

Finally, socioeconomic status has been shown to have a strong inverse relationship with the prevalence of overweight and obesity among natives (see Sobal and Stunkard 1989 for a review of the literature). However, the evidence for immigrants suggests a weak relationship.

Table 3 displays the same descriptive characteristics as in Tables 2a and 2b, this time breaking them out by self-reported health status. The indicators for acculturation that were particularly salient in Table 2b are no longer significant differentiators between individuals who

report that their health has worsened and those who report it as the same. Several characteristics in Table 3 exhibit a hill- or valley-like distribution across the three categories of health responses. For instance, more years of U.S. experience is linked both to a positive change and to a negative change, relative to no change in health. Similarly, individuals reporting either type of change in health since coming to the U.S. have lower average education levels than those reporting no change. Individuals with lower education levels may be more likely to make lifestyle choices or have jobs that put their health in jeopardy, while they also may also have worse health to begin with, leaving more room for improvement. There are significant differences as well in average household age such that the average is lower for both categories reporting a change in health status. Younger households may be savvier in their ability to navigate the U.S. health care system, resulting in improved health. Further, as shown in Tables 2a and 2b, immigrants consuming more meat and junk food, behavior possibly leading to worsened health, are more likely to be members of younger households. The pattern also indicates that increased meat consumption is associated with reports of improved and worsened health. When we consider that immigrants reporting worse health have more than two years of additional experience in the U.S. relative to those reporting better health, the pattern is consistent with the idea that an increase in the consumption of meat is experienced as beneficial for an initial period before it leads to other health-related problems later on, such as the increase in BMI.

Higher average BMIs are also observed for individuals reporting worse health and better health. The association with worse health is anticipated as weight gain is generally experienced in this manner. However, the fact that a higher average BMI is also seen with those reporting improved health suggests that this is not always the case. The estimate for average BMI among

those reporting worse health is 0.84 points higher than for those reporting improved health, which is what one might expect if a small amount weight gain can be ok, but beyond some threshold is experienced as too much.

Table 4a presents results from the OLS regression considering the determinants of dietary change. The higher the score on the dependent variable, the more the individual has changed her diet since coming to the U.S., such that a score of 10 indicates a current diet that is completely different to that prior to moving. It follows that a positive coefficient indicates the covariate is associated with a report of greater dietary change, while a negative coefficient indicates more similarity. The first specification is a baseline model including demographic, education, and household variables. The second adds indicators for assimilation and the third includes labor supply characteristics.

The baseline specification indicates that married individuals are more likely to maintain a diet similar to that which they had prior to immigration. However, with the inclusion of "Spouse Born in the Same Country" and "Spouse Born in the U.S.", the magnitude of the "married" coefficient shrinks by about one third, suggesting that the effect of marital status is partly through the spouse's place of birth. The relationship between years of education and dietary similarity is consistent across the three specifications such that individuals with more education are more likely to maintain their previous eating habits. Immigrants with more education may be more acutely aware of importance of maintaining their culture and one way to do this is through keeping culinary traditions alive in the kitchen. It may also be that they are more likely to have had a balanced diet prior to immigration and are, therefore, less likely deter from old patterns. The number of individuals in the household has no relationship to the level of dietary similarity.

The average age in the household has a nonlinear, convex relationship with dietary similarity that disappears when additional controls are added.

The second specification in the table includes the indicators for acculturation. In this setting, each shows an effect that significantly differs from zero and is in the expected direction. Speaking English well and having a spouse born in the U.S. are associated with a greater degree of dietary change, while having a spouse from the same country is associated with a diet that remains more similar. Years of U.S. experience exhibits a nonlinear positive relationship with dietary change.

The third specification includes covariates capturing the individual's hours worked and the log of household earnings. Neither of these characteristics is significantly associated with the degree to which the individual changes his diet, suggesting that the extent to which change is reported is not a function of a paucity of time away from work, the first hypothesis listed earlier. Including these covariates does not change the majority of the qualitative conclusions drawn from the second specification on the assimilation indicators.

To further examine the importance of labor supply on dietary change, Table 4b restricts the analysis to married men. With a traditional household division of labor, the woman would be responsible for the grocery shopping and the cooking. In that case, one might expect the wives' labor supply to have more of an impact on the changes taking place in their husbands' diets. The first specification in Table 4b includes an indicator for whether the wife is working for pay. This could be inside or outside the home, the idea being that any time devoted to paid employment is less time available for domestic chores. The coefficient on the indicator for whether the wife is working for pay does not significantly differ from zero. The second specification looks at levels of the wife's labor supply, rather than a yes/no indicator, by including a measure of her hours

worked per week. This also has no significant association with the husband's report of dietary change. These two tests do not support the first hypothesis listed previously, regarding the role of hours worked per week on change in diet. Also noteworthy in this specification is the magnitude and significance of the coefficient on the indicator for having a spouse born in the U.S. It suggests that the significant and positive coefficient in Table 4a on having a spouse born in the U.S. is operating through immigrant men married to U.S.-born women.

Table 5 considers how changing diet and other covariates relate to BMI. The first column is a baseline specification while the second include the acculturation and dietary covariates. The third includes labor characteristics. Across all three specifications, the individual's age and the average age of the household have strong nonlinear relationships with the respondent's BMI. The individual's own age is associated with an increase in BMI while the average household age indicates that individuals in older households have lower BMIs.

With respect to the respondent's age, the results are consistent with the knowledge that most individuals gain some amount of weight as they age and this trend reaches a plateau after a certain point. The observed convex pattern with household age aligns with the idea that households with more children and young people are likely to have different eating patterns and to have their refrigerators and cabinets stocked with items that may not be so prevalent in older households. For instance, younger households may have more junk food or processed food available, items that are often associated with weight gain.

The relationship between years of education and BMI is generally consistent across the three models, although there are slight fluctuations in magnitude. As one might expect based on the general negative relationship between education and BMI observed among the native population, higher education levels are associated with a lower BMI for immigrants as well.

In the second column, there is a weaker case for a direct effect of assimilation than there was in Table 4. However, the number of years the individual has been in the U.S. exhibits a strong nonlinear relationship with BMI such that more years are associated with higher BMI until about twenty years in the U.S. The inclusion of the dietary change characteristics does not dramatically change the significance or magnitude of the other covariates, yet they do yield strong positive coefficients themselves. These coefficients suggest that, after controlling for demographic, household, and acculturation characteristics, each one unit increase in the level of dietary change is associated with a 0.07 increase in BMI. In other words, the more changes the immigrant incorporates into his diet, the higher his BMI. Similarly, increases in the amount of junk food or meat consumed are linked to increases in BMI of 1.05 and 0.45, respectively. The third specification includes earnings and labor supply information, which shows a small but statistically significant positive relationship between hours worked per week and BMI, suggesting some support for a direct effect of labor supply on BMI, even though it exhibited no relationship with the level of dietary similarity.

In order to consider the relationship between dietary change and health, Table 6 displays the results from a multinomial logistic regression where the outcome is self-reported health status.[9] The results are presented as marginal effects, estimated as $\frac{\partial P(x)}{\partial x_i}$. The result of this partial derivative is the change in the probability of the outcome for an incremental change in the explanatory variable x_i, evaluated at the mean. For dummy variables, the marginal effect is calculated for a discrete change from 0 to 1.

[9] Table 6 is estimated using a multinomial logistic regression rather than an ordered logistic regression because of the relaxed assumptions associated with the former. Tests of the proportional odds assumption necessary to use an ordered logistic specification failed, leaving the multinomial model as the preferred estimation technique.

Responses are coded as -1 if the individual reported that his or her health is worse than before coming to the U.S., 0 if it is the same, and 1 if it is better. Each pair of columns 1a and 1b, 2a and 2b, and 3a and 3b is part of the same regression. Columns 1a, 2a, and 3a predict a response of health worse than it was prior to coming to the U.S. and columns 1b, 2b, and 3b predict a response of health better than it was prior to coming to the U.S. The baseline category for each equation is that in which the respondent reports his health as being the same now as prior to coming to the U.S. The difference between the three specifications is that the second adds dietary change measures and the third includes a measure of household income.

Results indicate that, as shown in Table 3, years in the U.S. has a positive relationship with both outcomes, although the magnitude of the point estimate for worse health is approximately double that for better health. In describing Table 3, we suggested that this pattern might be observed if certain dietary changes are experienced as positive in the short run and negative in the long run. An additional possibility is that there are two pathways of dietary change that immigrants follow. One is to eat more of the readily available, and often cheaper, junk food and processed food and the second is to take advantage of the U.S. importation of fruits and vegetables that allows for a wide selection of fruits and vegetables year round.

The dual effect of years of U.S. experience is also consistent with the idea that, for a given level of dietary similarity, the types of dietary changes reported among short duration immigrants systematically differ from the types reported by long duration immigrants. However, further inspection of Appendix Figure 1 suggests that this hypothesis is not supported by the data. The only discernable difference in the types of changes reported by immigrants of short, medium, and long durations is that the proportion reporting an increased consumption of meat

rises. That the other patterns remain consistent across years of U.S. experience suggests systematic differences can not explain the results.

Interestingly, years of education has a consistent negative association with the probability of reporting an improved health status. Table 4a showed that more education is associated with fewer dietary changes. It may also be that, given the endogeneity between education and health, those with more education are in the upper echelon of health to begin with, a level from which further improvement is difficult (see Smith 1999 for a discussion of the endogeneity between health status and wealth).[10]

Columns 2a and 2b (and 3a and 3b) reveal that the more changes an individual makes in her diet, the more likely she is to report any change in health status. In other words, the more change in diet the individual experiences, the more likely it is that her health remains the changes. If she does change her diet, the outcome will depend on the changes she makes. Column 2b suggests a positive link between eating more meat and improved health, yet this relationship disappears when income is controlled for.

DISCUSSION

In perhaps no realm more so than what one eats is assimilation more visible, tangible, and directly experienced. Changes in diet are felt at meal times and with every trip to the supermarket. Thirty-nine percent of respondents report at least one of the changes coded and the average level of dietary similarity is 5.233 (where a value of 10 represents a diet that is completely different than that prior to coming to U.S. and 1 represents a diet that is completely the same). Changes that immigrants make may have health consequences in the short and long

[10] Reports of current health status in the NIS data show that average education levels are monotonically lower with each drop in self-reported current health status (measure from 1-5, best to worst).

term. Understanding these changes and examining their determinants is an important precursor to a fuller understanding of immigrant health.

This analysis has highlighted several important factors. First, diet is shown to be an additional behavior affected by the length of time an individual is in the U.S. and by the level of acculturation, confirming dietary change as another component of the assimilation process. Second, the results indicate that dietary change should be considered as a factor in the decrease of the 'healthy immigrant effect'. In other words, the extent to which an immigrant changes his diet should be considered as part of the reason why immigrant health declines to converge with that of the native population.

The approach taken in this work of studying the determinants of changing food consumption habits and the subsequent link to BMI and health also makes an important contribution to the existing body of knowledge of immigrants and health. With an eye to explaining the changing health among immigrants as they remain in the U.S., one of the implicit questions studied is whether the U.S. is 'good' for immigrants. The analysis began by showing that the most common dietary changes after coming to the U.S. are an increased consumption of junk food, broadly defined, and of meat. Further analysis has shown that greater levels of dietary change are associated with higher BMIs.

Results from the analysis of health outcomes indicated that greater dietary change and increased time in the U.S. are linked to both an increased likelihood of better health and an increased likelihood of worse health. These results, while seemingly contradictory, are consistent with at least two possibilities. First is a story of divergent trajectories of changes in immigrant health resulting from dietary change. Second is a possibility that dietary changes experienced as positive in the short run (for instance, eating more meat) may be felt as negative

in the long run. Dietary change is a specific area of assimilation that has not previously been studied and this work suggests it is a major component of immigrants' health status. In other words, the dietary change made can be an increase in the amount of junk food, fried food, and pizza consumed resulting in declining health or it can be an increase in the consumption of fruits and vegetables readily available in most U.S. supermarkets.

There are policy implications that can be derived from these findings, particularly related to informing immigrants about the pros and cons of selecting the items in the grocery store that they might not be familiar with. Nutrition education targeting immigrants specifically may decrease this trend and increase the proportion of this population that chose the trajectory of dietary change associated with a positive health outcome. Future research should look more deeply into outcomes of obesity, overweight, and health behaviors such as physical activity and smoking.

Given the relationship between acculturation, time in the U.S., and the health outcomes studied here, a next step is to look at these associations for subgroups of immigrants. In particular, by using the individual's education as a proxy for information on the sector of U.S. society into which the immigrant is most likely to aspire to integrate, valuable information an be gleaned on variation in these outcomes. Specifically, it would lead to an exploration of whether the relationship between socioeconomic status and obesity (and overweight) that is observed for natives also influences immigrants' acculturation patterns.

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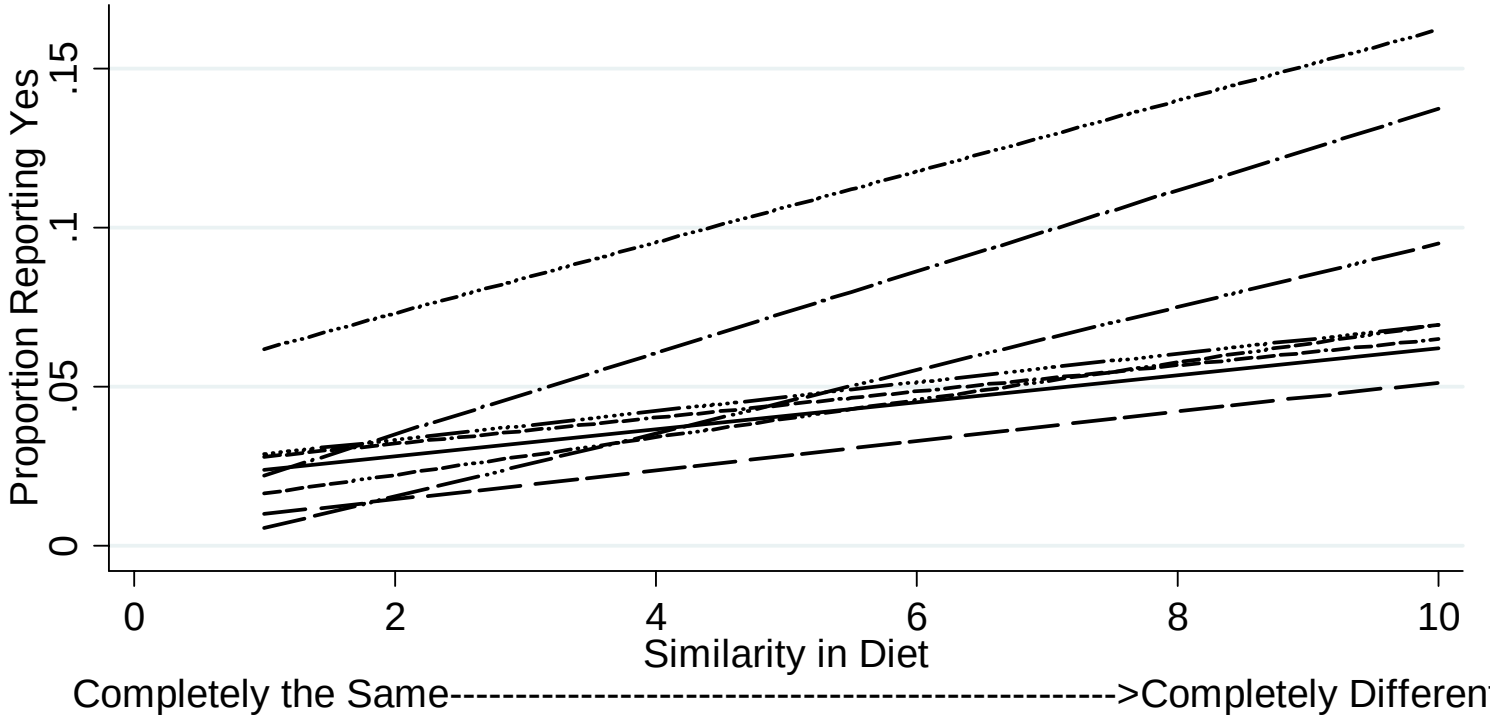
Figure 1. Patterns of Dietary Change among Legal Immigrants



Source: New Immigrant Survey, 2003

Table 1. Common Reports of Dietary Change (N=6637)

Dietary Change	%
Eats More Junk Food in the U.S. (current measure)	4.2
Eats More Junk Food in the U.S. (broad measure)	10.5
Eats More Meat in the U.S.	8.1
Eats Less Meat in the U.S.	2.9
Eats Less Vegetables in the U.S.	4.2
Eats Less Fruit in the U.S.	3.8
Eats Less Fish in the U.S.	3.9
Eats Less Beans/Rice in the U.S.	3.0

Source: New Immigrant Survey
Note: Categories are not mutually exclusive.

Table 2a. Conditional Means of Respondents Reporting an Increased Consumption of Meat and Those Who Do Not

	Doesn't Consume More Meat in the U.S. (1)	Consumes More Meat in the U.S. (2)	Difference (1)-(2)	Total (n=6637)
Female	0.471	0.400	0.071***	0.465
Age of Respondent	39.08	38.67	0.41	39.05
Married	0.733	0.778	-0.045**	0.737
Number of Biological Children	1.741	1.994	-0.253***	1.761
Years of U.S. Experience	4.411	6.888	-2.477***	4.611
Speaks English Well	0.529	0.456	0.073***	0.523
Years of Education	13.103	11.564	1.539***	12.979
Average Age in Household	28.467	26.008	2.459***	28.269
Number in Household	3.717	3.958	-0.241***	3.736
Spouse Born in the U.S. (of those who are married)	0.095	0.088	0.007	0.095
Spouse from the Same Country (of those who are married)	0.516	0.549	-0.033	0.518
Speaks English at Home (as one of multiple languages)	0.452	0.439	0.013	0.451
English Only Language with Friends	0.173	0.130	0.043***	0.169
English Only Language at Work	0.420	0.339	0.081***	0.413
Hours Worked per Week (n=3187)	38.246	39.727	-1.481*	38.377
Wife's Hours Worked per Week (for married men, n=1205)	23.562	20.229	3.333*	23.202
Log of Household Earnings (n=3187)	10.403	10.662	-0.259**	10.426
BMI	25.534	26.812	-1.278***	25.645
Index of Dietary Similarity	5.099	6.759	-1.660***	5.233
Consumes More Junk Food in the U.S.	0.045	0.008	0.037***	0.042
N	6124	513		6637

Table 2b. Conditional Means of Respondents Reporting an Increased Consumption of Junk Food and Those Who Do Not

	Doesn't Consume More Junk Food in the U.S. (1)	Consumes More Junk Food in the U.S. (2)	Difference (1)-(2)	Total (n=6637)
Female	0.467	0.432	0.035	0.465
Age of Respondent	39.266	33.975	5.291***	39.047
Married	0.739	0.691	0.048	0.737
Number of Biological Children	1.785	1.209	0.576***	1.761
Years of U.S. Experience	4.583	5.267	-0.684*	4.611
Speaks English Well	0.513	0.763	-0.250***	0.523
Years of Education	12.920	14.349	-1.429***	12.979
Average Age in Household	28.339	26.648	1.691**	28.269
Number in Household	3.752	3.363	0.389***	3.736
Spouse Born in the U.S. (of those who are married)	0.150	0.277	-0.127***	0.095
Spouse from the Same Country (of those who are married)	0.700	0.500	0.200***	0.518
Speaks English at Home (as one of multiple languages)	0.442	0.666	-0.224***	0.451
English Only Language with Friends	0.165	0.264	-0.099***	0.169
English Only Language at Work	0.406	0.563	-0.157***	0.413
Hours Worked per Week (n=3187)	38.294	39.811	-1.517	38.377
Wife's Hours Worked per Week (for married men, n=1205)	23.272	21.641	1.631	23.202
Log of Household Earnings (n=3187)	10.426	10.427	-0.001	10.426
BMI	25.613	26.384	-0.771**	25.645
Index of Dietary Similarity	5.619	6.723	-1.104***	5.233
Consumes More Meat in the U.S.	0.083	0.015	0.068***	0.081
N	6375	262		6637

Note: Asterisks indicate significant difference between those who report consuming more junk food and those who do not (difference between the first two columns).

Table 3. Conditional Means (N=6637)

	Health Worse than Before U.S. (1)	Health Same as Before U.S. (2)	Health Better than Before U.S. (3)
Female	0.480	0.468	0.449
Age	40.623***	38.857	38.957
Married	0.756	0.745	0.702***
Number of Biological Children	1.874**	1.701	1.910***
Years of U.S. Experience	7.469***	4.046	5.182***
Speaks English Well	0.536	0.527	0.507
Years of Education	12.699**	13.267	12.151***
Average Age in Household	27.701	28.542	27.622**
Number in Household	3.641	3.713	3.857**
Spouse Born in the U.S. (of those who are married)	0.137	0.120	0.116
Spouse from the Same Country (of those who are married)	0.661	0.698	0.690
Speaks English at Home (as one of multiple languages)	0.475	0.443	0.467
English Only Language with Friends	0.168	0.171	0.163
English Only Language at Work	0.426	0.415	0.400
Hours Worked per Week (n=3187)	40.015*	38.336	37.712
Wife's Hours Worked per Week (for married men, n=1205)	22.732	23.364	22.907
Log of Household Earnings (n=3187)	10.648***	10.401	10.400
Reported an Increased Consumption of Junk Food in the U.S.	0.059*	0.041	0.036
Reported an Increased Consumption of Meat in the U.S.	0.105***	0.067	0.115***
BMI	26.626***	25.468	25.784**
Similarity in Diet	5.916***	5.003	5.683***
Total	0.096	0.694	0.210
N	609	4633	1395

Note: Asterisks indicate a significant difference between those who report better health prior to coming to the U.S. and those who report their health as the same (difference between columns 1 and 2) and between those who report worse health than prior to coming to the U.S. and those who report their health as the same as prior to coming to the U.S. (difference between columns 2 and 3).

Table 4a. OLS Regression Predicting Level of Change in Diet with Pre- and Post-Immigration

Dependent Variable: Ranges from 1 to 10, 1 Diet Completely the Same, 10 Completely Different Diet	(1)	(2)	(3)
Female	-0.159**	-0.151**	-0.170
	(0.076)	(0.076)	(0.114)
Married	-0.405***	-0.255**	-0.216
	(0.090)	(0.119)	(0.179)
Age	-0.018	-0.021	-0.054
	(0.016)	(0.017)	(0.038)
Age Squared	-0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)
Years of Education	-0.071***	-0.077***	-0.072***
	(0.008)	(0.009)	(0.014)
Average Age of Household Members	-0.031***	-0.019*	-0.009
	(0.010)	(0.010)	(0.016)
Average Age of Household Members Squared	0.000**	0.000	0.000
	(0.000)	(0.000)	(0.000)
Number of Household Members	-0.032	0.012	0.053
	(0.021)	(0.021)	(0.034)
Years of U.S. Experience	--	0.071***	0.085***
	--	(0.013)	(0.023)
Years of U.S. Experience Squared	--	-0.001**	-0.002*
	--	(0.001)	(0.001)
Speaks English Well/Very Well	--	0.277***	0.225*
	--	(0.089)	(0.131)
Spouse Was Born in the U.S.	--	0.734***	0.486**
	--	(0.151)	(0.214)
Spouse Born in Same Country	--	-0.350***	-0.606***
	--	(0.109)	(0.160)
Respondent's Hours Worked per Week	--	--	-0.005
	--	--	(0.004)
Log of Household Earnings	--	--	0.036
	--	--	(0.037)
Constant	8.188***	7.468***	7.719***
	(0.384)	(0.386)	(0.797)
Observations	6637	6637	3187
Adjusted R-squared	0.034	0.055	0.054

Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

Note: Regressions including household income and hours worked per week yielded 3,187 observations.

Table 4b. OLS Regression Predicting Level of Change in Diet with Pre- and Post-Immigration

Dependent Variable: Ranges from 1 to 10, 1 Diet Completely the Same, 10 Completely Different Diet	(1)	(2)
Age	-0.014	-0.014
	(0.075)	(0.075)
Age Squared	-0.000	-0.000
	(0.001)	(0.001)
Years of Education	-0.074***	-0.074***
	(0.022)	(0.022)
Average Age of Household Members	0.014	0.015
	(0.033)	(0.033)
Average Age of Household Members Squared	-0.000	-0.000
	(0.001)	(0.001)
Number of Household Members	0.009	0.011
	(0.066)	(0.066)
Years of U.S. Experience	0.079**	0.079**
	(0.036)	(0.036)
Years of U.S. Experience Squared	-0.001	-0.001
	(0.002)	(0.002)
Speaks English Well/Very Well	0.144	0.147
	(0.210)	(0.210)
Spouse Not at Home (Working for Pay)	0.234	0.407
	(0.186)	(0.374)
Spouse Was Born in the U.S.	0.771***	0.774***
	(0.285)	(0.286)
Log of Household Income	0.001	0.001
	(0.060)	(0.060)
Spouse's Hours Worked per Week	--	-0.005
	--	(0.009)
Constant	6.272***	6.262***
	(1.592)	(1.592)
Observations	1205	1205
Adjusted R-squared	0.049	0.049

Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 5. OLS Regression Predicting Body Mass Index

	(1)	(2)	(3)
Female	-1.225***	-1.130***	-1.261***
	(0.106)	(0.105)	(0.150)
Married	-0.270**	-0.162	-0.310
	(0.125)	(0.165)	(0.236)
Age	0.349***	0.287***	0.273***
	(0.023)	(0.023)	(0.049)
Age Squared	-0.003***	-0.003***	-0.002***
	(0.000)	(0.000)	(0.001)
Years of Education	-0.158***	-0.127***	-0.140***
	(0.012)	(0.013)	(0.018)
Average Age of Household Members	-0.099***	-0.071***	-0.066***
	(0.014)	(0.014)	(0.021)
Average Age of Household Members Squared	0.001***	0.001***	0.001**
	(0.000)	(0.000)	(0.000)
Number of Household Members	-0.011	0.045	0.091**
	(0.030)	(0.030)	(0.045)
Years of U.S. Experience	--	0.212***	0.206***
	--	(0.018)	(0.031)
Years of U.S. Experience Squared	--	-0.005***	-0.005***
	--	(0.001)	(0.002)
Speaks English Well/Very Well	--	-0.289**	-0.145
	--	(0.123)	(0.173)
Spouse Was Born in the U.S.	--	-0.016	0.442
	--	(0.209)	(0.282)
Spouse Born in Same Country	--	-0.016	0.330
	--	(0.151)	(0.212)
Consumes More Junk Food in the U.S.	--	1.052***	1.271***
	--	(0.268)	(0.322)
Consumes More Meat in the U.S.	--	0.454**	0.430*
	--	(0.197)	(0.258)
Changes Between Pre-U.S. and Post-U.S. Diet	--	0.070***	0.073***
	--	(0.017)	(0.024)
Respondent's Hours Worked per Week	--	--	0.009*
	--	--	(0.005)
Log of Household Income	--	--	0.072
	--	--	(0.049)
Constant	21.649***	20.650***	19.703***
	(0.535)	(0.549)	(1.064)
Observations	6637	6637	3187
Adjusted R-squared	0.098	0.132	0.156

Standard errors in parentheses. * significant at 10%; ** at 5%; *** at 1%

Table 6. Multinomial Logit Predicting Self-Reported Health Now Compared to Before Coming to the U.S.

Dependent Variable: -1 Health Worse Now, 0 Health Same (reference category), 1 Health Better Now	Health Status Now Compared to Before Coming to the U.S.:					
	Worse (1a)	Better (1b)	Worse (2a)	Better (2b)	Worse (3a)	Better (3b)
Female	0.010	-0.023**	0.010	-0.020**	0.018*	-0.023
	(0.007)	(0.010)	(0.007)	(0.010)	(0.010)	(0.015)
Married	0.009	-0.028**	0.011	-0.026**	0.012	-0.014
	(0.008)	(0.012)	(0.008)	(0.012)	(0.013)	(0.018)
Age	-0.001	-0.004*	-0.001	-0.004*	-0.002	0.000
	(0.001)	(0.002)	(0.001)	(0.002)	(0.003)	(0.005)
Age Squared	0.000*	0.000*	0.000*	0.000*	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Years of Education	0.000	-0.007***	0.000	-0.006***	-0.001	-0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Average Age of Household Members	-0.001	-0.000	-0.001	0.000	0.000	-0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
Average Age of Household Members Squared	-0.000	0.000	-0.000	-0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Number of Household Members	-0.004**	0.005*	-0.004**	0.005*	-0.006	0.005
	(0.002)	(0.003)	(0.002)	(0.003)	(0.004)	(0.004)
Years of U.S. Experience	0.013***	0.007***	0.012***	0.006***	0.011***	0.006*
	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)	(0.003)
Years of U.S. Experience Squared	-0.000***	-0.000**	-0.000***	-0.000*	-0.000***	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Speaks English Well/Very Well	-0.003	0.012	-0.004	0.012	0.007	-0.002
	(0.008)	(0.012)	(0.008)	(0.012)	(0.013)	(0.018)
Changes Between Pre-U.S. and Post-U.S. Diet	--	--	0.004***	0.008***	0.004***	0.009***
	--	--	(0.001)	(0.002)	(0.002)	(0.002)
Consumes More Meat in the U.S.	--	--	0.005	0.056***	0.018	0.026
	--	--	(0.011)	(0.017)	(0.017)	(0.025)
Consumes More Junk Food in the U.S.	--	--	0.023	-0.033	0.034*	-0.046
	--	--	(0.014)	(0.027)	(0.020)	(0.035)
Log of household Income	--	--	--	--	0.003	-0.001
	--	--	--	--	(0.003)	(0.005)
Constant	-0.155***	0.004	-0.192***	-0.060	-0.205***	-0.122
	(0.034)	(0.051)	(0.034)	(0.052)	(0.074)	(0.108)
Observations	6637	6637	6637	6637	3187	3187

Pseudo R^2	0.030	0.036	0.026

Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Results are marginal effects.

Appendix Figure 1.