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Immigrant Obesity and Unhealthy Assimilation: Alternative Estimates of Convergence or Divergence, 1995–2005

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Abstract

We re-examine the pace of rising obesity among Hispanic immigrants and the effects associated with longer duration in the US, or what is referred to as unhealthy assimilation, the convergence of immigrant health to a less healthy native-born standard. Consistent with previous research, we find that across all race-ethnic groups, immigrants tend to be less obese than native-born persons. Second, obesity is clearly on the rise, with obesity rates increasing for both immigrant and native-born populations between 1995 and 2005. However, our findings are that immigrant obesity rises more slowly than for native-born Hispanics in the same age cohort. The significance is that immigrants do not converge to obesity prevalence of the native born as commonly assumed and in fact, the differential is wider in 2005 than it was in 1995. The analysis, which is based on the National Health Interview Survey tracks the obesity rates of different cohort populations observed in repeated cross-sections (1995 and 2005), as both immigrants and the native born grow older and additionally, as immigrants reside in the U.S. longer. More specifically, for immigrants, our study distinguishes the effects of length of U.S. residence (observed at a single point in time) and increasing duration of residence (observed over time). Of crucial importance, we contrast the changes over time for native and foreign-born residents passing through the same age range from 1995 to 2005. Misconclusions of previous research stem from 1) assuming that any change for immigrants equates to assimilation, without regard to native-born change, and 2) an unbalanced analysis that fails to track in parallel the growing obesity of both immigrant and native-born cohorts.

Keywords

USA; immigrant; obesity; unhealthy assimilation; Hispanic

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Main text

The prevalence of obesity continues to increase at an alarming rate in the United States, most significantly in the past decade (Center for Disease Control and Prevention [CDC], 2006; Flegal et al., 2002; Mokdad et al., 1999; Ogden et al., 2006). Between 1995 and 2005, the proportion of obese adults (i.e. those with a body mass index or BMI of 30 kg/m^2 or more) increased from 15% to 24% (CDC, 2006). The pace of rising obesity is fueled by a broad range of factors, both behavioral and environmental, and characterizes most segments of the population. However, the participation of the immigrant population in obesity trends yields some contradictory understandings.

For the population as a whole, it is well-established that the chances of becoming obese are greater for women than men, greater for those of lower education, and greater for some ethnic groups than others. Over time, it is clear that obesity increases with age (McTigue et al., 2002) and that children today are more likely to be obese than children in previous generations (National Center for Health Statistics [NCHS], 2007; Ogden et al., 2004). The current generation of middle-aged adults is also more obese than earlier generations.

A different trend in obesity is experienced by the immigrant population, about which there is both agreement and confusion. As part of what is called a healthy immigrant effect, foreign-born residents arrive in the U.S. with a lower prevalence of obesity than native-born persons of the same age and sex. However, the prevalence of obesity among immigrants rises with increasing duration in the U.S. (Antecol & Bedard, 2006; Barcenas et al., 2007; Goel et al., 2004; Kaplan et al., 2004; Lauderdale & Rathouz, 2000; Singh & Siahpush, 2002). The concept of unhealthy assimilation asserts that immigrants are converging to the obesity prevalence rates of the native-born population (Antecol & Bedard, 2006). The implication of convergence is that obesity must be rising faster for immigrants than for the native-born. Evidence to be presented shows this is not the case.

What has misled research on immigrant obesity is that so many changes are at work simultaneously. Not only is obesity rising over time, with growing age, and across generations, but for immigrants it is also changing with length of time in the U.S. In essence, obesity may be increasing for immigrants, but is this greater than to be expected by their growing age? And are these increases sufficient to catch up to the obesity of native-born persons, which is also rising over time? Inappropriate controls for native-born behavior have led to the notion of immigrant convergence or unhealthy assimilation. The practical implication of the research reported here is that, rather than immigrants rapidly adopting unhealthy practices of native-born coethnics, there appears to be a cultural resistance that protects against an accelerated slide into obesity.

Drawing upon the broader tradition of research on immigrant assimilation, we propose a relatively simple method for disentangling these different temporal dimensions of change. Given the complexity of temporal dynamics, the proposed method is more transparent than some multivariate procedures and avoids a major structural error that is embedded. Comparison of coefficients drawn from alternative statistical specifications can then be better understood and evaluated.

In this study, we examine the pace of rising obesity for native-born and immigrant Hispanics between 1995 and 2005, using the cohort populations observed from repeated cross-sections of the National Health Interview Survey (NHIS). Unlike previous research, our study considers the potential confounding effects of age and birth cohort, which are synonymous at one point in time but divergent over time. Differences between birth cohorts in 2005, for example, reflect both differences in age and in unique historical legacies, including the legacy of greater obesity in childhood in recent decades. (For example, the 1960 birth cohort was age 35 in 1995 but 45

in 2005, and at that time a different cohort, born in 1970 and raised with higher obesity, was age 35.) Additionally, for immigrants, our study distinguishes the effects of length of U.S. residence (observed at a single point in time) and increasing duration of residence (observed over time). Of crucial importance, we contrast immigrant trajectories to native-born within the same framework. Rather than employ a simple control for age—a cross-sectional measure—to describe native-born obesity prevalence, we contrast the changes over time for native and foreign-born residents passing through the same age range from 1995 to 2005.

We first explore the change in obesity rates for Hispanic native-born and foreign-born persons as related to other racial/ethnic groups. Second, we graphically display how the repeated cross-section approach tracks the prevalence of obesity for birth cohorts as they age 10 years from 1995 to 2005 and, additionally, the increasing U.S. duration for immigrants. Next we compare two alternative multivariate specifications, one that emphasizes cross-sectional differences between immigrants with different durations of U.S. residence, and the other that traces cohorts between repeated cross-sections as their age grows older and duration of residence grows longer. Finally, we directly compare the results of the traditional and cohort repeated cross-sectional approaches to evaluate how such different conclusions have been reached.

Background

Immigrant health behaviors are usefully understood as a form of cultural assimilation in response to lifestyles and environmental exposures present in the U.S. The present study seeks to draw upon the wealth of research findings regarding the broader process of immigrant adjustment, incorporation and assimilation. In particular, studies with large secondary data sets have developed experience with the benefits and pitfalls of different methodologies. Cross-sectional analysis that contrasts different length-of-residence groups has proven problematic, whether a single or multiple years are analyzed. Research on other indicators of immigrant assimilation, such as earnings, occupational attainment, education, and homeownership, suggests that findings based on cross-sectional data often are temporally biased (Borjas, 1985; Myers, 1999; Myers & Cranford, 1998; Smith, 2003). Cross-sectional inferences on the effects of differences in duration assume that immigrants all are on the same track, save for their length of time in the U.S. The observed differences at a moment in time are assumed to represent temporal patterns of changing behaviors or characteristics associated with increasing U.S. duration. In fact, those differences also reflect intercohort differences due to birth cohort differences in the timing of arrival into adulthood, when labor or housing markets were more or less favorable. This effect applies to both immigrants and the native-born. In addition, for immigrants, the cross-sectional differences in duration also reflect the varying receptivity, ease of employment, or other prevailing conditions associated with different periods of arrival to the U.S. (arrival cohorts).

Historically there has been a lack of longitudinal studies with adequate samples of immigrants (Gordon-Larsen et al., 2003; Popkin & Udry, 1998), and so cross-sectional analysis has been the primary means of research on immigrants' changes over time. With the resurgence of large-scale immigration after the 1965 Act, the 1970 census resumed collecting data on immigrants' year of arrival. Analysis with those data could only provide a cross-sectional account of duration effects. The major innovation proposed by Borjas in 1985 took advantage of a second observation provided by the 1980 census to compare changes in earnings for immigrant arrival cohorts as they advanced between census decades, and that method is still followed by many in labor economics (Antecol & Bedard, 2006; Borjas, 1985). A major limitation of that approach not widely noted is that age is treated cross-sectionally and is not traced over time as birth cohorts grow older. In an unbalanced design, only immigrants are traced in arrival cohorts, while the native-born are observed cross-sectionally. This unbalanced design may not

have proven faulty in its original application to labor economics, but the risk of erroneous interpretation deserves scrutiny in all cases.

In the present study, we adopt a repeated cross-sectional approach for cohort longitudinal analysis, which traces cohorts of both immigrants and the native-born over time. Although individuals are not followed, as in panel designs or the "cohort studies" common in health research, the members of the population cohort are independently sampled at two points in time and their average characteristics assessed. This cohort longitudinal design with repeated samples provides a middle ground between the traditional cross-sectional and individual longitudinal studies (Glenn, 2005; Myers, 1999). This method uses cross-sectional survey data, such as the NHIS, to track and compare different cohort populations observed at two or more points in time, i.e. 1995 and 2005. Although the same individuals are not followed over time, the cohort population is an aggregate construct whose temporal characteristics all change synchronically, as do individuals, growing older and achieving increased duration of immigrant residence in the U.S. (Ryder 1968). In effect, we sample from the cohort population to estimate the average characteristics of the group as the members pass through time. The key is to contrast immigrant and native-born cohorts that are passing through the same age range and not observe either one as a mere cross-sectional snapshot.

Data and Methods

Data

The study selects Hispanic adults aged 18 and older, using data pooled from the 1994 to 1996 and 2004 to 2006 National Health Interview Surveys (NHIS). For simplicity, we will refer to the 1994 to 1996 pooled data as the "1995" sample and the 2004 to 2006 pooled data as the "2005" sample. Due to the redesign of the survey that occurred in 1997, the 2005 sample is much smaller than the 1995 sample—numbering 81,977 and 191,211, respectively. The foreign-born population makes-up about 14% of the 1995 sample and 18% of the 2005 sample, with the highest proportions of foreign-born found in the Hispanic and Asian subsamples. Of the four racial/ethnic groups, only the Hispanic sample includes adequate numbers of both native-born and foreign-born persons for purposes of analysis. In the 1995 Hispanic sample, over half are foreign-born, while in the 2005 Hispanic sample, slightly over 60% are foreign-born.

For the purposes of presenting descriptive results in Figure 1 and Figure 2, all adult age groups are presented regardless of the sample size for each age group. However, for Hispanic immigrants with the specified U.S. length of residence, the sample sizes of the older age groups are especially small. The majority of Hispanic immigrants are in the younger age groups: 80% are under the age of 55 years in 1995 (among those who have resided in the U.S. for 0–4 years). For the purposes of the repeated cross-sectional cohort analysis, only age groups with sufficient observations will be tracked, which means adults up to age 54 in 1995 and 64 in 2005.

The NHIS provides information regarding an individual's nativity and, if they are born outside the U.S., his or her duration of residence in the U.S. Nativity is indicated by the geographic place of birth. To keep a consistent definition between different years, native-born persons are those who are born in the 50 United States or the District of Columbia. For foreign-born persons, duration in the U.S. is indicated by the number of years one has lived in the U.S.; however, the publicly released data file from the NHIS groups the data on duration into 5-year intervals, with the longest being 15 years and longer. In order to trace change in the prevalence of obesity sampled from the same immigrant cohort at two different points in time, 10 years apart, we focus on immigrants with durations of less than 5 years in 1995 and 10–14 years in 2005.

Obesity is indicated by having a body mass index (BMI) score of 30 or greater. The BMI is calculated by dividing an individual's self-reported height by the square of his or her weight (kilograms/meters^2). Prior to 1997, the NHIS includes only self-reported height and weight, while BMI is included as a variable thereafter. For consistency, we calculate the BMI for the entire sample. It is important to note that the use of self-reported height and weight tends to underestimate the prevalence of obesity and this underestimation can vary with age, gender, and across different racial/ethnic groups (Nyholm et al., 2007; Rillum & Sempos, 2005; Rowland, 1990). However, previous studies using the NHIS data have shown that there is no practical difference in findings if adjustments are imposed on these self reports (Antecol & Bedard, 2006). Furthermore, another study found that the weight classifications based on self-reported weight and height are not statistically different between immigrant and native-born Mexican Americans, except among the underweight group (Lee, 2005); our study focuses on the overweight group among the Hispanic population. In any event, any biases inherent in the measures are confronted equally by the two methods compared in the present paper.

Analysis

To illustrate clearly the differences between the cross-sectional and cohort approaches, we first compare the descriptive data, organized alternatively in cross-sectional and cohort format. Visual displays help to demonstrate the differences and similarities in perspective provided by the alternative approaches. Following that we estimate logistic regressions of obesity prevalence, under two alternative specifications:

$$\text{(Cross-section): Obesity} = \text{Age} + \text{Age}^{*}\text{Age} + \text{Duration} \quad (1)$$

$$\text{(Cohort): Obesity} = \text{Year} + \text{Age} + \text{Nativity} + \text{year}^{*}\text{Age} + \text{Year}^{*}\text{Nativity} \quad (2)$$

where:

Obesity = log odds of BMI >= 30,

Age = exact years in (1); coded as 10-year age cohorts in (2), with members of each age cohort 10 years older in 2005 than in 1995,

Duration = length of time residing in U.S., coded in groups of years, 0–4, 5–9, 10–14, and 15 or more, with native-born as reference category, (1) only,

Nativity = foreign-born cohort residing less than 5 years in U.S. in 1995 and 10–14 years in 2005, with native-born as reference group, (2 only),

Year = observation year, 1995 = 0 and 2005 = 1, reflects historical change for the native-born reference group age 25–34 in 1995 and 35–44 in 2005, (2 only),

Year*Age = the differential effects of aging for each birth cohort, (2 only), and

Year*Nativity = the differential effect of passing of time for the foreign-born relative to the native-born, (2 only),

Findings from the cross-sectional and cohort models are compared, and the expected values are also compared to the descriptive data. This permits a more fully transparent explanation of the temporal dynamics and a more well-versed interpretation of the changing tempo of obesity among immigrants compared to the native-born.

Results

Change in obesity by race and nativity

From 1995 to 2005, the obesity rate among adults increased by over 8 percentage points, with almost one-in-every-four adults being obese in 2005 (Table 1). Of the four major racial/ethnic groups, Blacks exhibit the largest increase (10%) during the period. The change in obesity rates for both Hispanics and Whites is slightly over 8 percentage points while the least change is found among Asians (3%). In 2005, Blacks had the greatest proportion of obese persons, followed by Hispanics. For both groups, obesity is prevalent in at least one-quarter of their populations. Both native-born and foreign-born populations became more obese, but the increase was significantly smaller for the foreign-born versus native-born.

Among Hispanics, obesity in the native-born population climbed 11.4 percentage points, versus an increase of 6.5 percentage points for the foreign-born, a statistically significant difference. It is observed that Black and Asian native-born populations also experienced larger increases in their percent obese than their foreign-born counterparts (10.4% and 8.7% for Blacks and 5.0% and 2.2% for Asians), but these differences are not statistically significant at the 95% confidence level. However, the comparison of the overall prevalence of obesity in 1995 to that in 2005 misses all of the underlying demographic dynamics that might partially contribute to the overall change. For instance, the smaller increase in obesity for all foreign-born populations might be explained largely by the addition of new immigrants who come to the U.S. with lower rates of obesity. Age differences could also be a factor, for example, if the native-born population tends to be older than the foreign born. To better gauge the changes over time for specific cohorts of the native-born and foreign-born, the next section graphically introduces obesity rates in 1995 and 2005 for Hispanics.

Hispanic Obesity by Period, Age, Nativity, and Duration

Obesity for the Hispanic population has risen by 8.2 percentage points from 1995 to 2005. This change reflects the overall change for the adult population as a whole, but there are sharp variations within the Hispanic population between immigrants and others. Figure 1 presents a series of subplots of obesity rates among the Hispanic population, organizing these along key temporal dimensions—age, period of observation, and length of residence in the U.S. The white dots represent the prevalence of obesity for each age group in 1995 while the black dots represent the prevalence of obesity for each age group in 2005. As all of the graphs show, Hispanics are more obese in every age group in 2005 than in 1995, reflecting the overall rise in obesity. The general downward curve shape of each year's cross-section tells us that middle-aged Hispanics have the highest rates of obesity compared to the youngest and the oldest age groups.

Viewed separately by nativity, obesity prevalence among the native born in 2005 is consistently 10 percentage points higher than in 1995 for every age group (upper right graph). There are much smaller differences between the foreign born in 1995 and 2005 (lower left graph). And the native born appear to be consistently more obese than the foreign born of the same age. In addition, among the foreign born, an additional factor of change is acculturation, the cultural and behavioral adjustment to life in America. The continuous flow of new arrivals keeps adding healthy individuals, but older age groups may accumulate residents with several decades' duration in the U.S. Accordingly, the lower right graph refines the foreign born comparison by specifying a particular arrival cohort (those recently arrived in 1995), comparing their obesity prevalence to the same cohort of foreign born who in 2005 are 10 years longer resident.

Changes over time for both native and foreign-born are not well represented in the simple age cross-sections. For better representation we should trace trajectories of change between age

groups observed in successive decades, for example, connecting the obesity prevalence of those age 25–34 in 1995 to that of the cohort aged 35–44 in 2005. These cohort trajectories reflect average changes experienced by a group over a decade, and they include not only aging effects but also period and acculturation effects of rising obesity. The native-born Hispanic trajectories, however, share the same age and period context as their native-born counterparts, and by contrasting the two we can evaluate the differential increase in obesity experienced over time by the foreign-born. The question to be determined is whether immigrants converge on the unhealthy behavior of their native-born counterparts and grow relatively more obese over time.

Varying tempo of rising obesity by nativity

These average changes can be represented graphically by diagonal arrows that connect the age groups occupied by cohorts at two points in time, illustrating the change in obesity among Hispanics from 1995 to 2005 (Figure 2). In this graphical representation of the repeated cross-section approach, we repeatedly observe each cohort with a separate sample in 1995 and 2005, with the identity of each cohort identified by their common age and duration in the US. The white dots demarcate the cohorts' average obesity rates in 1995 and the black dots represent the rates in 2005. Arrows link the cohort observations in 1995 and 2005 when the cohort is 10 years older. For the foreign born, the obesity rates in 1995 pertain only to selected immigrants who have been residing in the U.S. for less than 5 years. By 2005, the target cohort has been in the U.S. between 10 to 14 years and has also aged 10 years older. As the figure shows, the native-born Hispanic population was initially more obese than the immigrant population and this was the case across each age group. For example, among Hispanics aged 25–34 in 1995, the obesity rates for the native-born and foreign-born population were 19% and 11%, respectively. The difference between native-born persons and immigrants was greatest in the 45–54 age group (about 11 percentage points).

While native-born and foreign-born Hispanics are both growing more obese over time, the tempo of increase is slower for foreign-born persons. For example, the obesity rate for native-born Hispanics aged 18–24 in 1995 increased by approximately 19 percentage points by 2005 when they occupy the 25–34 age group. Sample restrictions in the NHIS to ages 18 and older prevent us from observing a cohort age 15–24 in 1995. That forces us to assume that the omitted early ages of the cohort would have had the same average level of obesity as displayed by the remainder. Meanwhile, Hispanic immigrants who occupy the same age group experienced a smaller increase in obesity prevalence of 11 percentage points. This graphical display of allows us to easily recognize that Hispanic native-born cohorts not only started with higher rates of obesity in 1995, but also experience a greater increase in obesity than their immigrant counterparts. These observations deserve statistical test, and in the next section, we carry that out while also offering a comparison between the conclusions reached by a simple cross-sectional approach and the cohort, repeated cross-section approach.

Traditional versus repeated cross-section to measure immigrant convergence to native born

The effect of lengthening duration of US residence on immigrants' obesity can be estimated in two different ways, one simpler but misleading. The simple cross-sectional approach uses an additive regression model that controls age by holding it constant and estimates the effect of duration in the U.S., as described above for the specification in Eq. 1. We have carried out estimations separately for each year, with similar results in each model. The expected obesity prevalence controlled for age is reported in the left panel of Table 2. Recent immigrant arrivals have much lower likelihood of reported obesity than longer resident immigrants, and all immigrants have lower chances of obesity than the native-born. A notable difference between 1995 and 2005 is that recent immigrants appear much less obese that longer-settled immigrants or the native-born in 2005 than in 1995. Overall, the clear implication of the cross-sectional

model is that immigrants converge toward native-born prevalence rates of obesity the longer they live in the U.S., consistent with other cross-sectional studies (Antecol & Bedard, 2006).

The right panel of Table 2 organizes the native born and immigrants in such a way that we can compare them in the same age group and in the same year. Additionally for immigrants, the cohort is also defined by 10 years longer residence in the U.S. in 2005 than in 1995. The lower and upper bounds of a 95% confidence interval are included in parentheses in order to determine whether the obesity rates of the native born are statistically significantly different from that of immigrants in the same age group. In 1995, the prevalence of obesity among the youngest native-born group (12.7%) is higher than that among foreign born (6.9%), a difference of 5.8 percentage points. Ten years later, when the cohort has arrived at the next older age group, the native-born prevalence has grown to 31.4% and the foreign born prevalence to 18.2%, a gap that has now expanded to 13.2 percentage points. Because the immigrants start from such a low level in 1995, their prevalence 10 years later has increased proportionally at a faster rate, but the obesity of immigrants is falling further behind that of the native born. Therefore the two groups appear to be diverging rather than converging as assumed by the unhealthy assimilation hypothesis.

Cohort modeling with the repeated cross-sectional data further substantiates the patterns observed in the right panel of Table 2. Estimations that follow specification Eq. 2 are reported in Table 3. Also reported in the first three columns are alternative cross-sectional models for 2005. The pattern of age effects shows the highest obesity rate at age 35–44 for native-born Hispanics and 45–54 for the foreign born. In the cohort framework, each age cohort is traced 10 years later, when it has aged 10 years older, as indicated by the coefficients for Year * Age (Table 3, model 4). The reference group of this change is the main effect of Year and pertains to the omitted age cohort, namely those age 25–34 in 1995 and 35–44 in 2005. Apparently this group experienced the greatest increase in obesity as it aged 10 years older (logit of 0.8938). Older age groups had significantly slower rates of increase relative to this, but none of these differences is sufficient to outweigh the main effect of Year, and so the net increase of obesity is positive for all age cohorts. This finding corresponds to the upward tracking cohort arrows in Figure 2 and is the opposite of the downward sloping cross-sectional age curve.

The major finding from the cohort estimation is the effect of growing duration in the U.S. Under the simple cross-sectional model, immigrants with longer duration became more similar to the native-born in the prevalence of obesity (Table 3, model 3). Estimation of the cohort model of change 1995 to 2005 reveals that immigrants initially have much lower chances of obesity than the native-born (logit of −0.7791). Under the hypothesis of convergence, or unhealthy assimilation, the effect of Year*Nativity is expected to be positive, bringing the immigrants closer to the obesity prevalence of the native born. Instead, we find that, with the passage of time, immigrants fail to converge toward the native-born level as expected, and in fact, the negative coefficient for Year*Nativity shows they *diverge*, becoming even less obese relative to the native-born (logit of −0.1897). The Year*Nativity coefficient is statistically significant at a probability of $p<0.089$, but a one-tailed test may be warranted because our null hypothesis is not of “no change” but of a positive coefficient showing convergence. In that case, the probability of significance for the coefficient is $p<0.045$. Therefore, whether under a 10% or 5% standard for significance, we believe that the hypothesis of convergence can be rejected.

Statistical validity of this estimated non-convergence is verified by a simple test of the gap between the obesity prevalence for immigrants and native-born in each cohort previously depicted in Figure 2 (Table 2). In this transparent framework graphed in Figure 2, aging is fully represented and is not held constant. Growing duration is also represented for the immigrants but is included in the aging effect across the decade. By making a pair wise comparison of

immigrants and native-born in the same birth cohort, we control the effect of age without the artifice of holding it constant in time. And if we compare immigrants and native-born persons in the same birth cohorts while they grow older together over the decade, we draw out the effect of growing immigrant duration. In this manner, we can directly answer the key question: is the gap between immigrant and foreign-born obesity narrower in 2005 than in 1995, as expected under the assumption of convergence to obesity levels of the native-born? Or do immigrants preserve or even widen their differences with the native-born?

The initial gap between obesity levels of immigrants and the native-born is substantial and statistically significant for all cohorts younger than 55. For example, in the cohort age 25–34 in 1995, 19.4% of the native-born Hispanics and 11.2% of immigrants are obese. The obesity gap of 8.2% is significantly greater than 0. By 2005, when the cohort is 10 years older, the native-born obesity prevalence has grown to 36.5% and the immigrant prevalence to 22.3%, a gap now widened to 14.3%. The obesity gaps are statistically significant ($p<.05$, two-tailed) for all cohorts younger than 55 and they have increased in magnitude from a decade earlier. This widening gap in obesity between immigrants and the native-born is statistically significant and create confidence that immigrants have *not* converged toward the obesity of the native-born. We have replicated this analysis for all immigrants with 5 or more years of US duration in 1995 and 15 or more years in 2005 and have found similar results.

Discussion

In this paper, we examine differences in the pace of rising obesity by nativity and duration in the US. Our findings reaffirm much of the previous research regarding obesity among the immigrant populations (Antecol & Bedard, 2006; Barcenas et al., 2007; Goel et al., 2004; NCHS, 2007). First, across all racial groups, immigrants tend to be less obese than native-born persons. Second, obesity is clearly on the rise, with obesity rates increasing for both immigrant and native-born populations between 1995 and 2005.

This study makes one important contribution to current knowledge of immigrant obesity trends. Our analysis of cohorts observed in repeated cross-sections yields an important correction to current assumptions about changes in immigrant health. Although it is clear that Hispanic immigrants grow more obese the longer they reside in the U.S., these trends are not converging on the obesity levels of the native-born. Traced within cohorts, native-born obesity is growing even more rapidly and the increases among immigrants are insufficient to close the gap, leaving an even greater gap between immigrant and native-born obesity prevalence after a decade. This finding challenges the assumption that growing obesity of immigrants could underlie the general convergence of immigrant health toward a less-healthy native-born standard (Antecol & Bedard, 2006).

What has misled research on immigrant obesity is that three changes are at work simultaneously: aging of immigrants and the native-born, growing duration of immigrant residents, and historical trends in rising obesity. Holding any one of these temporal processes statistically constant risks violence to conclusions about other temporal trends, especially when models are not made transparent and visually accessible for comparison to raw data. It is especially inappropriate to introduce controls that may skew comparison of the native born and immigrants. Both immigrants and the native born should be specified in cohort fashion, not solely the immigrants.

This study has several limitations. Due to restrictions placed on the NHIS public use data, we are limited in which immigrant duration groups can be tested. Present analysis has been restricted to immigrant adults who have lived less than 15 years in the U.S. Further research is needed to see whether the immigrant protection against growing obesity continues after they

have resided longer in the U.S. Currently, NHIS data on length of U.S. residence is top coded to 15 years or greater which prevents analysis of changes within that category. The National Center for Health Statistics (NCHS) could assist by making available data on longer-resident immigrants. What is beyond the scope of the NHIS data is the prevalence of obesity among children. Immigrant children who arrive at a young age may in fact assimilate more rapidly because they are more vulnerable to adopting American food and activity habits.

Given sample size considerations, we focus only on the Hispanic immigrant population and are unable to analyze the other racial groups (e.g. Asians). In addition, the use of repeated cross-sections for longitudinal analysis must assume that the underlying population being sampled is closed, i.e., that it is not substantially impacted by differential mortality or outmigration. Finally, because the main goal of this study is to compare methodologies, we did not control for the array of predictors of obesity found in previous studies, such as income or lifestyle characteristics (e.g. exercise, smoking, alcohol, etc.). Changes in these predictors also may vary across cohorts and deserve to be examined for their explanation of the cohort changes in obesity.

A caveat recognized in analysis of immigrant arrival cohorts is the potential for selective out-migration by sample members who are less healthy or more obese than average for the group. This potential bias is widely recognized but there is little evidence in the immigration literature for extensive bias on any particular outcome measure (Myers, 2004). Studies of the healthy immigrant effect are more certain of selection bias on arrival but there is much less evidence for selection bias for return migration to the home country. In particular, there is little direct evidence or theoretical basis for assessing whether return migrants would be likely to be more or less obese than their fellow cohort members. In any event, whatever bias may be latent in the NHIS sample for longer resident immigrants is equally present in both traditional cross-sectional analysis and cohort analysis with repeated cross-sections. Given that both approaches make use of the same duration data, any potential bias of selective out-migration does not explain the differential findings in our study.

A cohort study composed of individuals followed over time would be ideal for tracing the longitudinal changes in obesity, although the problems of panel attrition can be considerable. The sample would need to include both immigrants and native-born and the study would need to have been launched a decade ago in order to yield the required information today. However, for lack of such data, we have designed a cohort analysis with the repeated cross-sections available with large samples in the NHIS. Tracing the mean observations over time of specifically defined birth cohorts and immigrant arrival cohorts, this study has not suffered the fault of holding age constant. Direct comparison of matched pairs of birth cohorts, native-born and immigrant, provides a more transparent and realistic assessment of relative trends in immigrant health.

Finally, our ultimate conclusion is that, even with longer duration in the US, immigrants continue to demonstrate resiliency, as evidenced by the slower pace of rising obesity compared to native-born persons. There may be certain characteristics that may be buffering immigrants from selected behaviors associated with obesity, which deserves to be a topic of future research. It also would be valuable to extend this modeling process to other health outcomes and to other race-ethnic groups to determine whether this immigrant resiliency prevails more broadly.

The data limitations on years of immigrant residence in the U.S. (discussed above) prohibit this analysis from understanding how immigrants' obesity changes beyond 15 years of U.S. residence. Other studies on immigrant adaptation have shown that immigrants traditionally experience the greatest amount of change in the first 10 years after arriving in the U.S. (e.g. Borjas, 1995; Myers and Lee, 1998). Subsequently, the changes are smaller and more gradual

when immigrants have been in the U.S. longer. Studies have also shown that this general pattern is contingent on age at arrival (with the youngest immigrant arrivals experiencing the most change and the elderly immigrants experiencing very little) and period of arrival. Given the pattern of findings from previous research of immigrant adaptation processes more generally, we suspect that the largest gains in obesity prevalence might occur in the first few years of U.S. residence and that the immigrant resiliency to full convergence with the native-born will persist with longer U.S. duration. However, the contribution of this paper is to emphasize the appropriate modeling of the native born as a comparison. It is incorrect to assume that any changes in immigrant behavior equate to assimilation. Both immigrants and the native-born are changing over time and need to be analyzed in parallel fashion.

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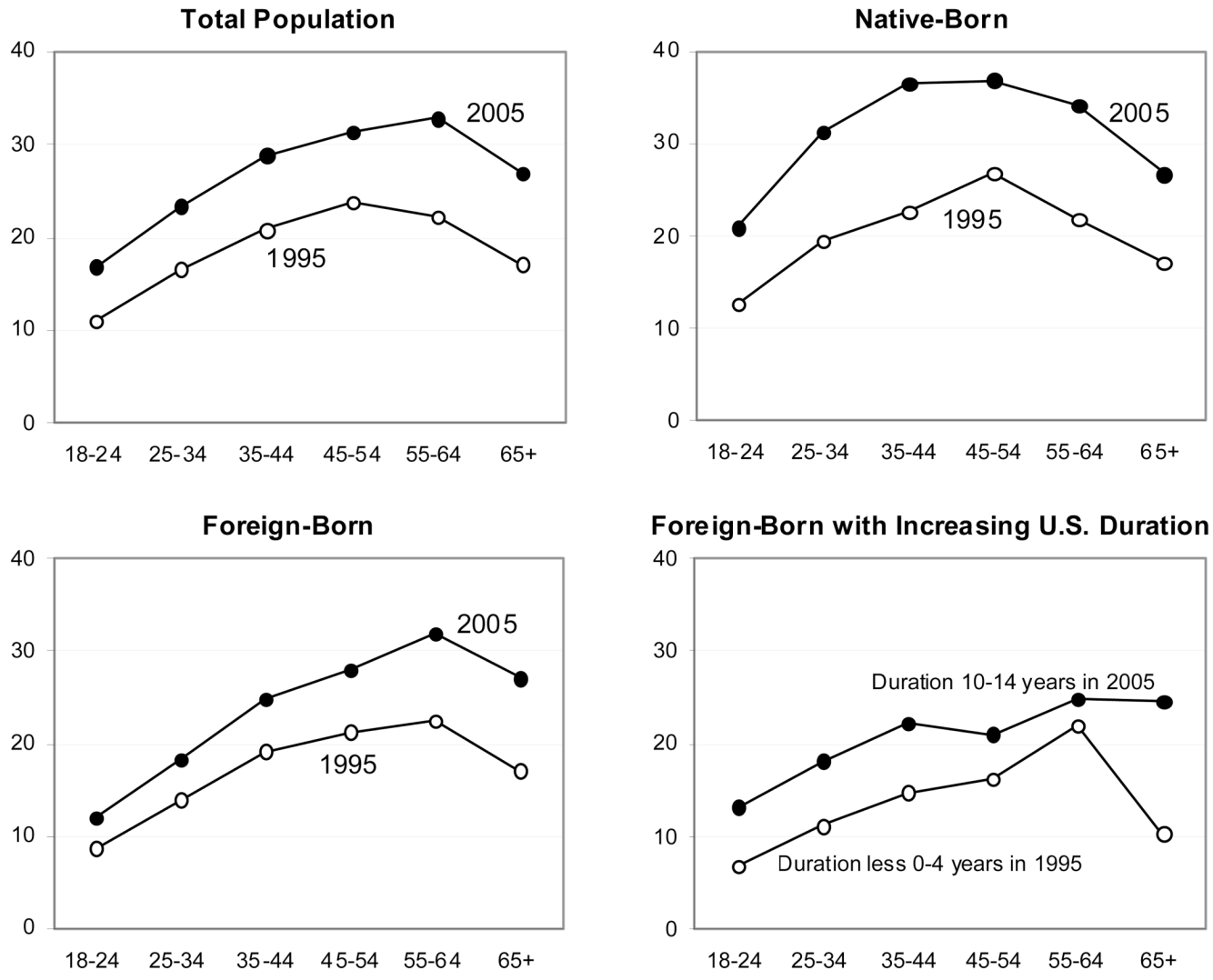

Figure 1.
Obesity Prevalence (%) for the U.S. Hispanic Population by Age Group

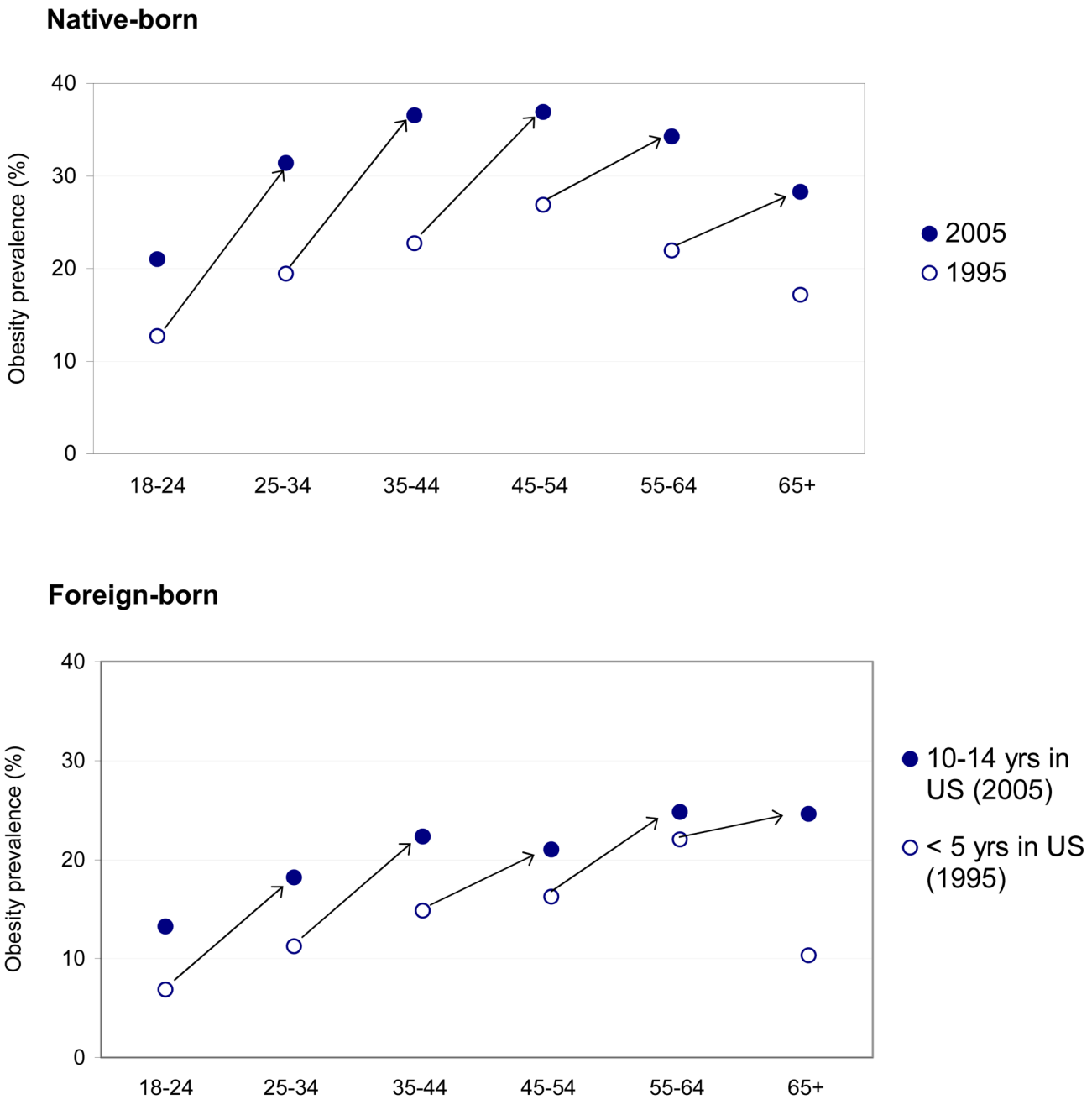

Figure 2.
Change in Hispanic Obesity with Aging and Increasing Immigrant Duration

Table 1

Obesity rates by race/ethnicity and nativity, 1995–2005 Adults aged 18 and over

	1995			2005			Percent	
	n	% obese	95% CI	n	% obese	95% CI	change	95% CI
Total	**191,211**	**16.0**	**15.9 16.2**	**81,977**	**24.4**	**24.1 24.7**	**8.4**	**8.1 8.7**
Native-born	164,690	16.6	16.5 16.8	67,457	25.5	25.2 25.8	8.8	8.5 9.2
Foreign-born	26,521	11.5	11.1 11.9	14,520	17.5	16.8 18.1	5.9	5.2 6.6
Hispanic	**27, 201**	**17.9**	**17.4 18.3**	**14,302**	**26.1**	**25.3 26.8**	**8.2**	**7.9 8.5**
Native-born	12,931	19.4	18.7 20.1	5,530	30.9	29.6 32.1	11.4	10.1 12.8
Foreign-born	14,270	16.4	15.8 17.0	8,772	22.9	22.0 23.8	6.5	5.5 7.6
White NH	**134,544**	**15.1**	**14.9 15.2**	**52,604**	**23.2**	**22.8 23.6**	**8.2**	**7.3 9.0**
Native-born	128,489	15.2	15.0 15.4	50,236	23.6	23.2 24.0	8.3	8.0 8.7
Foreign-born	6,055	11.2	10.4 12.0	2,368	14.9	13.5 16.3	3.7	2.1 5.2
Black NH	**23,807**	**24.5**	**24.0 25.0**	**12,079**	**34.5**	**33.6 35.3**	**1 0.0**	**9.6 10.4**
Native-born	22,263	25.3	24.7 25.8	11,035	35.6	34.7 36.5	10.4	9.3 11.4
Foreign-born	1,544	13.2	11.5 14.9	1,044	21.9	19.4 24.5	8.7	5.7 11.7
Asian & PI NH	**5,659**	**4.3**	**3.7 4.8**	**2,992**	**7.3**	**6.4 8.3**	**3.1**	**2.1 4.1**
Native-born	1,007	9.3	7.5 11.1	656	14.2	11.5 16.9	5.0	1.9 8.1
Foreign-born	4,652	3.1	2.6 3.6	2,336	5.3	4.4 6.2	2.2	1.2 3.1

Source : National Health Interview Survey (weighted)

Notes: NH= Non-Hispanic.The 1995 and 2005 samples represent pooled data from the 1994–96 and 2004–06 surveys, respectively. Confidence intervals based on unweighted sample.

Table 2

Comparison of Obesity Prevalence Rates for Native-Born and Foreign-Born Hispanics with Aging and Increasing U.S. Duration

Single Cross-Section		Repeated Cross-Section (with 95% Confidence Intervals)			
1995	Expected Value*	Age in 1995	**Native Born**	**Foreign Born (0–4 yrs duration)**	**Difference**
Foeign-Born (by U.S. Duration)		18–24	**12.7** (11.4, 13.9)	**6.9** (5.2, 8.6)	**5.8** (3.4, 8.3)
Less then 5 yrs	12.3%	25–34	**19.4** (18.1, 20.8)	**11.2** (8.8, 13.6)	**8.2** (5.1, 11.4)
5–9 years	13.9%	35–44	**22.7** (21.1, 24.3)	**14.8** (10.8, 18.9)	**7.9** (3.1, 12.6)
10–14 years	16.6%	45–54	**26.8** (24.6, 29.1)	**16.2** (9.8, 22.7)	**10.6** (3.0, 18.2)
15+ years	19.5%	55–64	----	----	----
Native Born	20.6%	65+**	----	----	----
2005	Expected Value**	2005 (10 Yrs Older)	**Native Born**	**Foreign Born (10–14 yrs duration)**	**Difference**
Foeign-Born (by U.S. Duration)		25–34	**31.4** (29.0, 33.8)	**18.2** (14.9, 21.4)	**13.2** (8.8, 17.6)
Less then 5 year	14.3%	35–44	**36.5** (33.6, 39.4)	**22.3** (18.1, 26.4)	**14.3** (8.8, 19.7)
5–9 years	18.7%	45–54	**36.9** (33.6, 40.2)	**21.0** (13.5, 28.6)	**15.9** (6.5, 25.2)
10–14 years	20.7%	55–64	**34.2** (29.9, 38.5)	**24.8** (12.4, 37.2)	**9.4** (−4.0, 22.8)
15+ years	27.9%	65+**	----	----	----
Native Born	32.5%				

*Controlled for age. Mean age is 39.1 years in 1995 and 40.8 years in 2005. These mean ages were used to calculate expected values.

**Prevalence rates are not calculated for a sample smaller than 100.

Table 3

Logistic Regression Results of Obesity, 2005 and 1995–2005, Hispanic Only

		2005			1995–2005
		Native-Born	**Foreign-Born**	**Foreign-Born (With Duration)**	**NB & FB (Less than 5 years duration in 1995 and 10–14 years duration in 2005)**
Intercept		−0.4594 ***	−1.4927 ***	−1.1157 ***	−0.9437 ***
Year					
1995	Ref.				
2005					0.8938 ***
Age					
18–24		−0.6727 ***	−0.5735 ***	−0.4769 ***	−0.6038 ***
25–34	Ref.				
35–44		0.2482 ***	0.4152 ***	0.2519 ***	0.2122 ***
45–54		0.2248 **	0.5657 ***	0.3210 ***	0.4079 ***
Year*Age					
2005 * 18–24					0.3364 ***
2005 * 25–34	Ref.				
2005 * 35–44					−0.2613 **
2005 * 45–54					−0.5542 ***
Nativity					
Nativ-born	Ref.				
Foreign-born					−0.7791 ***
Year*Nativity					
					−0.1897 *

		2005			1995–2005
		Native-Born	**Foreign-Born**	**Foreign-Born (With Duration)**	**NB & FB (Less than 5 years duration in 1995 and 10–14 years duration in 2005)**
Gender					
male	Ref.				
female		−0.0608	0.2319 ***	0.2209 ***	0.0341
Education					
less than HS	Ref.				
HS		−0.1726 *	−0.1557 **	−0.1866 **	−0.4217 ***
Some college		0.1638 *	−0.0897	−0.1631 *	−0.4992 ***
BA +		−0.7667 ***	−0.5461 ***	−0.5453 ***	−0.9593 ***
Duration					
less than 5 years				−0.7361 ***	
5–9 years				−0.4689 ***	
10–14 years				−0.4091 ***	
15+ years	Ref.				
Number of Observations		4,476	6,960	6,960	17,300
−2 Log Likelihood		5,490	7,205	7,134	17,733
Pseudo R-Square		0.0323	0.0248	0.0346	0.0560

*** p<0.01

** p<0.05

* p<0.1