The American Diet: The Case of Immigrants*

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Abstract

We compare body mass index (BMI) of immigrants in the United States to that of natives. We observe that (on average) immigrants' BMI converges to natives' the longer they have lived in the U.S. For the analysis, we use the National Health and Nutritional Examination Survey (NHANES), a large nationally representative cross-sectional survey which contains extensive microdata on demographics, health, weight history, nutrition, physical activity, and more. For the respondents who are immigrants, we observe their time since migration, which allows us to isolate differences in their attributes, conditional on how long they have lived in the U.S. We find that BMI convergence persists across all age-ranges after controlling for a large set of observable demographic and physical characteristics. The phenomenon is also robust to compositional effects, and it occurs across all income levels. We explore the root causes of this "catch-up effect," determining that it occurs primarily due to changes in immigrants' nutrition– the longer they live in the U.S., the more likely they are to adopt high fat, high sugar diets. Changes in their physical activity levels are small and thus have little impact on BMI.

JEL classfication: I10, I12, I18, J11

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1 Introduction

One out of every eight persons in the United States of America is foreign-born. According to the 2009 American Community Survey, almost 40 million immigrants claim the U.S. to be their country

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of residence.[1] A migratory process affects the lives of immigrants as well as the recipient community. An immigrant assimilates along socioeconomic, cultural, and civic dimensions in the host country. Movement across borders and the consequential acculturation might necessitate lifestyle changes. Health is one of the dimensions of an immigrant's life that could be affected and bears extensive study. The sheer magnitude of immigrants along with their differing ethnicities and socioeconomic backgrounds can spell changes in health care provisions and costs for the U.S.

In this paper, we study the impact of immigration and length of stay on an important aspect of health: the weight of an individual, measured by his or her Body Mass Index (BMI).[2] Diet and exercise together determine the BMI of an individual. As part of the process of assimilation, an immigrant may have to adopt food types and habits common to the rest of the U.S. population. Alternatively, an immigrant may adhere to the cuisine of their native country even if they mostly use locally-available ingredients. By virtue of being a "richer" and "developed" nation than many of the home countries of today's immigrants, the U.S. is able to provide healthier and multiple varieties of food to immigrants. Immigrants may also have to implement changes in their levels of physical activity as a result of their new occupations and living conditions. Immigrants are more likely than natives to work in non-sedentary jobs involving heavy levels of activity.[3] On the other hand, any benefits from physical activity or abundance of good food options can be offset by unhealthy eating. Dietary habits of the American population have often been criticized for being high in sugars and fats. It is natural to presume that the decision to immigrate and reside in another country could spell changes in an individual's BMI.

We use the National Health and Nutritional Examination Survey (NHANES) to compare the BMI of immigrants in the U.S. to that of natives and investigate reasons behind any observed changes in the BMI of immigrants. The NHANES, conducted by the CDC, is a multiple year, nationally representative cross-sectional survey which contains extensive micro-data on demographics, health, weight history, nutrition, physical activity and more. We use data from both the interview and examination modules of the survey. The interview provides self-reported information on an individual's demographics, health, and activity histories. The examination provides a lab-conducted BMI measure which we use in our study.[4]

[1] An immigrant is any person born outside the 50 contiguous states. People born in U.S. territories like Puerto Rico or an U.S. island area are considered to be immigrants in this paper even though they enjoy U.S. citizenship.

[2] See Section 3 for a definition of BMI.

[3] Table B.1 shows that immigrants are 1.5 percentage points more likely to engage in "heavily active" jobs, while they are over 3 percentage points less likely to engage in sedentary employment.

[4] It is crucial that we use the BMI results from the examination module. There are gender and age-specific

Our main finding is that, within the same group, recently-arriving immigrants have a lower BMI than natives–between 2 to 3.5 points lower for immigrant men and 2 to 4.5 points lower for immigrant women. However immigrants close this gap as they continue to reside in the U.S. The convergence of the immigrants' BMI to that of natives is true for both men and women. The result is robust to controls of income and education, marital status, insurance status and smoking habits. This "catching-up" phenomenon in BMI could be the result of a diet rich in fatty and unhealthy foods or the lack of physical activity or a combination of both. We investigate these reasons and find that the rise in BMI of immigrants can be attributed to their adoption of high-fat, high-sugar diets. The longer immigrants stay in the U.S., the more their food habits converge to the preferences of natives, though differences still persist over time. On the other hand, immigrants who recently enter the U.S. engage in *lower* levels of physical activity compared to natives. However, with extended stay, their levels of physical activity approach that of natives. Thus immigrants' weight gain persists despite the observation that physical activity levels for immigrants increase over time. We conclude that dietary changes that mirror the eating habits of natives are the main cause for the increase in BMI of immigrants.

Compositional effects are also disregarded as the source of this trend. We do not find evidence that "thinner immigrants" are returning to their home country.[5] There is also no evidence that income prompts this trend. Eating healthy or following federal guidelines to increase nutrient consumption is more expensive (Monsivais et al. (2011)). Immigrants earn lower personal and household incomes than natives and may not be able to afford good food options. The BMI-convergence persists even after income controls are added. Additionally, we include a robustness test in which we stratify the sample by income quartiles to further ensure that the effect is genuine.[6]

The rest of the paper is organized as follows. Section 2 presents a literature review of the existing work on immigrant health and weight. Section 3 discusses the data extracted from the NHANES. Section 4 presents the results for BMI, nutritional content, and physical activity levels for immigrants and natives. Section 5 presents robustness checks and Section 6 concludes.

biases in self-reports of height and weight. Men and women significantly over-report their height, increasingly so at older ages. Men tend to overestimate their weight, but women under-report their weight, more so in younger ages. Corresponding BMI is underestimated, more so for women than for men at each age and increasingly so with older age for both sexes (Merrill and Richardson (2009)).

[5] See Subsection 5.1.

[6] See Subsection 5.2.

2 Literature Review

Obesity rates have risen across all industrialized countries in recent decades. However, the rates of over-weightness and obesity in the U.S. are higher than other developed nations (Streib (2007)). Obesity is now considered an epidemic in the U.S. (Ogden et al. (2007)). As of 2010, the Center of Disease Control puts the population of overweight people at 66% of the population, and 35% of the population is obese. While the percentage of men and women who are overweight has stayed more or less constant over the last 50 years, the proportion of adults in the U.S. now recognized as being obese has more than doubled (Nguyen and El-Serag (2010)). Obesity is the leading cause of many health problems like diabetes, hypertension, cardiovascular disease, and even cancer. Almost 110 thousand additional deaths each year can be attributed to obesity-related diseases (Flegal et al. (2005)).[7] Obesity-attributable medical expenses cost the U.S. taxpayer about $75 billion annually (Finkelstein et al. (2004)). In the context of the obesity-related epidemic, it becomes important to study the health of immigrants as their numbers increase in the U.S. and they continue to assimilate.

An unhealthy BMI is an outcome of "energy imbalances." This involves eating too many calories and not getting enough physical activity (U.S. Surgeon General's Call to Action to Prevent and Decrease Overweight and Obesity, 2001). The rise in proportion of American adults who are obese can be traced to the increase in calorie intake. The easy availability of "externally" prepared processed food and "snacking" have contributed to this trend (Cutler et al. (2003)). The Center for Disease Control's *State Indicator Report on Fruits and Vegetables 2009* references the unhealthy eating habits of U.S. adults–33% of adults eat the recommended daily two or more servings of fruits and merely 27% of adults consume the targeted three or more servings of vegetables. And eating healthy according to federal guidelines costs the average American adult more.[8] Physical exercise interventions, on the other hand, are seen to have limited success in reducing obesity among children and adults (Henderson et al. (2008)).

Given dietary and physical activity preferences, researchers have questioned the health of immigrants in the U.S. Immigrants comprise over 12.5% of the U.S. population, and their children account for almost a quarter of U.S children. Research on height showed that children born to European immigrants in the mid-20th century in the United States were taller and had larger heads

[7] This is 4.5% of the total annual deaths.

[8] The Federal Dietary Guidelines for Americans, 2010, emphasized the need for Americans to consume more potassium, dietary fiber, vitamin D, and calcium. Increasing the consumption of potassium, which is the most expensive of the four recommended nutrients, would add $380 per year to the average consumer's food costs. The average adult already spends about $4000 per year on food (Monsivais et al. (2011)).

and broader facial features than their foreign-born parents and siblings who were born abroad. Nutrition was cited as the main cause for "taller" generations.[9] Immigrants originate in countries where the prevalence of obesity is lower (Streib (2007)). There is also evidence to show that immigrants enter the U.S. "thinner" than natives (Goel et al. (2004)). These researchers also find that as immigrants continue to reside in the U.S., their weight increases, but they do not investigate the underlying reasons. Another study has compared foreign-born children in the United States to U.S.-born children of immigrants, finding that foreign-born children also tend to exhibit less "overweight-related" behavior (Gordon-Larsen et al. (2003)). Our study strives to strengthen these findings via use of broader and more precise NHANES data, robustness checks (including a key test for compositional effects), and a more comprehensive econometric analysis.

Additionally, our paper investigates the causal nature of immigrants' weight gain–in particular, whether diet or exercise (or both) are contributing factors. Several other studies have examined related topics applied to single-nationality sub-samples of the immigrant population. Researchers have found that cultural beliefs play an important role in dietary practices. The diet of older immigrants has a "traditional" bias, whereas younger immigrants tend to be indifferent between American and ethnic diets. Similarly, it has been documented that Chinese immigrants increase their consumption of Western foods and decrease the consumption of ethnic foods as they acculturate (Lv and Cason (2004)). The convenience and wide availability of American foods is cited as the reason for their widespread appeal (Satia-Abouta et al. (2002)). The desire to fit in and belong to American society prompts some immigrant groups to adopt foods they perceive to be prototypically American (Guendelman et al. (2011)). It has been noted that eating healthy costs more. It is also known that a disproportionate number of immigrants are concentrated in the bottom quartile of the income distribution. It might be conjectured that immigrants are less likely to be able to afford healthy food compared to natives and this contributes to their weight gain. Researchers also show that new immigrants, especially those living in low-income densely populated neighborhoods, are more likely to engage in physical activity—like using bicycles to travel to work—than natives (Smart (2010)). The effect of higher levels of physical activity is lost across generations of immigrants. Adopting a more sedentary lifestyle in the U.S. may contribute to weight gain. In one study, while children of Guatemalan immigrants are taller than their Guatemalan counterparts, the ones who report watching TV and playing video games as their primary leisure activity are more likely

[9] The height of the European stock of immigrants in the U.S. has hit its plateau. Height increases are mainly seen in the Asian and Hispanic immigrant populations living in the U.S.

to be obese (Smith et al. (2002)).

Our paper attempts to explain the convergence of immigrants' BMI, over time, to the BMI level of natives. Immigrants may gain weight as function of their adoption of American fat-and-sugar rich foods. Immigrants may be unable to afford healthy foods or their tastes may shift towards a less healthy diet. And finally, a lack of exercise could contribute to their weight gain. We try to add to the existing body of literature on immigrant health by isolating the factors that contribute to changes in immigrant BMI. The next section describes the NHANES and the data used in our analysis.

3 Data Description

In our study, we utilize data from the National Health and Nutrition Examination Survey (NHANES), which is a multi-year cross sectional study conducted by the Centers for Disease Control. The NHANES surveys a nationally representative sample via both interviews and formal medical examinations. The most modern form of the NHANES was introduced in 1999, with new cross sections of data being gathered every two years. The biennial cross sections are labeled "2001-2002," "2003-2004," etc., because the data collection process overlaps the calendar year. Our analysis combines data from four waves, starting with the 1999-2000 collection and finishing with the 2005-2006 collection. It is important to note that our dataset is not a panel; it is a large cross section built from four smaller ones.

Although the NHANES is nationally representative, it over-samples individuals older than age 60, African Americans, and Hispanics. Each cross section contains sampling weights, strata, and clustering variables to properly account for the complex survey design. Due to its size and structure, many NHANES respondents are immigrants. Our final sample contains 3,729 immigrants out of a total sample size of 13,838.

The NHANES is split into two main components: an interview and an examination. Interviews are conducted in respondents' homes, and examinations take place in large mobile trailers under the supervision of doctors and medical technicians. From the interview component, we utilize questionnaire modules on family and individual demographics, weight history, smoking habits, health insurance status, dietary information, and physical activity levels. From the examination, we take information on body measures—in particular Body Mass Index (BMI)—which is a broadly

accepted proxy used to classify an individual as underweight, normal weight, overweight, or obese. BMI is equal to an individual's weight in kilograms divided by the square of his or her height (in meters). BMI values less than 18.5 correspond to underweight status, 18.5 to 25 are healthy weights, 25 to 30 are overweight values, and measurements over 30 classify an individual as obese.[10]

Some respondents receive the interview but not the examination (about 5% of the sample). Since BMI is a crucial variable in our study, we only use data from examination-takers. Although this introduces the potential for reporting bias, we can easily circumvent this issue. The NHANES provides two sets of sampling weights: one is for the full sample, one is for the sub-sample of examination-takers. We strictly use the second set of weights. Additionally, Figure A.3 presents a few key variables' distributions from both the full sample and the examination-restricted sub-sample. There are no notable differences.

For our study, the main sample consists of examination-takers from the 1999-2000, 2001-2002, 2003-2004, and 2005-2006 surveys who are at least 20 years old but less than 70. There are 16,152 individuals who meet these criteria. We exclude pregnant women[11] (1,169 observations), extremely underweight individuals with BMI less than 15 (5 observations), and exceedingly overweight individuals with BMI greater than 75 (1,032 observations). We omit respondents with missing values for education level (12 observations), smoking habits (11 observations), immigration status (74 observations), and on-the-job physical exertion (11 observations). This leaves us with a final sample size of 13,838 individuals.

Table B.1 contains summary statistics for notable variables, divided into two groups, natives and immigrants. We observe gender and five distinct races: Mexican, White, Black, other Hispanic, and other race. The average age is 42.7, and the average BMI is 28.3.[12] We also observe health insurance status (covered or not), marital status (married, previously married, never married), and smoking behavior (never smoked, smoked but quit, smokes every day, smokes occasionally). Approximately 79% of the sample has insurance, 61% is married, and 50% has never smoked. We split family income into quartiles[13] and on-the-job strain variables into four levels of strain: sedentary, light,

[10] Interested readers may refer to the World Health Organization's website for more details on BMI.

[11] We also exclude responses for whom we "cannot ascertain if pregnant at the exam."

[12] Thus the average individual in the United States is overweight. See Figure A.3 for more detailed information on age and BMI distributions.

[13] Note that family income quartiles are approximate (i.e. the second "quartile" consists of 17.85% of the sample, as

moderate, or heavy.[14] Education levels are split into five groups, with the lowest having less than any high school education and the highest having a college degree or above. About a quarter of the sample has a college degree and less than 18% has no high school degree. The immigration status variable reports whether the respondent is native to the U.S. or if not, how long he or she has been in the U.S (in five or ten year ranges). 85% of respondents are natives, and the remaining 15% are distributed fairly uniformly between the various time spans. See Figure A.3 for the specific distribution. In the main results section, we stratify the sample into five age groups: 20 to 29, 30 to 39, 40 to 49, 50 to 59, and 60 to 69. It is important that each duration-of-residency bin contains enough observations within each age group. Refer to Table B.2 for these conditional distributions. The middle age groups possess more uniform distributions, and as a result, our quantitative analyses on these segments are noticeably cleaner.

4 Results

This section presents our initial analysis of the raw data, followed by the main regression results, and investigations into nutrition and physical activity levels, which (we argue) drive the catch-up effect.

4.1 Raw Data

Since the NHANES is not a panel study, we cannot track particular respondents' BMI changes over time. Instead, we utilize the survey question regarding respondents' immigration status (whether native or immigrant, and if the latter, how long they have lived in the U.S.) to calculate sample averages of BMI conditional on both weight and immigration status. Figure A.1 presents these

seen in the Table B.1) because the NHANES reports only discrete income ranges, such as $5,000 to $9,999, $10,000 to $14,999, etc.

[14] This variable also applies to students, unemployed respondents, retirees, and other non-workers. The specific question is phrased as follows:

> "Please tell me which of these four sentences best describes your usual daily activities? Daily activities may include work, housework if a homemaker, going to and attending classes if a student, and what you normally do throughout a typical day if a retiree or unemployed.
>
> 1. You sit during the day and do not walk about very much.
> 2. You stand or walk about a lot during the day, but do not have to carry or lift things very often.
> 3. You lift light loads or have to climb stairs or hills very often.
> 4. You do heavy work or carry heavy loads."

averages along with their 95% confidence intervals. The plots compare immigrants' average BMI (depending on their length of stay in the U.S., on the horizontal axis) to the sample average of natives' BMI (given by the horizontal lines in each plot). The plots are grouped by gender and 10-year age groups. The most notable feature in nearly every plot is the convergence of immigrants' BMIs to natives', over time. This holds true for men, women, and the pooled sample. The "catch-up effect" is more pronounced and the confidence intervals are tighter for the pooled sample because of the larger sample size. It is important to note that these observations are only correlational; the remainder of this section examines the phenomenon in greater detail.

4.2 OLS Regressions

In various economic applications, past literature has modeled a "production function" of BMI using OLS (Cawley (2004); Chou et al. (2004); Philipson and Posner (1999))[15]. Following this literature, we control for BMI-affecting observables that can be found in the NHANES. Compared to observations from the raw data, if the immigration status variables remain statistically significant after implementing controls, then OLS provides further evidence that the catch-up effect is genuine. As before, we stratify the sample (for each regression) by 10-year age group and gender. The general OLS specification is as follows, where we model a linear relationship between individual i's body mass index (BMI_i), and his or her observable covariates (X_i), physical activity level (PhysAct_i), time in the United States (YrsInUSA_i), and a constant term (α):

$$\text{BMI}_i = \alpha + \theta X_i + \delta \text{PhysAct}_i + \beta \text{YrsInUSA}_i + u_i$$

u_i includes all unobserved characteristics that affect BMI_i. X_i includes race, survey cohort, education level, family income quartile, health insurance status, marital status, and smoking behavior. PhysAct_i is a variable that measures the intensity of work and home life activities, and YrsInUSA_i is a set of dichotomous variables corresponding to five and ten year ranges of immigrants' lengths of stay in the U.S. For natives, all of these dummy variable are equal to zero.[16] We interpret this variable as the "environmental impact" of years in the United States; attributes such as food and physical activity (in leisure time) preferences, as well as their prices and availability, are the primary conjectured components of YrsInUSA_i. We closely examine these characteristics in Subsection 4.3.

[15] The cited papers focus on the study of how obesity may impact wage determination.
[16] Refer to Section 3 and Table B.1 for details on these covariates.

If there are omitted variables correlated with YrsInUSA_i, then our estimate of β is inconsistent. For instance, in this specification, there may be a reverse effect of BMI on immigration status (simultaneity). Perhaps there is some unobserved force that causes thinner immigrants to return to their home countries more readily. In this case, estimates of the longer-residency β's would be biased upwards (driving the catch-up effect, at least in part). The composition tests in Subsection 5.1 provide evidence against this hypothesis.

Tables B.3, B.4, and B.5 contain OLS estimation results for sub-samples of men and women, and the full sample, respectively. From all three tables, it is clear that across all age groups, less educated individuals, African Americans, and Hispanics tend to have higher body mass index. In the full sample (Table B.5), everyday smokers tend to be thinner, with average BMI differences ranging from 0.76 to 2.8 points less than non-smokers (even occasional smokers exhibit the same trend). Workers who engage in more strenuous employment tend to be thinner; average BMI differences range from 0.74 (workers with "light strain" in their twenties) to 3.6 (workers with "heavy strain" in their sixties) point differences compared to those with sedentary jobs. Estimates for family income quartile coefficients are largely statistically insignificant because of their strong correlation with education level. These results are similar to the separated samples of men and women (Tables B.3 and B.4), with a few exceptions. For men, race and education do not have as much explanatory power, but men who were never married tend to be thinner by 1 to 2 points.

We are mainly interested in the "Years in USA" length of residency indicators. It is helpful to visualize these estimates as in Figure A.2. The figures plot each point estimate (marked by circles) and 95% confidence intervals (marked by x's) of the immigration status coefficients. The point estimates represent the average differences of immigrants' BMI compared to natives' BMI, after controlling for all other observables. We include a horizontal line at zero to indicate the point where there is no BMI difference, all else equal. The two columns are for sub-samples of men and women and the third includes the entire sample. As expected, confidence intervals are more narrow for the full sample, but the trend is clear: Cleansed of observable characteristics, new immigrants tend to be thinner than natives, but their BMI converges as their length of stay increases. The effect is most pronounced for immigrants from ages 30 to 59. Direct interpretation of the estimates provides specific information on these trends. For instance, we observe that new immigrants (with residency for less than five years) in their thirties tend to have lower BMI than natives by 3.8 points, but those who have been here for twenty to thirty years tend to be lower by only 2.4 points. The

difference becomes insignificant for those have have been here for thirty years or more.[17] The next subsection investigates the underlying forces behind the catch-up effect, establishing that changes in immigrants' dietary habits are the main factors while their physical activity levels do not appear to have a role.

4.3 Nutrition and Physical Activity

To study immigrants' dietary patterns, we incorporate some additional sample restrictions. Beginning with the 2003-2004 wave, the NHANES implemented a new and more comprehensive dietary questionnaire. In addition to adding many detailed questions about daily nutrition, surveyors began to collect dietary information from two distinct days during the same week of the primary interview. This allows for much more precision in the measurement of dietary habits, which tend to be volatile on a day-to-day basis.[18] Our new sample appends the three most recent waves: 2003-2004, 2005-2006, and 2007-2008. To avoid the issue of reporting bias (only 87% of respondents have complete (two day) and reliable intake reports), the NHANES provides a modified set of sampling weights. Along with this restriction, we exclude respondents who claim to be "on a diet" at the time of their survey. This leaves us with a final sample size of $N = 6,679$. The dietary module contains a raw file of individual foods taken by each respondent on both survey days. Using a USDA food code database, the NHANES aggregates the individual foods information into a file of total nutrient intakes (for each individual on both survey days). We use information on total caloric intake, total fat intake (in grams), and total sugar intake (in grams). In addition, we observe the day of the week for each nutritional interview and whether the individual reports eating more or less than usual on each survey day.

[17] Insignificance in these extreme cases may occur do to small sample size. In this example, we only observe 50 individuals in their thirties who report being in the U.S. for at least 30 years. See Table B.2 to see the age/immigrant status groups which might suffer small sample problems.

[18] The following descriptive excerpt is taken from NHANES documentation:

> "The dietary intake data are used to estimate the types and amounts of foods and beverages consumed during the 24-hour period prior to the interview (midnight to midnight), and to estimate intakes of energy, nutrients, and other food components from those foods and beverages....One of the most important changes is the release of two days of intake data for each participant. The first day (Day 1) is collected in the Mobile Examination Center (MEC) and the second day (Day 2) is collected by telephone 3 to 10 days later. Most MEC participants (87 percent) have 2 days of complete and reliable intakes. The release of 2 days of data will permit the estimation of usual (long-run average) nutrient intakes in order to assess diets in the U.S. The Institute of Medicine recommends that assessment of the diets of population groups in relation to Dietary Reference Intakes be based on usual intake distributions of nutrients (Institute of Medicine, 2000). A minimum of two nonconsecutive days of dietary intake data for at least a sub-sample of the individuals is necessary for a more accurate estimation of the usual intake of nutrients."

To measure acculturation associated with nutritional choices, we adopt a similar OLS model as in Subsection 4.2:

$$\log(\text{gramsFat})_i = \alpha + \theta X_i + \psi \text{BMI}_i + \delta \text{PhysAct}_i + \beta \text{YrsInUSA}_i + u_i$$

X_i includes the same set of controls as in the main model, as well as dichotomous indicators for whether individual i reported eating more than usual at both food intake interviews, less than usual (also at both interviews), whether both interviews took place on weekdays, and whether both interviews took place on weekend days.[19] We also control for individuals' current BMI, as larger individuals may simply require more nutrients than smaller individuals. With only three waves of survey data, we estimate the models on 15-year age group sub-samples instead of 10-year groups to mitigate small sample variation. Table B.8 presents regression results for three versions of the dietary model; the first has logarithm of Calories[20] as the dependent variable, the second has log of grams of fat, and the third has log of grams of sugar.

In each model, higher BMI is associated with higher food consumption. For individuals between 35 and 50, 1 more point of BMI corresponds to 0.32% higher Calorie consumption (or about 6.4 Calories for a 2000 Calorie per day diet) and 0.54% more grams of fat consumed. There is also evidence that the survey timing matters; respondents with food intake interviews on weekends tend to eat more, and respondents with both interviews on weekdays tend to eat less. Figure A.4 depicts the coefficient estimates and confidence intervals for the immigration status dummies from Table B.8 (these are the same type of plots as in Figure A.2). The left column includes Calorie regression results, the middle column has grams of fat regression results, and the right column contains grams of sugar results. There is a clear upward trend in immigrants' caloric intake. The trend is particularly prominent for fat consumption for the older two age groups. Results from models predicting sugar intake are more volatile, but they also suggest an upward trend. Direct interpretation of specific point estimates allows statements such as: 35 to 49 year old immigrants who have been in the U.S. for 20 to 30 years tend to consume nearly 8% more fat per day than immigrants who have been in the U.S. for 5 to 10 years. These percentage increases are similar in magnitude for both sugar and caloric intakes.

[19] These covariates are designed to help control for daily volatility in eating habits because dietary behavior may tend to differ on the weekend.

[20] "Food calories" are typically written as capitalized "Calorie." This is the same as a kilocalorie, the amount of energy required to raise the temperature of 1 gram of water by 1° Celsius.

To track possible changes in immigrants' physical activity levels, we estimate similar models with exercise level indicators as dependent variables. These models utilize the same sample as in the main model (Section 4). There are two different dependent variables for exercise: vigorous activity and moderate activity. The NHANES questionnaire is phrased as follows:

> "The next questions are about physical activities including exercise, sports, and physically active hobbies that you may have done in your leisure time or at school over the past 30 days. First I will ask you about vigorous activities that cause heavy sweating or large increases in breathing or heart rate. Then I will ask you about moderate activities that cause only light sweating or a slight to moderate increase in breathing or heart rate. Over the past 30 days, did you do any vigorous activities for at least 10 minutes that caused heavy sweating, or large increases in breathing or heart rate? Some examples are running, lap swimming, aerobics classes or fast bicycling."

Responses are coded as dichotomous variables. We estimate a linear probability model, using the same right hand side as in Section 4, with the sole addition of BMI as a control variable. Recall that the PhysAct_i covariate is merely an measure of on-the-job strain, not of leisure time exercise. Table B.9 contains regression results.

$$\text{Exercise}_i = \alpha + \theta X_i + \psi \text{BMI}_i + \delta \text{PhysAct}_i + \beta \text{YrsInUSA}_i + u_i$$

Results from these models suggest that patterns in exercise behaviors are less predictable than eating habits. Immigrants in their fifties who have been in the U.S. for less than 5 years have a 23.7% lower probability of reporting moderate activity (than natives). However, immigrants in their fifties who have been in the U.S. for 30 to 40 years only have a 15.1% lower chance of moderate activity. We observe this uptick in activity levels for every age group (for models with "moderate activity" dependent variable) except for 40 to 49, as well as for respondents in their twenties for the "vigorous activity" dependent variable. In either case, the majority of estimates for the length of residency variables are negatively signed; immigrants tend to exercise less than natives. Thus we have observed that immigrants' food intake—particularly of high fat, high sugar foods—has moved towards natives' while their activity levels have (at worst) improved at the same time. We conclude that dietary changes are the main cause of the convergence of immigrants' BMI to natives'.

5 Robustness Checks

5.1 Composition Test

One might suggest that the BMI-convergence occurs due to compositional effects; in particular, what if thin immigrants tend to leave the U.S. sooner than overweight immigrants? Since our data is not a panel, there is no simple test for this phenomenon. Fortunately, the NHANES contains a questionnaire module on weight history, including a question phrased as follows:

> "How much did you weigh 10 years ago? [If you don't know your exact weight, please make your best guess.]"

This question is asked to all respondents who are age 36 or older. If it is true that BMI convergence occurs due to compositional effects, then longer stays in the U.S. must be associated with larger weight gains (and shorter stays in the U.S. must be associated with smaller weight gains).

To perform this test, we regress the 10-year *change* in BMI on the set of covariates from the main regressions. We now limit our sample to only immigrants, and although we still stratify the sample by 10-year age groups, we can only construct three distinct age groups for this test (because only individuals age 36 and older receive the weight history questionnaire). The age groups include individuals from ages 36 to 44, from ages 45 to 54, and from 55 to 64. For each regression, we check the complete set of Wald tests for the immigration status indicators, as shown in Table B.6. Each table entry corresponds to a p-value from a test of the form:

$$H_0 : \beta_{YrsInUSA(row)} = \beta_{YrsInUSA(column)}$$

For example, the top-left entry of the first table is the p-value for the test that the coefficient indicating 5 to 10 years of U.S. residency ($\beta_{YrsInUSA(5to10)}$) is equal to the coefficient indicating 10 to 15 years of U.S. residency ($\beta_{YrsInUSA(10to15)}$). For the first two age groups, we do not reject the null for any pair of coefficients, even at the 90% confidence level. For the oldest age group, we reject the null for five comparisons at the 90% level (or four comparisons at the 95% level). All but one of these cases correspond to the point estimate for $\beta_{YrsInUSA(20to30)}$, which takes a negative (but statistically insignificant) value equal to -1.02. This estimate is larger in magnitude than most

others, likely due to small sample variation, but due to its sign, it does not imply the presence of compositional effects.[21] The final case is the comparison of $\beta_{YrsInUSA(50+)}$ to $\beta_{YrsInUSA(15to20)}$, but since the estimate of the latter is also negative (although smaller in magnitude), the previous argument again applies. To conclude, we do not find evidence of compositional effects.

5.2 Income Stratification Test

It is possible that this effect may be unique to particular income levels, due in part to food pricing and availability. Although the main model controls for income, we further examine this question by redoing the regressions on sub-samples of each income quartile. To minimize small sample size issues, we use 15-year age groups as in the nutritional models. Table B.7 contains estimates of the immigration status coefficients for the income-stratified models. Standard errors are noticeably larger, resulting in "rougher" estimates. For example, in the youngest age group of the lowest income quartile (where we might expect the BMI-convergence to be the most pronounced), BMI point predictions increase from -3.7 (for the most recent immigrants) to -1.9 to -1.1, but then jump back down to -2.9 for those with 20 to 30 years of residency. Similar patterns can be seen in the second and fourth quartiles for ages 35 to 49. More typical BMI-convergence occurs in the lowest quartile (ages 50 to 59) and the third quartile (ages 35 to 49). In summary, this test provides further evidence that the "catch-up" effect is robust to personal income.

6 Conclusion

This paper expands upon the existing literature on immigrant health–in particular on the weight, diet, and physical activity behavior of the immigrant population in the United States. Using data from the NHANES, we find strong evidence that immigrants enter the U.S. thinner than natives, but that their body mass index converges to natives' as their length of stay increases. This effect persists through a comprehensive set of control variables that are widely accepted (in past literature) "inputs" in a "production function of weight," and it is robust to composition effects (we find no evidence that thinner immigrants tend to leave the U.S. more readily) and is present for all income levels. Our analysis of nutrition and exercise levels suggests that immigrants' food choices are the primary cause of the catch-up effect.

[21] Under the presence of compositional effects, we would expect the coefficient estimates for longer-stay indicators to have a positive sign.

This study opens a number of possible avenues for future research. The acculturation effect of American diets on immigrants serves as a "natural experiment" that may allow further study of the economic impact of the American diet and resultant obesity levels. In the current economic discourse, issues surrounding health care costs are becoming increasingly important. It may be worthwhile to extend our analysis of weight-related variables to weight-related ailments and costs. The NHANES contains very specific information on nutrition intake; it may be advantageous to study more specific changes in immigrants' diets (in more meticulous detail than in this paper) to research the impact of variables like food prices and availability on choices. In addition to the sizable group of immigrants in the United States (which by itself can affect changes in health care provisions and costs), the "natural experiment" aspect of this question may allow us to extend our conclusions to the U.S. population as a whole.

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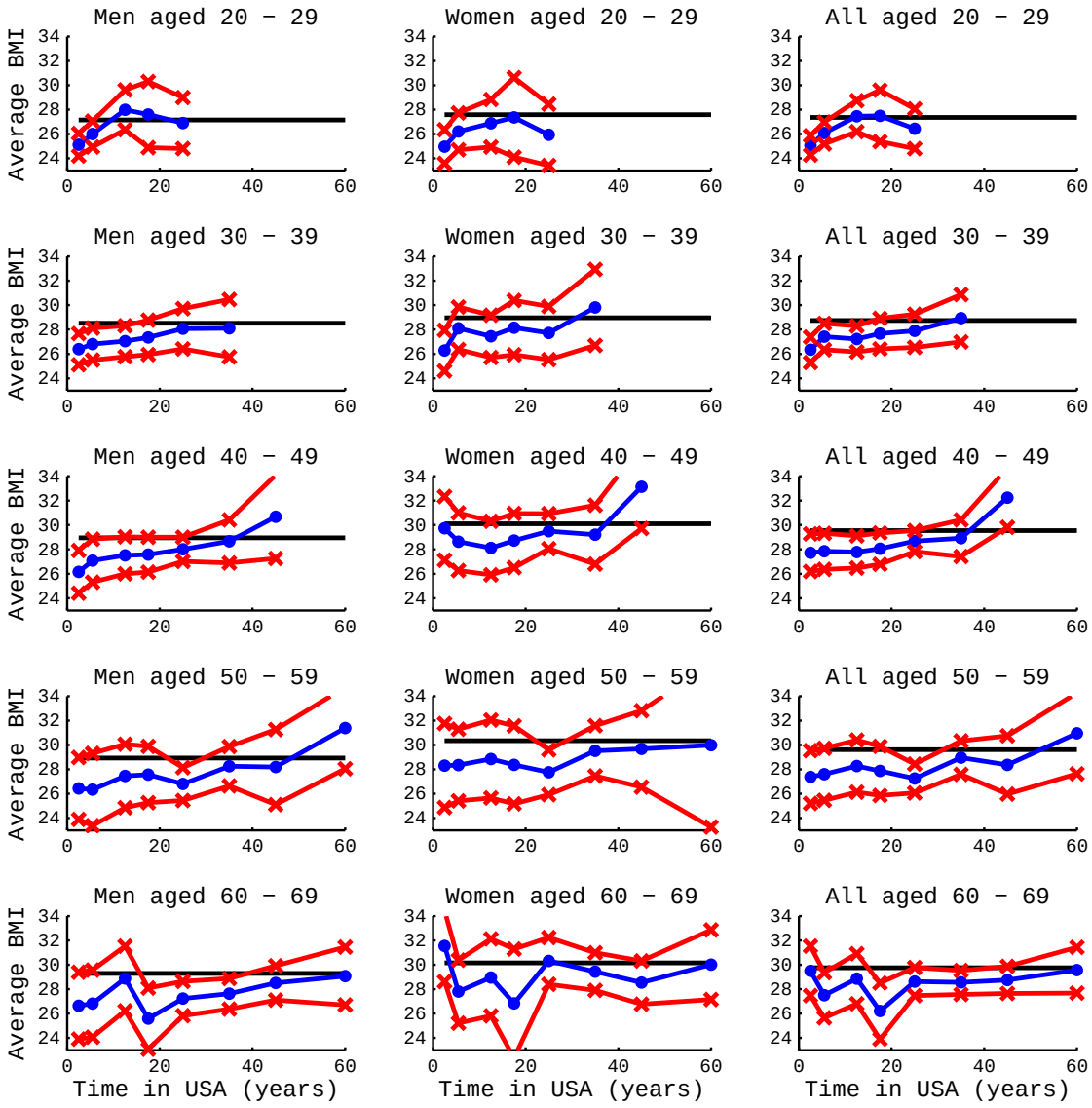
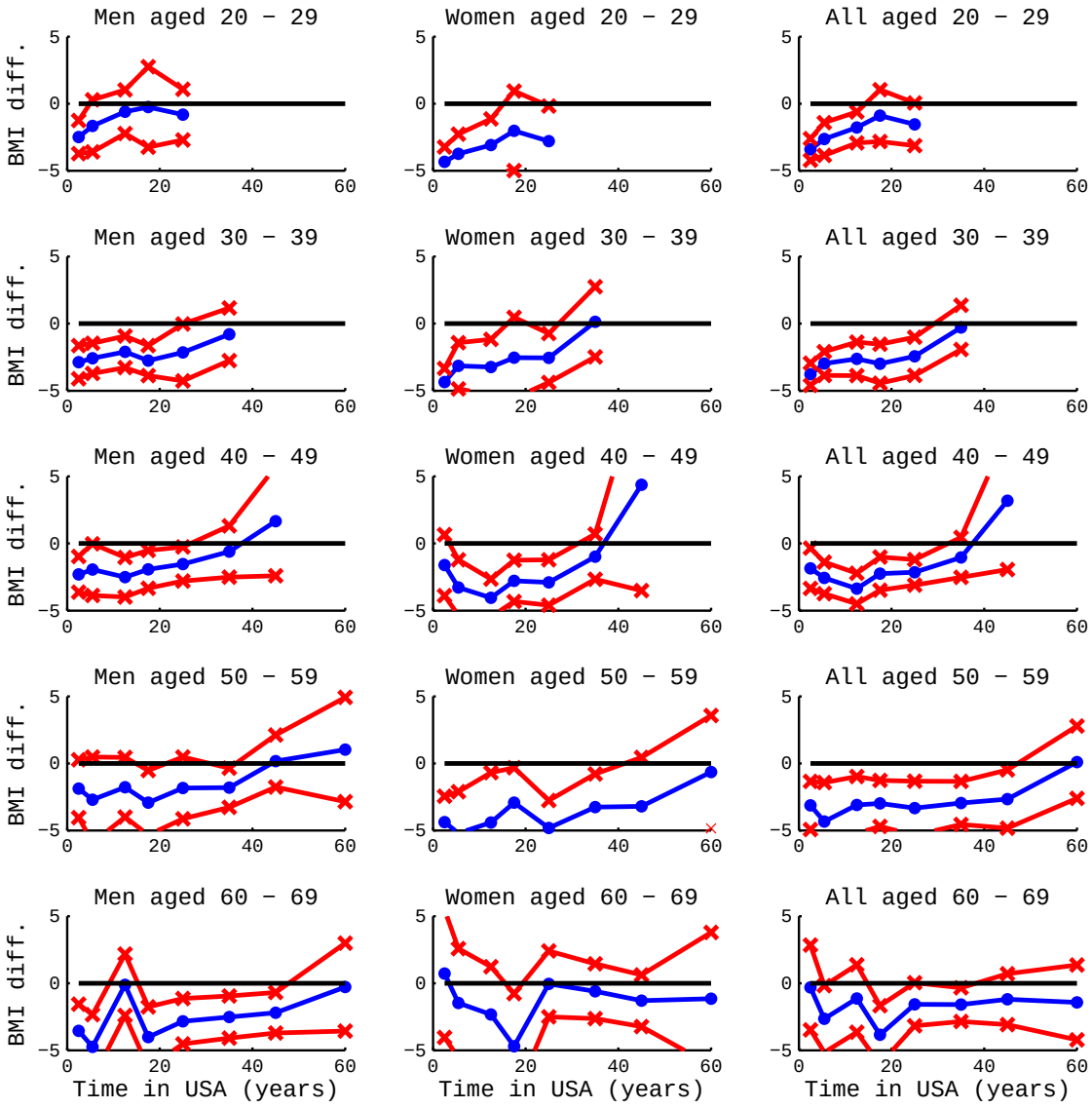
A Appendix: Figures

Figure A.1: Average BMI Plots - by Age and Immigration Status



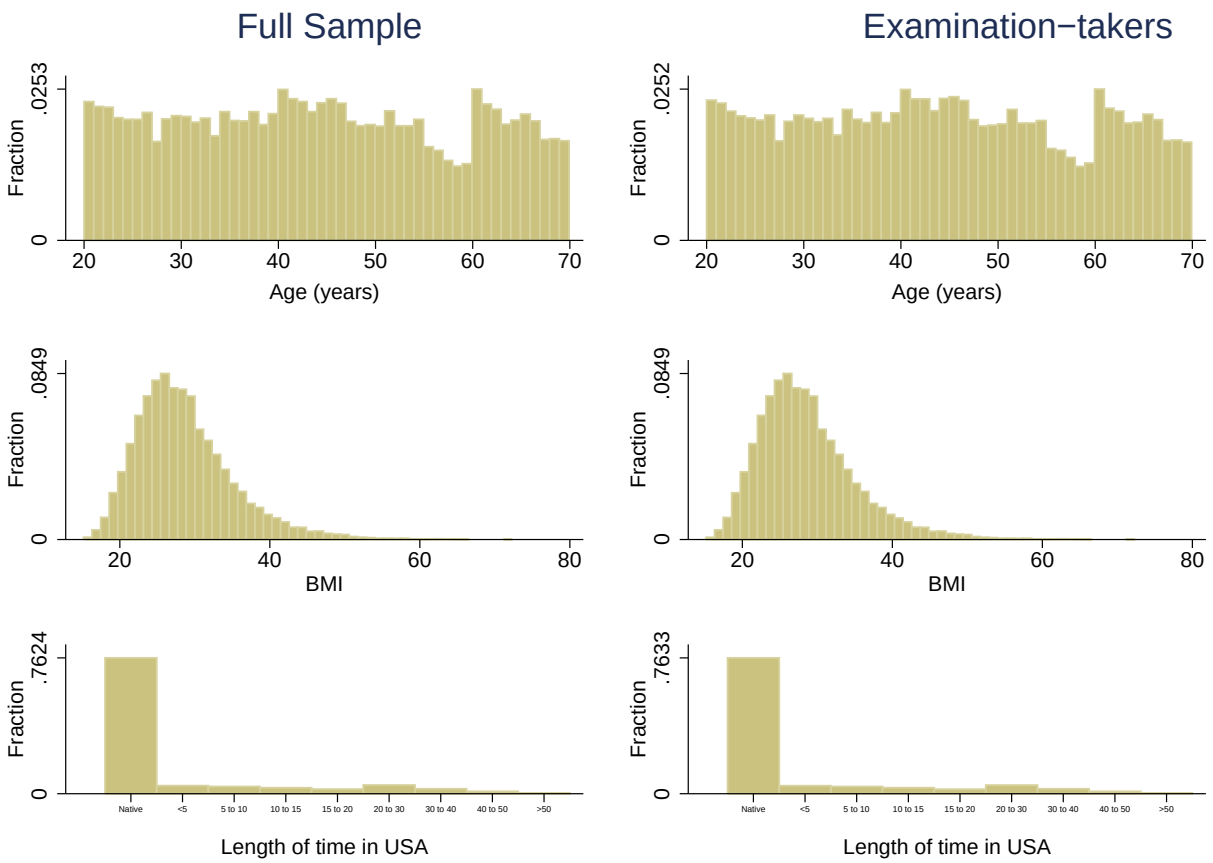
Note: The figures above are based entirely on the raw data (i.e. before any regression analysis). They compare sample averages (points are marked by circles) and 95% confidence intervals (marked by x's) of immigrants' BMI (conditional on their length of stay in the U.S. on the horizontal axis) to the sample average of natives' BMI (marked by the horizontal line in each plot). The plots are grouped by gender and age.

Figure A.2: BMI Differences - by Age and Immigration Status



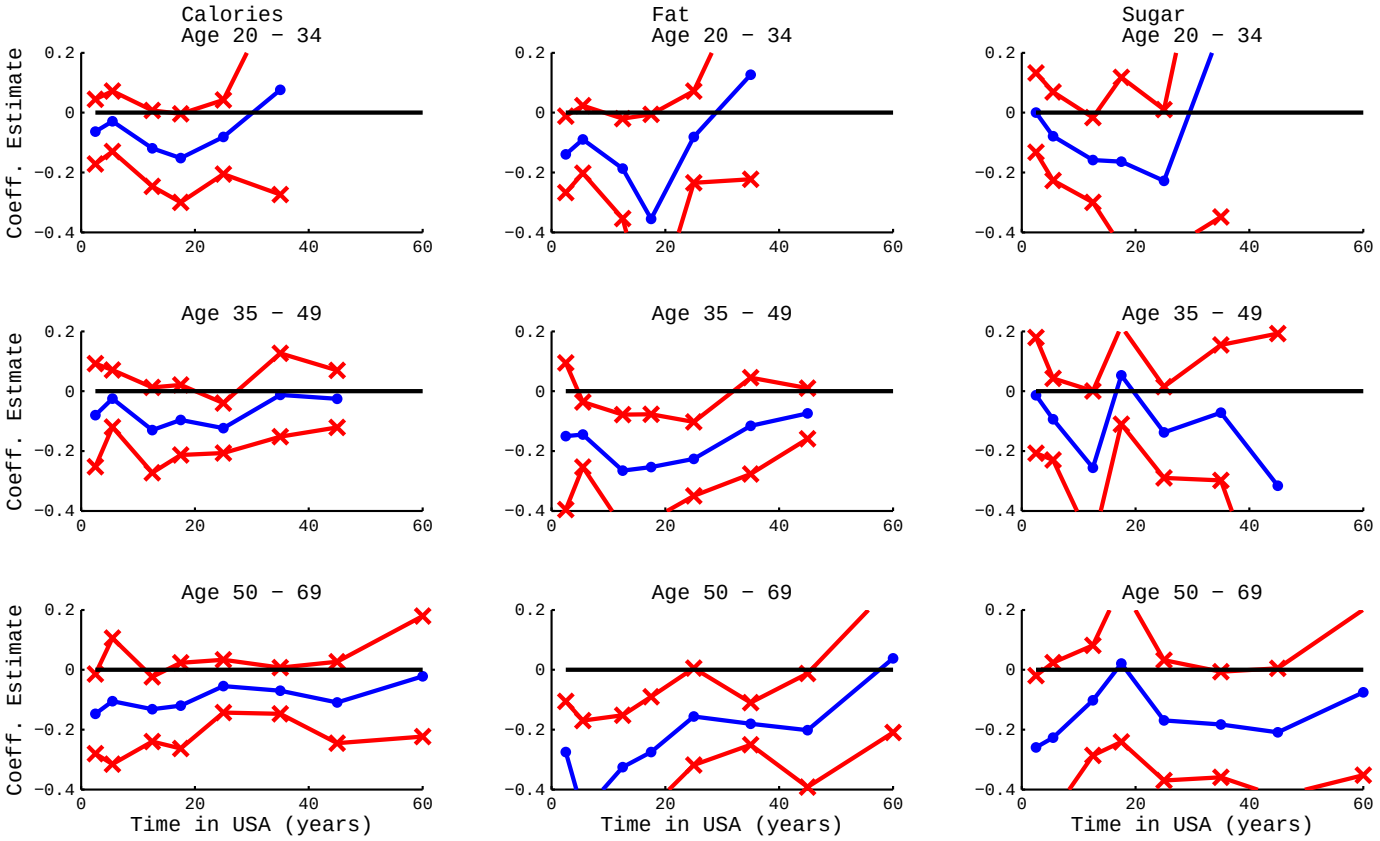
Note: The figures above are derived from the regression analysis. They plot point estimates (marked by circles) and 95% confidence intervals (marked by x's) of the immigration status (or "years of stay") coefficients. The point estimates represent the average differences of immigrants' BMI compared to natives' BMI, after controlling for all other observables.

Figure A.3: Distributions for Reporting Bias Test



Note: The figures on the left column present the distributions of age, BMI, and immigration status from the full sample (including some individuals who did not receive the medical examination). The figures on the right column present the distributions of these variables from the main sample, which includes only examination-takers. The main sample is used for plots and regressions of BMI in the main results section. The physical activity and dietary results sections use different samples; refer to the corresponding sections for further information.

Figure A.4: Nutritional Plots



Note: These figures present the coefficient estimates and confidence intervals for the years-of-residency dummies from the regressions described in Subsection 4.3. The left column is from Calorie regressions, the middle column is from grams of fat regressions, and the right column is from grams of sugar regressions. The value of each point estimate on the vertical axis corresponds to the mid-point of that particular dummy's year range (for instance, for the 10 to 15 year indicator, we plot its coefficient estimate at year 12.5 on the horizontal axis). The circular points are the coefficient estimates, and the x's are their confidence intervals. We include a horizontal line at zero to depict the benchmark case where immigrants do not differ from natives.

B Appendix: Tables

Table B.1: Summary Statistics

	Natives		Immigrants	
	Mean	Std. Dev.	Mean	Std. Dev.
Female	0.5066	0.0045	0.4665	0.0034
Age	43.1202	0.2288	40.4443	0.4018
BMI	28.5765	0.1173	26.9078	0.0168
Mexican	0.0365	0.0053	0.3157	0.0232
Other Hispanic	0.0211	0.0054	0.2111	0.0315
Black	0.1228	0.0101	0.0708	0.0026
Other (non-white) race	0.0279	0.0029	0.1769	0.0033
Insured	0.8231	0.0070	0.5992	0.0068
Insured missing	0.0082	0.0013	0.0111	0.0024
Never married	0.1826	0.0077	0.1843	0.0077
Formerly married	0.1548	0.0056	0.1197	0.0096
Marital status missing	0.0228	0.0075	0.0291	0.0154
Education: less than 9th grade	0.0238	0.0020	0.2198	0.0120
Education: some high school	0.1154	0.0055	0.1591	0.0038
Education: high school grad. or GED	0.2692	0.0072	0.1802	0.0115
Education: some college or Jr. college	0.3300	0.0063	0.2200	0.0078
Education: college graduate or above	0.2615	0.0118	0.2209	0.0042
Fam. Income: lowest quartile	0.1846	0.0079	0.2856	0.0027
Fam. Income: second quartile	0.1710	0.0063	0.2188	0.0023
Fam. Income: third quartile	0.2639	0.0067	0.2425	0.0013
Fam. Income: highest quartile	0.3569	0.0131	0.2162	0.0035
Fam. Income: missing	0.0236	0.0021	0.0369	0.0009
Smoked but quit	0.2342	0.0061	0.1847	0.0048
Smokes everyday	0.2453	0.0075	0.1437	0.0075
Smokes occasionally	0.0394	0.0025	0.0562	0.0006
Job strain: sedentary	0.2379	0.0060	0.2028	0.0090
Job strain: light activity	0.4829	0.0059	0.5494	0.0054
Job strain: moderate activity	0.1932	0.0059	0.1460	0.0070
Job strain: heavy activity	0.0860	0.0040	0.1017	0.0044
N	10,559		3,279	

Note: This table presents sample means and standard deviations for the variables included in the main sample, which is used for plots and regressions of BMI in the main results section. The physical activity and dietary results analyses use different samples; refer to their sections for further information. For ease of comparison, summary statistics are stratified into two groups: natives and immigrants.

Table B.2: Immigration Status Distribution (by age group)

	Age 20 to 29	*30 to 39*	*40 to 49*	*50 to 59*	*60 to 69*
Native	2,145	2,018	2,301	1,925	2,170
Fewer than 5 years in USA	283	173	82	38	36
5 to 10 years	226	162	89	39	43
10 to 15 years	111	167	112	39	35
15 to 20 years	40	120	118	44	28
20 to 30 years	67	102	260	128	112
30 to 40 years		50	87	94	153
40 to 50 years			33	31	119
More than 50 years				16	42
Total	2,872	2,792	3,082	2,354	2,738

Note: This table presents the number of natives and immigrants (grouped by how long they have lived in the U.S.) in each 10-year age group in the main sample. The main sample is used for plots and regressions of BMI in the main results section. The physical activity and dietary results sections use different samples; refer to the corresponding sections for further information.

Table B.3: Main Results - Men - by 10-year Age Groups

BMI Dependent Variable, Men Only	20 to 29	30 to 39	40 to 49	50 to 59	60 to 69
(Race, omitted group: White)					
Mexican	1.013*	2.102***	1.142**	-0.0586	0.976*
	(0.577)	(0.571)	(0.512)	(0.580)	(0.519)
Other Hispanic	1.544*	1.034	0.598	-0.480	-0.498
	(0.804)	(0.751)	(0.688)	(0.745)	(0.957)
Black	0.701	0.980**	-0.131	-0.150	-0.365
	(0.459)	(0.436)	(0.466)	(0.430)	(0.399)
Other race	0.322	0.520	0.545	0.796	-1.827***
	(0.740)	(0.607)	(0.824)	(1.144)	(0.661)
(Cohort, omitted group: 1999-2000)					
Survey year 2001-2002	0.139	-0.242	0.298	0.0408	0.538
	(0.383)	(0.467)	(0.536)	(0.653)	(0.359)
Survey year 2003-2004	0.405	0.178	0.309	0.111	0.773
	(0.454)	(0.507)	(0.486)	(0.640)	(0.465)
Survey year 2005-2006	0.232	0.886*	1.235**	0.460	0.906**
	(0.547)	(0.449)	(0.471)	(0.629)	(0.435)
(Education, omitted group: College or more)					
Education: less than 9th grade	1.067	1.262	0.378	2.453***	1.616***
	(0.903)	(0.783)	(0.664)	(0.782)	(0.590)
Education: some HS	1.008	1.940**	0.476	1.445*	1.095*
	(0.791)	(0.800)	(0.668)	(0.768)	(0.637)
Education: HS grad or GED	0.995	2.025***	1.644***	2.028***	1.274**
	(0.660)	(0.554)	(0.603)	(0.601)	(0.515)
Education: some college or AA	0.771	1.123**	1.285**	1.532***	1.951***
	(0.623)	(0.535)	(0.501)	(0.504)	(0.505)
(Fam. Inc., omitted group: Highest Quartile)					
Family Income: Lowest quartile	-1.118**	0.525	-0.782	-0.0894	-0.362
	(0.493)	(0.639)	(0.690)	(0.595)	(0.576)
Family Income: Second quartile	-0.553	1.263***	-0.242	0.112	0.0264
	(0.614)	(0.468)	(0.509)	(0.650)	(0.492)
Family Income: Third quartile	0.326	0.926*	-0.394	0.251	0.178
	(0.519)	(0.475)	(0.442)	(0.468)	(0.464)
Family Income: Refused specific	-1.397	-1.377	0.483	0.921	1.045
	(1.620)	(1.141)	(1.321)	(1.441)	(0.723)
(Insurance Status)					
Insured	-0.512	1.081***	0.385	0.240	0.149
	(0.480)	(0.300)	(0.471)	(0.509)	(0.784)
Insured missing	0.333	4.390**	-1.291	-1.344	-1.310
	(1.073)	(1.933)	(1.575)	(2.241)	(1.210)
(Marital status, omitted group: Married)					
Marital status: Never married	-1.116***	-1.190***	0.0780	-2.291**	-2.638***
	(0.322)	(0.417)	(0.696)	(0.949)	(0.818)
Marital status: Formerly married	-0.102	-0.965	-0.0457	-0.714	-0.799
	(0.954)	(0.678)	(0.610)	(0.565)	(0.572)
Marital status: Missing/refused	-1.186	-1.128*	-1.919***	0.0682	4.232***
	(0.829)	(0.658)	(0.718)	(1.246)	(0.892)
(Smoking, omitted group: Never Smoked)					
Smoking: Smoked but quit	-1.279**	0.00315	0.469	-0.461	-0.261
	(0.487)	(0.511)	(0.492)	(0.414)	(0.346)
Smoking: Smokes everyday	-1.164**	-2.241***	-1.533***	-2.565***	-2.374***
	(0.539)	(0.358)	(0.522)	(0.531)	(0.490)
Smoking: Smokes occasionally	-1.598***	-1.216**	-0.711	-0.191	-0.214
	(0.542)	(0.546)	(0.654)	(1.557)	(2.142)
(Job strain, omitted group: Sedentary Work)					
Light work	-0.604	-1.265***	-1.069*	-1.804***	-1.928***
	(0.519)	(0.465)	(0.550)	(0.452)	(0.483)
Moderate work	-1.394**	-0.990*	-2.239***	-2.336***	-2.124***
	(0.529)	(0.564)	(0.613)	(0.549)	(0.575)
Heavy work	-0.666	-1.667***	-0.888	-2.259***	-2.795***
	(0.634)	(0.490)	(0.603)	(0.611)	(0.669)
(Imm. Status, omitted group: Natives)					
Years in USA: less than 5yrs	-2.489***	-2.873***	-2.301***	-1.889*	-3.552***
	(0.616)	(0.619)	(0.665)	(1.078)	(0.995)
Years in USA: 5 to 10yrs	-1.659*	-2.589***	-1.948**	-2.705*	-4.746***
	(0.968)	(0.564)	(0.961)	(1.589)	(1.202)
Years in USA: 10 to 15yrs	-0.599	-2.107***	-2.514***	-1.784	-0.119
	(0.813)	(0.589)	(0.737)	(1.112)	(1.142)
Years in USA: 15 to 20yrs	-0.248	-2.758***	-1.931***	-2.932**	-4.014***
	(1.499)	(0.555)	(0.705)	(1.197)	(1.126)
Years in USA: 20 to 30yrs	-0.818	-2.148**	-1.532**	-1.835	-2.836***
	(0.946)	(1.058)	(0.636)	(1.151)	(0.848)
Years in USA: 30 to 40yrs		-0.800	-0.605	-1.815**	-2.516***
		(0.981)	(0.955)	(0.730)	(0.784)
Years in USA: 40 to 50yrs			1.654	0.171	-2.202***
			(2.030)	(0.970)	(0.756)
Years in USA: more than 50yrs				1.028	-0.287
				(1.943)	(1.638)
Constant	28.55***	27.20***	28.91***	29.74***	29.85***
	(0.768)	(0.567)	(0.802)	(0.870)	(1.118)
N	1509	1432	1531	1171	1340
F-test: Joint significance of "Years in USA:"	3.55	5.85	3.49	1.56	7.36
F-test: Joint equality of "Years in USA:"	1.87	1.32	1.09	0.72	1.99

$^{*}p < .10,^{**}p < .05,^{***}p < .01$

Table B.4: Main Results - Women - by 10-year Age Groups

BMI Dependent Variable, Women Only	20 to 29	30 to 39	40 to 49	50 to 59	60 to 69
(Race, omitted group: White)					
Mexican	2.788***	2.051***	2.532***	2.197***	0.588
	(0.714)	(0.750)	(0.625)	(0.769)	(0.589)
Other Hispanic	2.364**	2.249**	1.666*	0.990	-0.715
	(0.922)	(0.896)	(0.955)	(1.340)	(1.414)
Black	3.285***	3.093***	2.643***	2.220***	2.201***
	(0.577)	(0.576)	(0.568)	(0.631)	(0.531)
Other race	0.787	-0.731	-1.065	0.536	-1.901
	(0.652)	(0.853)	(0.661)	(0.846)	(1.166)
(Cohort, omitted group: 1999-2000)					
Survey year 2001-2002	0.556	-0.676	0.238	-0.510	-0.221
	(0.656)	(0.682)	(0.745)	(0.802)	(0.639)
Survey year 2003-2004	0.277	0.120	0.568	-0.287	-1.219**
	(0.720)	(0.769)	(0.828)	(0.778)	(0.532)
Survey year 2005-2006	0.227	0.279	1.164	0.733	0.128
	(0.644)	(0.778)	(0.783)	(0.771)	(0.822)
(Education, omitted group: College or more)					
Education: less than 9th grade	2.534**	3.839***	2.843***	2.540**	0.0286
	(0.957)	(0.946)	(0.989)	(0.959)	(0.902)
Education: some HS	2.223***	2.397***	2.398**	2.576***	1.442
	(0.644)	(0.732)	(1.011)	(0.697)	(0.893)
Education: HS grad or GED	2.278***	2.286***	2.132***	1.720**	1.577*
	(0.567)	(0.626)	(0.680)	(0.720)	(0.805)
Education: some college or AA	1.714***	2.914***	1.698**	1.799***	1.611**
	(0.507)	(0.599)	(0.705)	(0.540)	(0.803)
(Fam. Inc., omitted group: Highest Quartile)					
Family Income: Lowest quartile	1.201**	1.973***	0.877	1.775**	3.080***
	(0.546)	(0.715)	(0.846)	(0.872)	(0.728)
Family Income: Second quartile	1.789***	1.396*	0.692	1.475**	1.429*
	(0.608)	(0.727)	(0.796)	(0.680)	(0.748)
Family Income: Third quartile	1.025*	1.234**	0.244	0.178	1.701**
	(0.575)	(0.528)	(0.720)	(0.494)	(0.824)
Family Income: Refused specific	1.892*	3.016	0.511	1.195	2.108
	(0.971)	(1.987)	(1.601)	(1.630)	(1.557)
(Insurance Status)					
Insured	-0.0493	0.0208	0.387	1.167*	0.659
	(0.487)	(0.526)	(0.687)	(0.636)	(0.650)
Insured missing	2.640	1.746	-2.140	0.778	1.385
	(1.897)	(6.335)	(1.737)	(2.085)	(1.777)
(Marital status, omitted group: Married)					
Marital status: Never married	-0.219	0.535	3.316***	2.697**	2.232
	(0.468)	(0.816)	(1.095)	(1.120)	(1.539)
Marital status: Formerly married	1.921*	-0.827	0.629	0.443	-0.210
	(1.048)	(0.730)	(0.618)	(0.612)	(0.644)
Marital status: Missing/refused	0.408	1.534	1.268	-2.990***	-1.159
	(0.912)	(1.467)	(1.903)	(1.012)	(1.039)
(Smoking, omitted group: Never Smoked)					
Smoking: Smoked but quit	1.688**	0.345	-0.580	0.932	-0.265
	(0.820)	(0.693)	(0.503)	(0.649)	(0.448)
Smoking: Smokes everyday	-0.453	-1.409***	-1.802***	-3.222***	-2.843***
	(0.523)	(0.526)	(0.551)	(0.480)	(0.681)
Smoking: Smokes occasionally	1.025	-1.514	-0.359	-1.620	-2.842**
	(0.748)	(0.908)	(1.131)	(1.623)	(1.203)
(Job strain, omitted group: Sedentary Work)					
Light work	-0.662	-0.829	-1.662***	-1.199**	-2.660***
	(0.496)	(0.516)	(0.526)	(0.492)	(0.610)
Moderate work	-1.534**	-1.213*	-2.249***	-2.629***	-3.942***
	(0.721)	(0.688)	(0.615)	(0.594)	(0.876)
Heavy work	0.311	-2.732***	-1.045	-2.778*	-5.053***
	(1.315)	(0.946)	(1.194)	(1.419)	(1.021)
(Imm. Status, omitted group: Natives)					
Years in USA: less than 5yrs	-4.342***	-4.348***	-1.615	-4.389***	0.721
	(0.555)	(0.505)	(1.136)	(0.968)	(2.383)
Years in USA: 5 to 10yrs	-3.743***	-3.145***	-3.287***	-5.195***	-1.482
	(0.736)	(0.860)	(1.030)	(1.536)	(2.033)
Years in USA: 10 to 15yrs	-3.096***	-3.233***	-4.051***	-4.414**	-2.339
	(0.978)	(1.025)	(0.700)	(1.858)	(1.786)
Years in USA: 15 to 20yrs	-2.030	-2.542*	-2.788***	-2.934**	-4.696**
	(1.482)	(1.501)	(0.770)	(1.300)	(1.956)
Years in USA: 20 to 30yrs	-2.803**	-2.556***	-2.908***	-4.821***	-0.0508
	(1.310)	(0.910)	(0.843)	(1.023)	(1.230)
Years in USA: 30 to 40yrs		0.132	-0.983	-3.269**	-0.597
		(1.305)	(0.842)	(1.236)	(1.021)
Years in USA: 40 to 50yrs			4.371	-3.208*	-1.307
			(3.936)	(1.828)	(0.964)
Years in USA: more than 50yrs				-0.641	-1.150
				(2.104)	(2.467)
Constant	23.76***	26.01***	27.44***	27.90***	29.17***
	(0.962)	(1.021)	(1.168)	(1.115)	(1.067)
N	1363	1360	1551	1295	1286
F-test: Joint significance of "Years in USA:"	13.48	14.43	7.18	3.96	1.12
F-test: Joint equality of "Years in USA:"	1.14	4.70	3.15	0.64	0.98

$^{*}p < .10,^{**}p < .05,^{***}p < .01$

Table B.5: Main Results - Full Sample - by 10-year Age Groups

BMI Dependent Variable, Full Sample	20 to 29	30 to 39	40 to 49	50 to 59	60 to 69
Female	-0.406	-0.247	-0.185	0.368	0.0314
	(0.287)	(0.248)	(0.343)	(0.297)	(0.304)
(Race, omitted group: White)					
Mexican	1.784***	2.150***	1.862***	1.294**	0.801**
	(0.501)	(0.477)	(0.397)	(0.511)	(0.390)
Other Hispanic	2.089***	1.753***	1.241**	0.571	-0.222
	(0.615)	(0.602)	(0.606)	(0.938)	(0.893)
Black	1.961***	2.171***	1.496***	1.255***	1.190***
	(0.340)	(0.344)	(0.326)	(0.415)	(0.319)
Other race	0.312	-0.0234	-0.495	0.822	-2.107***
	(0.602)	(0.541)	(0.547)	(0.719)	(0.653)
(Cohort, omitted group: 1999-2000)					
Survey year 2001-2002	0.333	-0.455	0.281	-0.546	0.304
	(0.415)	(0.479)	(0.546)	(0.540)	(0.363)
Survey year 2003-2004	0.355	0.150	0.506	-0.206	-0.0616
	(0.395)	(0.542)	(0.518)	(0.566)	(0.310)
Survey year 2005-2006	0.232	0.546	1.241**	0.291	0.750
	(0.467)	(0.535)	(0.555)	(0.564)	(0.495)
(Education, omitted group: College or more)					
Education: less than 9th grade	2.022***	2.377***	1.472**	2.310***	0.581
	(0.665)	(0.598)	(0.608)	(0.634)	(0.459)
Education: some HS	1.748***	2.191***	1.414**	1.983***	1.205**
	(0.482)	(0.565)	(0.626)	(0.605)	(0.494)
Education: HS grad or GED	1.897***	2.174***	1.926***	1.604***	1.449***
	(0.403)	(0.381)	(0.494)	(0.544)	(0.421)
Education: some college or AA	1.453***	2.009***	1.420***	1.653***	1.558***
	(0.388)	(0.366)	(0.453)	(0.427)	(0.423)
(Fam. Inc., omitted group: Highest Quartile)					
Family Income: Lowest quartile	0.0711	1.405***	0.185	0.863	1.241***
	(0.421)	(0.473)	(0.493)	(0.588)	(0.424)
Family Income: Second quartile	0.502	1.366***	0.192	0.727	0.520
	(0.516)	(0.456)	(0.489)	(0.485)	(0.426)
Family Income: Third quartile	0.595	1.111***	-0.111	0.288	0.733
	(0.414)	(0.323)	(.453)	(0.323)	(0.503)
Family Income: Refused specific	-0.136	1.050	0.678	0.891	1.794*
	(1.159)	(1.120)	(1.021)	(1.086)	(0.919)
(Insurance Status)					
Insured	-0.188	0.694**	0.450	0.772*	0.309
	(0.329)	(0.282)	(0.452)	(0.461)	(0.441)
Insured missing	1.491	2.914	-1.614	0.150	-0.777
	(0.999)	(3.358)	(1.106)	(1.881)	(1.312)
(Marital status, omitted group: Married)					
Marital status: Never married	-0.537*	-0.532	1.564***	0.243	0.889
	(0.288)	(0.412)	(0.546)	(0.740)	(1.075)
Marital status: Formerly married	1.312*	-0.750	0.438	0.0247	-0.232
	(0.749)	(0.460)	(0.381)	(0.405)	(0.424)
Marital status: Missing/refused	-0.484	-0.259	-0.511	-1.441**	0.954
	(0.550)	(0.802)	(0.552)	(0.651)	(0.687)
(Smoking, omitted group: Never Smoked)					
Smoking: Smoked but quit	0.124	0.191	0.0153	0.118	-0.161
	(0.473)	(0.400)	(0.386)	(0.402)	(0.274)
Smoking: Smokes everyday	-0.760**	-1.923***	-1.678***	-2.830***	-2.788***
	(0.363)	(0.328)	(0.408)	(0.405)	(0.344)
Smoking: Smokes occasionally	-0.729	-1.243***	-0.768	-0.906	-2.194**
	(0.438)	(0.445)	(0.633)	(1.314)	(1.075)
(Job strain, omitted group: Sedentary Work)					
Light work	-0.738*	-1.171***	-1.330***	-1.502***	-2.273***
	(0.399)	(0.344)	(0.396)	(0.354)	(0.360)
Moderate work	-1.572***	-1.344***	-2.364***	-2.547***	-3.031***
	(0.406)	(0.438)	(0.456)	(0.431)	(0.445)
Heavy work	-0.662	-2.010***	-1.187***	-2.192***	-3.558***
	(0.588)	(0.417)	(0.431)	(0.527)	(0.589)
(Imm. Status, omitted group: Natives)					
Years in USA: less than 5yrs	-3.416***	-3.771***	-1.854**	-3.139***	-0.319
	(0.407)	(0.415)	(0.749)	(0.894)	(1.578)
Years in USA: 5 to 10yrs	-2.637***	-2.973***	-2.571***	-4.342***	-2.659**
	(0.612)	(0.443)	(0.587)	(1.454)	(1.241)
Years in USA: 10 to 15yrs	-1.774***	-2.628***	-3.361***	-3.097***	-1.145
	(0.576)	(0.625)	(0.570)	(1.056)	(1.256)
Years in USA: 15 to 20yrs	-0.894	-2.994***	-2.251***	-2.985***	-3.847***
	(0.969)	(0.724)	(0.614)	(0.855)	(1.085)
Years in USA: 20 to 30yrs	-1.543*	-2.438***	-2.150***	-3.336***	-1.572*
	(0.795)	(0.709)	(0.475)	(1.005)	(0.803)
Years in USA: 30 to 40yrs		-0.283	-1.038	-2.954***	-1.594**
		(0.821)	(0.742)	(0.805)	(0.628)
Years in USA: 40 to 50yrs			3.174	-2.661**	-1.195
			(2.559)	(1.084)	(0.947)
Years in USA: more than 50yrs				0.0908	-1.429
				(1.348)	(1.393)
Constant	26.21***	26.75***	28.20***	28.85***	29.69***
	(0.674)	(0.617)	(0.798)	(0.789)	(0.711)
N	2872	2792	3082	2354	2738
F-test: Joint significance of "Years in USA:"	14.32	13.88	8.32	4.33	2.53
F-test: Joint equality of "Years in USA:"	3.28	5.18	2.70	0.88	0.75

$^{*}p < .10,^{**}p < .05,^{***}p < .01$

Table B.6: *P*-values from Composition Tests (Wald Tests)

Ages 35 to 44, $H_0 : \beta_{YrsInUSA(row)} = \beta_{YrsInUSA(column)}$

	10 to 15 years	15 to 20 years	20 to 30 years	30 to 40 years	40 to 50 years
5 to 10 years	0.233	0.542	0.180	0.591	0.264
10 to 15 years		0.525	0.880	0.123	0.118
15 to 20 years			0.399	0.269	0.182
20 to 30 years				0.089	0.108
30 to 40 years					0.399
N	723				

Ages 45 to 54, $H_0 : \beta_{YrsInUSA(row)} = \beta_{YrsInUSA(column)}$

	10 to 15 years	15 to 20 years	20 to 30 years	30 to 40 years	40 to 50 years	50+ years
5 to 10 years	0.974	0.824	0.739	0.995	0.588	0.677
10 to 15 years		0.746	0.690	0.961	0.539	0.662
15 to 20 years			0.493	0.798	0.422	0.574
20 to 30 years				0.668	0.693	0.770
30 to 40 years					0.521	0.660
40 to 50 years						0.957
N	558					

Ages 55 to 64, $H_0 : \beta_{YrsInUSA(row)} = \beta_{YrsInUSA(column)}$

	10 to 15 years	15 to 20 years	20 to 30 years	30 to 40 years	40 to 50 years	50+ years
5 to 10 years	0.818	0.311	0.070	0.949	0.969	0.359
10 to 15 years		0.318	0.161	0.839	0.793	0.609
15 to 20 years			0.445	0.132	0.192	0.037
20 to 30 years				0.016	0.046	0.009
30 to 40 years					0.879	0.259
40 to 50 years						0.254
N	434					

Table B.7: Income Stratification Tests - by 15-year Age Groups

	Lowest Income Quartile			2nd Income Quartile		
Imm. Status, omitted group: Natives	20 to 34	35 to 49	50 to 69	20 to 34	35 to 49	50 to 69
Years in USA: less than 5yrs	-3.739**	-3.616**	-2.854***	-2.945	-4.483***	-3.580
	(0.666)	(0.564)	(0.0553)	(1.209)	(0.330)	(1.254)
Years in USA: 5 to 10yrs	-1.968*	-2.684***	-3.940	-2.974*	-3.613*	-1.058
	(0.509)	(0.121)	(1.839)	(0.727)	(0.856)	(3.483)
Years in USA: 10 to 15yrs	-1.148*	-3.689	-3.166	-2.690**	-2.975*	-3.570***
	(0.388)	(2.236)	(2.680)	(0.287)	(0.910)	(0.0263)
Years in USA: 15 to 20yrs	0.434	-4.167**	-3.506	-3.399***	-2.603***	-4.267
	(2.483)	(0.656)	(3.663)	(0.0607)	(0.128)	(2.069)
Years in USA: 20 to 30yrs	-2.939***	-2.503	-3.380**	-0.945	-2.723**	-4.354***
	(0.0791)	(0.965)	(0.600)	(0.738)	(0.338)	(0.430)
Years in USA: 30 to 40yrs	6.689	-2.300	-3.300**	1.532***	-2.164	-0.801
	(2.644)	(1.184)	(0.477)	(0.0514)	(2.145)	(0.830)
Years in USA: 40 to 50yrs		1.141	-3.066**		-1.407	2.853*
		(0.396)	(0.317)		(1.319)	(0.878)
Years in USA: more than 50yrs			-1.307			-1.133
			(0.451)			(1.770)
N	1315	1021	1360	966	847	985

	3rd Income Quartile			Highest Income Quartile		
Imm. Status, omitted group: Natives	20 to 34	35 to 49	50 to 69	20 to 34	35 to 49	50 to 69
Years in USA: less than 5yrs	-2.895	-3.556**	-1.210	-3.071	-3.178***	-1.277
	(1.284)	(0.518)	(0.716)	(1.064)	(0.0936)	(3.535)
Years in USA: 5 to 10yrs	-2.767	-2.630***	-3.762	-1.928	-3.403**	-4.914*
	(1.500)	(0.191)	(1.673)	(1.228)	(0.428)	(1.460)
Years in USA: 10 to 15yrs	-1.927	-2.468	-0.586	-2.246	-2.982**	-3.437
	(0.879)	(0.890)	(1.408)	(1.304)	(0.594)	(2.138)
Years in USA: 15 to 20yrs	-2.055	-0.779*	-3.523***	-1.894	-3.312**	-3.054
	(1.131)	(0.251)	(0.195)	(0.780)	(0.405)	(1.081)
Years in USA: 20 to 30yrs	-0.227	-2.763	-1.973*	-2.417*	-1.632	-0.373
	(0.239)	(0.957)	(0.460)	(0.601)	(1.286)	(1.577)
Years in USA: 30 to 40yrs	-2.905	-0.618*	-2.901**	2.641***	-0.142	-2.105***
	(1.588)	(0.173)	(0.528)	(0.0421)	(1.358)	(0.138)
Years in USA: 40 to 50yrs		-0.540	-2.743*		4.461	-3.547**
		(0.818)	(0.807)		(6.058)	(0.782)
Years in USA: more than 50yrs			1.792			-1.487
			(1.535)			(1.698)
N	1000	1085	1214	816	1413	1333

Note: $^{*}p < .10$,$^{**}p < .05$,$^{***}p < .01$. This table presents coefficient estimates of the immigration status indicators from the main model stratified by income quartile. The OLS specifications included the following additional regressors (not presented above): BMI, gender, race, survey cohort, education, family income quartile, health insurance status, marital status, smoking behavior, job strain, and a constant term. These controls were implemented just as in the main results Tables B.3, B.4, and B.5.

Table B.8: Nutritional Results - Full Sample - by 15-year Age Groups

Dependent Variable:	log(Calories consumed per day)			log(Grams of fat consumed per day)			log(Grams of sugar consumed per day)		
	20 to 34	35 to 49	50 to 69	20 to 34	35 to 49	50 to 69	20 to 34	35 to 49	50 to 69
BMI	0.00219	0.00322**	0.000427	0.00471*	0.00536***	0.00548***	-0.00177	0.00300	-0.00719***
	(0.00199)	(0.00127)	(0.00166)	(0.00258)	(0.00179)	(0.00186)	(0.00254)	(0.00258)	(0.00265)
Age	-0.000753	-0.00184	-0.00844***	0.00220	-0.00240	-0.00961***	-0.0124***	0.00158	-0.00970***
	(0.00279)	(0.00234)	(0.00169)	(0.00403)	(0.00309)	(0.00233)	(0.00391)	(0.00418)	(0.00258)
Female	-0.338***	-0.344***	-0.291***	-0.322***	-0.342***	-0.296***	-0.238***	-0.256***	-0.210***
	(0.0192)	(0.0170)	(0.0196)	(0.0265)	(0.0215)	(0.0251)	(0.0381)	(0.0297)	(0.0281)
(Days of week of personal dietary samples)									
Saturday and Sunday	-0.0213	-0.00171	0.157***	-0.0319	-0.0108	0.167***	0.0299	-0.0530	0.203**
	(0.0343)	(0.0359)	(0.0475)	(0.0453)	(0.0512)	(0.0617)	(0.0569)	(0.0646)	(0.0850)
Neither Saturday nor Sunday	-0.0230	-0.0431**	-0.0103	-0.0443*	-0.0580**	-0.0338	-0.00446	-0.00437	0.0236
	(0.0204)	(0.0178)	(0.0172)	(0.0255)	(0.0220)	(0.0205)	(0.0337)	(0.0299)	(0.0349)
(Atypical eating during dietary samples)									
Ate more than usual	0.0384	0.0552*	0.0819***	0.0635	0.0714**	0.0755**	0.0687	0.102	0.142***
	(0.0356)	(0.0309)	(0.0241)	(0.0434)	(0.0319)	(0.0331)	(0.0513)	(0.0620)	(0.0438)
Ate less than usual	-0.0398	0.164***	-0.0223	-0.0983	0.250***	0.0946	-0.316**	0.580***	-0.371
	(0.0846)	(0.0550)	(0.186)	(0.114)	(0.0651)	(0.278)	(0.118)	(0.0893)	(0.320)
(Smoking, omitted group: Never Smoked)									
Smoking: Smoked but quit	0.0789***	0.0333	-0.0201	0.120***	0.0486*	-0.0211	0.0915**	-0.0431	-0.0548
	(0.0258)	(0.0262)	(0.0206)	(0.0340)	(0.0282)	(0.0264)	(0.0451)	(0.0441)	(0.0355)
Smoking: Smokes everyday	-0.0219	0.0132	-0.0510**	-0.0780*	0.0472	-0.0179	0.0177	-0.0588	-0.165***
	(0.0291)	(0.0243)	(0.0203)	(0.0408)	(0.0308)	(0.0351)	(0.0423)	(0.0457)	(0.0415)
Smoking: Smokes occasionally	0.0573	0.128***	-0.0263	0.0357	0.114**	-0.0394	0.0725	0.0127	-0.0751
	(0.0407)	(0.0475)	(0.0535)	(0.0561)	(0.0542)	(0.0510)	(0.0484)	(0.0802)	(0.116)
(Job strain, omitted group: Sedentary Work)									
Light work	0.0484	0.00116	-0.00412	0.0915**	0.00748	0.0102	0.0405	0.00494	-0.00366
	(0.0305)	(0.0300)	(0.0277)	(0.0433)	(0.0372)	(0.0376)	(0.0477)	(0.0385)	(0.0432)
Moderate work	0.0525	0.0631	0.0397	0.0914	0.0589	0.0391	0.0443	0.0911	0.0583
	(0.0358)	(0.0450)	(0.0370)	(0.0561)	(0.0426)	(0.0476)	(0.0457)	(0.0634)	(0.0665)
Heavy work	0.120***	0.155***	0.0892*	0.168***	0.0762	0.0556	0.119	0.217**	0.176**
	(0.0443)	(0.0492)	(0.0528)	(0.0557)	(0.0531)	(0.0513)	(0.0760)	(0.0820)	(0.0821)
(Imm. Status, omitted group: Natives)									
Years in USA: less than 5yrs	-0.0620	-0.0809	-0.148**	-0.137**	-0.151	-0.275***	-0.00194	-0.0126	-0.263**
	(0.0537)	(0.0861)	(0.0661)	(0.0633)	(0.121)	(0.0842)	(0.0657)	(0.0987)	(0.119)
Years in USA: 5 to 10yrs	-0.0268	-0.0263	-0.106	-0.0859	-0.148***	-0.476***	-0.0776	-0.0919	-0.229*
	(0.0500)	(0.0477)	(0.104)	(0.0558)	(0.0537)	(0.152)	(0.0733)	(0.0677)	(0.124)
Years in USA: 10 to 15yrs	-0.108	-0.139*	-0.132**	-0.171**	-0.283***	-0.326***	-0.141*	-0.268*	-0.103
	(0.0650)	(0.0744)	(0.0541)	(0.0850)	(0.0983)	(0.0866)	(0.0748)	(0.134)	(0.0915)
Years in USA: 15 to 20yrs	-0.150**	-0.0969	-0.119	-0.353**	-0.255***	-0.274***	-0.164	0.0545	0.0207
	(0.0730)	(0.0582)	(0.0712)	(0.173)	(0.0872)	(0.0916)	(0.140)	(0.0811)	(0.131)
Years in USA: 20 to 30yrs	-0.0808	-0.125***	-0.0546	-0.0788	-0.227***	-0.156*	-0.233*	-0.138*	-0.169*
	(0.0615)	(0.0415)	(0.0437)	(0.0762)	(0.0611)	(0.0806)	(0.117)	(0.0758)	(0.0999)
Years in USA: 30 to 40yrs	0.0878	-0.0174	-0.0700*	0.121	-0.120	-0.180***	0.269	-0.0720	-0.183**
	(0.168)	(0.0690)	(0.0384)	(0.161)	(0.0799)	(0.0350)	(0.299)	(0.111)	(0.0878)
Years in USA: 40 to 50yrs		-0.0237	-0.108		-0.0729*	-0.202**		-0.314	-0.208*
		(0.0477)	(0.0675)		(0.0420)	(0.0945)		(0.254)	(0.106)
Years in USA: more than 50yrs			-0.0215			0.0384			-0.0740
			(0.100)			(0.122)			(0.137)
N	1998	2153	2528	1998	2153	2528	1998	2153	2528
F-test: Joint significance of "Years in USA:"	1.16	1.41	1.22	1.78	3.24	5.15	1.57	1.99	1.39
F-test: Joint equality of "Years in USA:"	0.98	0.82	0.58	1.04	0.97	1.82	1.54	1.74	0.72

Note: $^{*}p < .10, ^{**}p < .05, ^{***}p < .01$. This table presents partial regression results from the nutritional sub-sample. The OLS specifications included the following additional regressors (not presented above): race, survey cohort, education, family income quartile, health insurance status, marital status, and a constant term. These controls were implemented just as in the main results Tables B.3, B.4, and B.5.

Table B.9: Physical Activity Results - Full Sample - by 10-year Age Groups

	Dependent variable: Vigorous Activity					Dependent variable: Moderate Activity				
	20 to 29	30 to 39	40 to 49	50 to 59	60 to 69	20 to 29	30 to 39	40 to 49	50 to 59	60 to 69
Immigration Status, omitted group: Natives										
Years in USA: less than 5yrs	-0.169***	-0.0625	-0.0975	-0.158**	-0.0625	-0.118***	-0.154***	-0.105*	-0.237**	-0.206**
	(0.0410)	(0.0500)	(0.0809)	(0.0671)	(0.0484)	(0.0443)	(0.0435)	(0.0604)	(0.100)	(0.0905)
Years in USA: 5 to 10yrs	-0.0779	-0.0239	-0.0653	-0.175**	0.0284	-0.0802**	0.0125	-0.137**	-0.192*	-0.0673
	(0.0517)	(0.0475)	(0.0646)	(0.0740)	(0.0855)	(0.0390)	(0.0447)	(0.0681)	(0.103)	(0.120)
Years in USA: 10 to 15yrs	-0.110	0.0107	0.0523	-0.157*	-0.0358	0.0221	-0.0130	-0.0846	-0.116	-0.122
	(0.0775)	(0.0465)	(0.0604)	(0.0831)	(0.0810)	(0.0544)	(0.0455)	(0.0627)	(0.113)	(0.111)
Years in USA: 15 to 20yrs	0.00979	-0.0613	0.0200	0.000940	0.118	-0.137	-0.110**	-0.140**	-0.214**	0.0468
	(0.106)	(0.0495)	(0.0554)	(0.0920)	(0.138)	(0.0897)	(0.0437)	(0.0637)	(0.0926)	(0.125)
Years in USA: 20 to 30yrs	-0.109*	-0.0109	-0.0336	-0.173***	0.0401	0.0110	-0.0253	-0.0204	-0.0839	-0.0468
	(0.0551)	(0.0503)	(0.0381)	(0.0453)	(0.0641)	(0.0708)	(0.0667)	(0.0487)	(0.0679)	(0.0720)
Years in USA: 30 to 40yrs		0.104	0.0272	-0.107	-0.0200		0.0726	-0.118	-0.151**	0.0261
		(0.0873)	(0.0696)	(0.0751)	(0.0481)		(0.0779)	(0.0746)	(0.0713)	(0.0764)
Years in USA: 40 to 50yrs			0.0504	-0.00407	-0.00838			-0.0314	-0.110	0.100
			(0.0892)	(0.0799)	(0.0726)			(0.103)	(0.0947)	(0.0747)
Years in USA: more than 50yrs				-0.204*	0.00864				0.0255	-0.0249
				(0.102)	(0.0612)				(0.152)	(0.107)
N	2871	2792	3079	2354	2736	2870	2792	3080	2353	2736
F-test: Joint significance of "Years in USA:"	3.7	0.76	0.89	2.67	0.54	2.09	3.95	1.61	1.83	1.51
F-test: Joint equality of "Years in USA:"	1.41	0.83	1.05	0.9	0.6	1.39	4.35	0.81	0.56	1.61

Note: $^{*}p < .10$,$^{**}p < .05$,$^{***}p < .01$. This table presents coefficient estimates of the immigration status dummy variables from the physical activity regressions. The five age groups on the left have "vigorous physical activity" as the dependent variable, and the five age groups on the right have "moderate physical activity." The OLS specifications included the following additional regressors (not presented above): BMI, gender, race, survey cohort, education, family income quartile, health insurance status, marital status, smoking behavior, job strain, and a constant term. These controls were implemented just as in the main results Tables B.3, B.4, and B.5.