Biodemography and Social Biology, 61:65–80, 2015

ISSN: 1948-5565 print / 1948-5573 online
DOI: 10.1080/19485565.2014.950721

Routledge
Taylor & Francis Group

Cohort and Duration Patterns Among Asian Immigrants: Comparing Trends in Obesity and Self-Rated Health

ANNIE RO,[1] ARLINE GERONIMUS,[2] JOHN BOUND,[3] DEREK GRIFFITH,[4] AND GILBERT GEE[5]

[1]Program in Public Health, University of California, Irvine, Irvine, California, USA
[2]Population Studies Center, Institute for Social Research, University of Michigan, Ann Arbor, Michigan, USA
[3]Department of Economics, University of Michigan, Ann Arbor, Michigan, USA
[4]Center for Medicine, Health and Society, Vanderbilt University, Nashville, Tennessee, USA
[5]Fielding School of Public Health, Department of Community Health Sciences, University of California, Los Angeles, Los Angeles, California, USA

*Many studies, but not all, suggest that immigrant health worsens with duration of residence in the United States. Cohort effects may explain the inconsistent findings; not only are cohort effects confounded with duration, but the timing of entry into the United States may also create qualitatively different migration experiences. The present study tests for duration and cohort patterns among Asian immigrants to the United States across six year-of-entry cohorts (pre-1980, 1981–85, 1986–90, 1991–95, 1996–2000, 2001–05). Data come from the Asian American sample (*n = *44,002) of the 1994–2009 waves of the National Health Interview Survey. The data show cohort differences for self-rated health, such that more recent cohorts showed improved baseline health compared to older cohorts. After accounting for cohorts, there was no significant change in self-rated health by duration of residence. Older cohorts actually showed improving self-rated health with longer duration. Obesity showed the opposite pattern; there were no differences across cohorts, but duration in the United States correlated with higher obesity. These results imply that immigrant health is not simply an issue of duration and adaptation; instead, they underscore the utility of considering cohorts as broader contexts of migration. Collectively, the results encourage future research that more carefully examines the etiological mechanisms that drive immigrant health.*

Introduction

Many studies indicate that immigrants' health deteriorates the longer they live in the United States (Cho and Hummer 2001; Cho, Frisbie, and Rogers 2004; Frisbie, Cho, and Hummer 2001; Goel et al. 2004), yet other literature reveals some inconsistency in the role duration plays in affecting immigrants' health. Immigrant health status declines with longer residence in the United States for some outcomes but not others (Cho and Hummer 2001), and there also are group differences by gender (Lauderdale and Rathouz 2000), age (Ro and Gee

Address correspondence to Annie Ro, UC Irvine, Program in Public Health, 653 E. Peltason Road, Irvine, CA 92697-3957, USA. E-mail: annie.ro@uci.edu

2012), and region of origin (Oza-Frank and Venkat Narayan 2010). Duration appears to be an important component of immigrant health patterns, but the variability in the literature raises questions about other potential factors that may explain the nature of its relationship to health.

Recent studies have highlighted the importance of considering time of entry into the United States, or cohorts, when considering duration of residency (Hamilton et al. 2011). Cohorts have several important implications for the relationship between duration and health. First, duration and cohorts are confounded in cross-sectional data. For example, differences between immigrants with 5 years versus 20 years of U.S. residence may not be due to the time these groups have spent in the United States, but rather differences in their composition at the year of entry (Lauderdale 2001). Second, individual cohorts may have unique health trends, both at the point of entry and with longer duration in the United States. That is, immigrants who arrived in the 1980s and stayed for 10 years may have had a qualitatively different experience compared to immigrants who arrived in 2000 and stayed for 10 years. These differences may be due to changes in immigration policy, compositional differences (e.g., higher proportions of youth in some years compared to others), and secular changes in the global patterns of disease.

Initial studies have provided some support for the study of immigrant cohorts. Antecol and Bedard (2006) showed that body mass index (BMI) varied by year of entry among Hispanic immigrants, indicative of cohort differences in obesity. Yet they also found that BMI increased with duration of residence after accounting for immigrants' year of entry, suggesting that both cohort and duration effects were important in understanding underlying BMI patterns. Hamilton and Hummer (2011) found cohort differences in self-rated health among African immigrants but did not find any duration effects. This literature provides emerging evidence for the role of cohorts but is far from definitive. The variation in previous studies suggests that the role of cohorts likely depends on the health outcomes and population under investigation.

The present study contributes to the literature by investigating Asian immigrant cohorts, defined by their year of entry, with regard to two outcomes: self-rated health and obesity. Cohort patterns have not been widely studied among Asian immigrants, and the experience of this group may provide a useful contrast to the experiences of Latino and black immigrants. While data limitations prevented us from creating cohorts that align precisely with specific policies or events, this article is a first step in considering how health patterns vary by immigration cohort among Asians. We investigate three major questions. First, are there differences in health at arrival across immigrant cohorts? Second, does health decline with duration after controlling for cohorts? Third, does health decline with duration of residence within individual cohorts?

Background

We examined six Asian immigrant cohorts (pre-1980, 1981–85, 1986–90, 1991–95, 1996–2000, 2001–05). This time frame represents the era of modern immigration that began after the 1965 Immigration Act. Portes and Zhou (1993) suggest that macrosocial factors, such as immigration policy, geopolitical events, labor market conditions, racial discrimination, co-ethnic communities, and immigrant-related domestic policies, can produce unique assimilation experiences across groups of immigrants. Several macro-level shifts occurred in both common sending countries and the United States during the study period. These, in turn, may have shaped compositional differences across cohorts. For example, changes in immigration policy can affect who immigrates, as well as the resources available to them once they are in the United States (Gee and Ford 2011). Asian sending countries

have also undergone significant development in the past 30 years and now have a primary role in the global economy (Wolf et al. 2005). Economic development can impact immigrants' human capital characteristics, as well as their baseline health, which can then facilitate distinct integration patterns. Because such factors also shift over time, we expect different factors to affect different cohorts at their point of immigration and during their subsequent integration.

Self-Rated Health and Obesity

Cohort and duration patterns likely depend on the health outcome being investigated. Examining two health outcomes in the same population can provide useful contrasts that underpin distinct processes.

Among Asian immigrants, duration of residence appears to be more consistently associated with obesity than with self-rated health. Many studies have found that longer duration in the United States is related to higher body weight (Dey and Wilson Lucas 2006; Goel et al. 2004; Lauderdale and Rathouz 2000; Park et al. 2008; Roshania, Venkat Narayan, and Oza-Frank 2008; Singh and Siahpush 2002), although there are a minority of studies that have shown that there is no association between duration and obesity (see, e.g., Sanchez-Vaznaugh et al. 2008).

Studies of duration and self-rated health among Asian immigrants have been less consistent. Some studies have found that longer duration is related to poorer self-rated health (Frisbie, Cho, and Hummer 2001; Uretsky and Mathiesen 2007; Zhang and Ta 2009). Other studies, however, have found no relationship between the two (Ihara 2011; Jang, Kim, and Chiriboga 2005), while others have even found that self-rated health improves with duration (Dey and Wilson Lucas 2006).

Cohorts may provide some clarity regarding the relationship between duration and self-rated health and obesity. The standard of living has risen while mortality has dropped in many Asian countries, such as China (Banister and Hill 2004) and India (Saikia et al. 2009). Moreover, U.S. immigration policy has encouraged the entrance of more highly skilled and educated workers in recent years (Park and Park 2005). Both of these developments suggest that recent cohorts of immigrants coming to the United States should have better self-rated health compared to older cohorts.

The increased selectivity and greater human capital among recent immigrants have further implications for the study of duration and self-rated health. If more recent cohorts are entering with higher human capital and more global exposure, they may also make fewer cultural adjustments that negatively impact their health. That is, migration is stressful, but may be less stressful for immigrants with more resources. Accordingly, we expected more recent cohorts to show a slower decline in self-rated health with duration compared to older cohorts.

We expected to find different patterns for obesity. Obesity was first declared a global epidemic by the World Health Organization in 1997. Since then, obesity prevalence has risen steadily worldwide (Caballero 2007). Asian countries have also experienced a rise in obesity commensurate with the global trend (Yoon et al. 2006), which likely reflects their rapid development and the globalization of food production and consumption. We thus expected more recent cohorts to have higher rates of baseline obesity than older cohorts.

As noted previously, duration in the United States is correlated with higher obesity. There is reason to suspect that this relationship may be attenuated among more recent cohorts, however. With globalization, many American practices and products are being marketed worldwide, such as restaurants (e.g., fast food chains) and retail goods (e.g.,

carbonated beverages) (Hawkes 2006). The global proliferation of such products suggests that immigrants are already coming into contact with obesity risks in their countries of origin. We thus expected this prior exposure to weaken the association between duration in the United States and obesity for more recent cohorts.

In summary, our study views immigrant health as heterogeneous and influenced by context. Specifically, we hypothesized that compared to older cohorts, newer cohorts of immigrants would report better self-rated health but higher obesity rates at arrival in the United States. We further hypothesized that obesity and poor self-rated health would increase with duration in the United States, but that the rate of increase would vary across cohorts. For self-rated health, more recent cohorts would show a slower decline with duration because of human capital characteristics that may better facilitate migration transitions. For obesity, more recent cohorts would show a slower increase in obesity because they had already been exposed to obesogenic environments in their country of origin.

Methods

An ideal exploration of cohort and duration effects would follow distinct cohorts of immigrants longitudinally and examine differences both within and across cohorts (Lauderdale 2001). While there is no dataset currently available that enables such an analysis, we created synthetic cohorts using multiple waves of cross-sectional data. This method was first utilized by Borjas (1985) and has been used more recently in other investigations (Antecol and Bedard 2006; Hamilton and Hummer 2011; Kaushal 2009).

Data

The sample includes 44,002 single-race Asian adults over the age of 18 from the 1994–2009 waves of the National Health Interview Surveys (NHIS). The NHIS is an annual nationwide in-person survey of households. We included survey waves that were congruent with the year-of-entry variable in the Current Population Survey (CPS), which we used to create cohort weights (described later). The CPS started collecting year-of-entry information in 1994. The datasets were obtained from the Integrated Health Interview Series (IHIS) (Ruggles et al. 2010). We matched all analyses to the appropriate samples and weights depending on the availability of the variables across survey waves and the sample universe.

Outcome Variables

Obesity. We classified persons with a body mass index (self-reported weight in kilograms/height in meters squared) of 30 or more as obese. We restricted height to 59 and 76 inches and weight to 98 to 289 pounds to account for the changing top- and bottom-censored codes across different survey waves. Less than 1 percent of the sample with a valid height and weight value fell outside of this range.

Self-Rated Health. Self-rated health measured respondents' self-reported general health on a five-point Likert scale: "excellent," "very good," "good," "fair," and "poor," along with an "unknown" category. The question wording was consistent throughout the period from 1994 to 2009. Respondents who answered "fair" or "poor" were coded as 1, and all others were coded as 0. Previous studies examining self-rated health among Asian immigrants have applied this coding scheme (Acevedo-Garcia et al. 2010; Zhang et al. 2010). We ran

additional checks with self-rated health coded as "excellent" health versus all others and found similar results as those reported here (results available upon request).

Independent Variables

Cohorts. Cohort was made up of a series of indicator variables representing the year an immigrant entered the United States. We included six year-of-entry cohorts: pre-1980, 1981–85, 1986–90, 1991–95, 1996–2000, and 2001–05. Other studies examining cohorts in the NHIS have also coded cohorts in five-year intervals (Antecol and Bedard 2006).

Nativity/Duration. The nativity/duration variable designated the nativity and years of U.S. residence for the sample. This variable was divided into the following categories: U.S. born, 0–4 years, 5–9 years, 10–14 years, and over 15 years duration. These categories represent the available duration information in the NHIS and have also been used in previous studies (Cho and Hummer 2001; Frisbie, Cho, and Hummer 2001).

Any duration patterns could simply be due to age. To distinguish age trends from duration trends, we included a U.S.-born Asian comparison group. Additionally, we repeated this analysis with a U.S.-born, non-Hispanic white comparison group and obtained similar results for the cohort and duration trends (not shown).

Period. We included survey year dummy variables to account for period differences in obesity and self-rated health between 1995 and 2009. Because cohort, duration, and period are fully predictive for immigrants, we estimated the period effects from the U.S.-born Asians in our sample and assumed they were equivalent for the foreign-born Asians (Antecol and Bedard 2006; Borjas 1985).

Sociodemographic Variables. Sociodemographic variables included Asian ethnicity, sex, age, and a sex by nativity interaction. Prior research suggests significant variations in obesity and self-rated health by sex and nativity (Lauderdale and Rathouz 2000). Asian ethnicities were coded using the NHIS coding scheme: Chinese, Filipino, Asian Indian, and other Asian (the latter category included Koreans, Japanese, Vietnamese, and smaller subgroups). We controlled for characteristics that remained constant throughout the survey waves (e.g., sex) in order to capture a consistent representative sample of the cohorts. Likewise, we did not include other demographic characteristics such as marital status or education, as these may change within a cohort across time. We also controlled for age, as everyone in the sample aged at the same rate and thus had the same age effect.

Cohort Coding

Had the data allowed, we could have created cohorts by examining individuals' year of entry or by subtracting number of years in the United States from the year of the survey. However, the publicly available version of the NHIS obscures this information by categorizing respondents' year of entry in two-, three-, or four-year intervals. To address this data limitation, we created weights that corresponded to the likelihood that a respondent was in a cohort based on his or her years of U.S. residence in a given survey year. We derived the weights using the CPS, which contains information on an immigrant's year of entry in two-, three-, or four-year intervals (we assumed immigrants were evenly distributed across years). For each NHIS survey year between 1994 and 2009, we used the March CPS survey from the same year to calculate the percentage of Asian immigrants who entered the United States in a given year.

For example, in NHIS survey year 2002, an immigrant who had lived in the United States 5–9 years entered the United States between 1993 and 1997. This interval straddled the 1991–95 and 1996–2000 cohorts. According to the CPS, 22 percent of Asian immigrants with 5–9 years' duration in 2002 entered in 1997, 22 percent entered in 1996, 17 percent in 1995, 17 percent in 1994, and 21 percent entered in 1993. To calculate the likelihood that the respondent falls in the 1991–95 cohort, we summed the prevalence for 1993, 1994, and 1995, the three years of overlap between the actual year-of-entry interval and the analysis cohort. We then created a duplicate copy of the observation. One observation received a weight of .55 to correspond to the likelihood of being in the 1991–95 cohort. The second copy received a weight of .45 to represent its likelihood of being in the 1996–2000 cohort. We multiplied this cohort weight by the person's weight in the complex survey weighting scheme to create a new person weight.

We checked the robustness of this procedure in several ways. First, we repeated the analyses with another sample that did not use the CPS weighting method. Instead, we coded all respondents in the same duration category across several NHIS survey waves as being in the same cohort. For example, all respondents with 0–4 years duration during the 1994, 1995, 1996, and 1997 NHIS waves were coded as entering the United States between 1991 and 1995. Previous cohort research has used this method (Antecol and Bedard 2006; Kaushal 2009). This additional sample produced similar results for the analyses presented.

Second, to take account of the fact that we imputed cohorts, we estimated standard errors using a bootstrap procedure. These standard errors are very similar to the naive standard errors that were produced in the original analysis. All of these replications are available upon request.

Analyses

We first calculated the weighted prevalence of obesity and fair/poor self-rated health for each available duration group in each cohort and for an age- and gender-matched U.S.-born comparison group. We compared the foreign-born and U.S.-born groups by taking the ratio of the fair/poor self-rated health and obesity prevalence rates (foreign born/U.S. born). Matching by age and gender to the U.S.-born group enabled some distinctions between age and duration; variation across the matched U.S.-born groups is due to age, while variation for the foreign-born groups is due to age and duration. For example, if the ratio between the immigrant and U.S.-born groups remained relatively constant over the duration categories within a cohort, we could surmise that U.S.-born and foreign-born rates increase in a parallel fashion and are due to age and other common group factors. If the ratio differed, this meant that obesity or poor self-rated health among the foreign-born and U.S.-born groups are not increasing at the same rate. Some of the rate difference can thus be attributed to duration patterns over and above aging.

We then tested the relationships between duration, cohort, and the health outcomes using the following logistic regression equation (Antecol and Bedard 2006; Borjas 1985; Hamilton and Hummer 2011):

$$Y_i = X_i\beta + A_i\gamma + C_i\delta + T_i\pi + \in_i$$

where X is a vector of covariates (Asian ethnicity, sex, age, and a sex by nativity interaction), A is the vector of dummy variables indicating duration in the United States (0–4 years duration is set at 0), C is the vector of dummy variables indicating the year of arrival

(pre-1980 is set at 0), T is a vector of dummy variables for survey year (1994 is set at 0), and ϵ is an error term.

We ran this model twice, once with duration variables (A), survey year dummies (T), and covariates (X) only. The second time, we included the cohort dummy variables (C). This second model enabled comparison between the duration estimates before and after controlling for cohort differences. The cohort effects in the second model can be interpreted as the odds of fair/poor self-rated health or obesity at arrival (i.e., 0–4 years' duration in the United States). The duration effects in the second model can be interpreted as the odds of fair/poor self-rated health or obesity accounting for cohort baseline health differences.

To test duration differences within separate cohorts, we stratified by cohorts and ran the following model:

$$Y_i = X_i\beta + A_i\gamma + T_i\pi + \in_i$$

This model is similar to the previous one, except that it omits cohort indicator variables. The baseline duration category is the group with the shortest residence.

All analyses were conducted using Stata, Version 12. We also accounted for the NHIS complex survey design using Stata's *svy* command.

Results

Table 1 provides the sample sizes and demographic characteristics of each cohort. The sample had slightly more men than women. In earlier cohorts, Chinese and Filipino immigrants composed a substantial percentage of the Asian immigrant sample. The percentage share of Filipinos declined over cohorts, however, and by the 2001–05 cohort, Asian Indians made up the largest percentage of the sample.

Table 2 outlines the prevalence of health outcomes for each cohort and duration sample, along with the prevalence of a sex- and age-matched comparison group from the U.S.-born

Table 1
Sample characteristics by cohort

	Cohorts entering						
	U.S.–born Asian	Pre-1980	1981–85	1986–90	1991–95	1996–2000	2001–05
N^+	8,629	9,158	4,812	4,942	5,408	3,943	2,394
Mean age (*SD*)	39 (18)	47 (15)	46 (15)	44 (15)	39 (15)	36 (13)	35 (13)
Male	48.8%	46.7%	48.1%	48.6%	47.2%	48.8%	48.0%
Chinese	19.3%	21.1%	21.9%	22.5%	22.2%	21.0%	19.7%
Filipino	27.5%	22.7%	21.6%	21.1%	18.9%	14.7%	15.1%
Asian Indian	7.2%	13.3%	14.2%	16.9%	19.9%	31.4%	35.0%
Other Asian	46.0%	42.9%	42.3%	39.5%	39.1%	32.9%	30.2%

Note: $^+$Sample sizes reflect the cohort weighting and thus do not sum to the total sample size.

Table 2
Prevalence of health outcomes for cohort/duration groups, matched by age and sex to U.S.-born Asians

	Fair/poor self-rated health			Obesity		
	Foreign born	U.S. born	Ratio (foreign/U.S.)	Foreign born	U.S. born	Ratio (foreign/U.S.)
Cohort: Pre-1980						
10–14 years	39.2%	29.8%	1.3	3.3%	13.2%	0.3
15+ years	35.9%	35.3%	1.0	6.9%	14.1%	0.5
Cohort: 1981–85						
5–9 years	37.3%	28.9%	1.3	2.2%	12.6%	0.2
10–14 years	34.4%	29.9%	1.1	4.1%	13.2%	0.3
15+ years	36.0%	35.8%	1.0	7.8%	14.2%	0.5
Cohort: 1986–90						
0–4 years	35.0%	27.3%	1.3	1.9%	12.6%	0.2
5–9 years	35.3%	28.8%	1.2	2.5%	13.0%	0.2
10–14 years	31.4%	30.3%	1.0	6.0%	13.5%	0.4
15+ years	37.7%	36.6%	1.0	8.8%	14.4%	0.6
Cohort: 1991–95						
0–4 years	30.6%	27.0%	1.1	2.4%	12.1%	0.2
5–9 years	30.5%	28.8%	1.1	3.1%	13.1%	0.2
10–14 years	31.6%	30.3%	1.0	7.2%	13.8%	0.5
15+ years	39.0%	37.6%	1.0	9.6%	14.5%	0.7
Cohort: 1996–2000						
0–4 years	23.7%	26.2%	0.9	3.5%	12.3%	0.3
5–9 years	29.7%	28.2%	1.1	5.0%	12.8%	0.4
10–14 years	29.9%	30.1%	1.0	9.3%	14.3%	0.7
Cohort: 2001–05						
5–9 years	25.2%	26.2%	1.0	3.4%	12.3%	0.3
10–14 years	30.1%	28.3%	1.1	7.4%	12.4%	0.6

Asian sample. Because of the survey's limited waves, not all cohorts have the full range of duration represented.

There are several trends to consider in this table. First, the prevalence of obesity rose with longer duration within each cohort. For example, in the 1991–95 cohort, the prevalence of obesity increased from 2.4 percent to 9.6 percent. However, age influences some of this trend in duration; as immigrants live longer in the United States, they also grow older. The matched U.S.-born group corroborates this age pattern; their rate went from 12.1 percent to 14.5 percent. The immigrant rate had a much steeper increase, however, suggesting that duration still had a significant association apart from age. Indeed, the foreign-born/U.S.-born ratio changed from 0.2 to 0.7, which suggests that there is a duration association independent of age differences. This contrasts with the self-rated health results, in which the ratio remained relatively constant, suggesting only age differences.

Second, we can also examine cohort baseline health differences. At 0–4 years' duration for the 1986–90, 1991–95, and 1996–2000 cohorts, the foreign-born obesity rates rose from 1.9 percent to 2.4 percent to 3.5 percent, respectively. This suggests that later cohorts entered the United States with higher obesity. Self-rated health showed the opposite pattern. For the same years and cohorts, the fair/poor self-rated health rates were 35.0 percent, 30.6 percent, and 23.7 percent. Thus, the data suggest that newer cohorts of immigrants are more likely to be obese, yet to also rate their health more favorably.

Finally, we can compare the duration trends within the cohorts to one another. Rates across duration categories seemed comparable across cohorts. For example, rates of obesity for the 1986–90 cohort rose threefold from the 0–4-year group to the 10–14-year group (1.9% to 6%). The 1991–95 and 1996–2000 cohorts displayed patterns of similar magnitude. Fair/poor self-rated health also appeared to rise similarly within cohorts.

Regression Results

Table 3 displays the results of the logistic regression models. Model 1 includes duration variables (with 0–4 years as baseline), and Model 2 adds cohort variables (with pre-1980 cohort as baseline).

The multivariate results replicate many of the bivariate patterns. Looking first at the self-rated health results for Model 1, we see that only one duration group, the 5–9-year group, differs significantly from the 0–4-year reference group (OR = 1.13). The difference disappears when we add the cohort variables in Model 2, however, and there is a slightly negative trend, such that the odds of reporting fair/poor self-rated health decrease with duration. The odds for the 15-plus-year category (OR = 0.86) are lower than for the

Table 3
Logistic regression results for cohort and duration differences in health outcomes

	Fair/poor self-rated health				Obesity			
	Model 1		Model 2		Model 1		Model 2	
	OR	$p > \|t\|$	OR	$p > \|t\|$	OR	$p > \|t\|$	OR	$p > \|t\|$
Duration								
U.S. born	0.92		0.79	*	6.30	**	7.74	**
0–4 years	Ref.		Ref.		Ref.		Ref.	
5–9 years	1.13	*	1.07		1.37		1.36	
10–14 years	1.06		0.94		2.13	**	2.32	**
15+ years	1.00		0.86	†	2.42	**	2.90	**
Cohorts								
Pre-1980			Ref.				Ref.	
1981–85			1.01				1.02	
1986–90			1.01				1.07	
1991–95			0.95				1.10	
1996–2000			0.85	*			1.33	
2001–05			0.84	†			1.34	

Notes: $^{**}p < .01$; $^{*}p < .05$; $\dagger p < .10$. Models controlled for Asian ethnicity, sex, age and nativity/sex interaction, and survey year.

reference group at the $p < .10$ level. The cohort differences in Model 2 indicate that the most recent cohorts (entering 1996–2000 and 2001–05) came in with lower reports of fair/poor self-rated health than did the earliest cohort (OR = 0.85, 0.84, respectively). Additional analyses using multinomial regressions indicate that this difference arose from the higher likelihood of these cohorts reporting "very good" self-rated health compared to the earliest cohort (results available upon request).

Obesity increases with longer duration. In Model 1, the 10–14-year and 15-plus-year groups have significantly higher odds of obesity than the 0–4-year reference group (OR = 2.13, 2.42, respectively). The point estimates stay very similar and the pattern continues after adding the cohort variables in Model 2. None of the cohort groups are significantly different from the baseline comparison group, meaning that there are no cohort differences in obesity.

Duration Differences Across Cohorts

Table 4 displays the results of duration differences in the stratified cohorts. The individual cohorts appear to replicate the pattern of improving self-rated health with duration seen in the aggregated data, although only the pre-1980 cohort displayed a significant trend (OR = 0.66). Similarly, for obesity, the individual cohorts displayed a similar pattern as that seen in the aggregate data, although only the most recent cohort (2001–05) showed a statistically significant trend (OR = 1.94).

Additional Analyses

We additionally conducted the analyses on the individual Chinese, Filipino, and Asian Indian samples. The three ethnic groups replicated most of the overall trends, but some findings did not reach statistical significance, likely because of the smaller sample sizes.

Table 4
Logistic regression results for duration differences within cohorts

	Pre-1980		1986–90		1991–95		1996–2000		2001–05	
	OR	$p > \|t\|$	OR	$p > \|t\|$	OR	$p > \|t\|$	OR	$p > \|t\|$	OR	$p > \|t\|$
Fair/poor self-rated health										
0–4 years			Ref.		Ref.		Ref.		Ref.	
5–9 years			1.00		1.00		1.16		0.79	
10–14 years	Ref.		1.09		0.99		1.09			
15+ years	0.66	*	0.92		1.16					
Obesity										
0–4 years			Ref.		Ref.		Ref.		Ref.	
5–9 years			1.12		0.98		1.01		1.94	†
10–14 years	Ref.		1.85		1.58		1.39			
15+ years	0.99		2.85		1.60					

Notes: $^{**}p < .01$; $^{*}p < .05$; $\dagger p < .10$. Models controlled for Asian ethnicity, sex, age and nativity/sex interaction, and survey year.

For example, more recent Asian Indian cohorts displayed better baseline self-rated health than older cohorts, but this pattern did not reach significance (tables available upon request).

We also conducted the analyses separately for men and women. We found similar results as those found in the aggregate sample, with one exception. For men, more recent cohorts had higher odds of obesity compared to the oldest cohort. For women, there were no cohort differences. For both sexes, obesity increased with longer duration.

We also examined whether health behaviors mediated the cohort and duration patterns. Acculturation theories predict that immigrants change their behaviors with longer duration, which in turn changes their health. To evaluate this idea, we included three health behavior variables: smoking, alcohol use, and exercise. These analyses used a subset of the full data, because data for these behaviors are not available for all survey years ($n = 7{,}489$). The inclusion of health behavior variables did not change the magnitude or significance of the cohort and duration patterns for either the self-rated health or obesity results, suggesting that health behaviors alone do not drive cohort and duration differences. The contextual effects that we considered to form our hypothesis may have a role in determining potential pathways.

We conducted another sensitivity check in which we limited the sample to those who migrated after the age of 25. Because of their older age at migration, individuals from this sample likely completed their education in their country of origin. This in turn raised the likelihood that their educational attainment stayed stable over their duration in the United States. This check produced similar results to those presented, which suggests that our duration patterns were not merely a result of increasing education with longer residence in the United States. Immigrants in the 15- plus-year duration group were not included in this check, however, as we could not calculate their age at migration ($n = 14{,}578$). This sensitivity check also addressed potential age at migration problems. Migration during certain critical developmental periods (e.g., during childhood) can impact one's subsequent integration and produce disparate duration patterns (Rumbaut 2004). This check, however, suggests that age of migration does not impact the consistency of the results.

Discussion

In this study, we examined the roles of cohorts and duration in affecting self-rated health and obesity among Asian immigrants. Based on increasing standards of living and compositional differences, we hypothesized that self-rated health would be better among more recent compared to older cohorts upon arrival to the United States. But based on global increases in obesity, we hypothesized increased rates of obesity among more recent cohorts. We also hypothesized a weaker relationship between duration in the United States and health among more recent cohorts for both outcomes.

Some of these hypotheses were confirmed for self-rated health. We found that most recent cohorts had a significantly lower likelihood of self-reporting fair/poor health compared to the oldest cohorts. The self-rated health cohort patterns may arise from the improved standard of living in common Asian sending countries, as well as U.S. immigration guidelines that affected certain socioeconomic characteristics of incoming migrants. The results may also reflect compositional differences in sending countries across cohorts, as the proportion of Asian Indians steadily grew while the proportions of Filipinos and Chinese declined. Our data do not permit us to preference one possibility over the other, but it is likely that there are several factors at work. Some scholarship has questioned the validity of the self-rated health measure among Asian immigrants because of the potential for cultural differences to impact individuals' interpretations of the survey question and general

conceptualizations of health (Kandula, Lauderdale, and Baker 2007). However, a comparison between U.S.-born and foreign-born Asians—the two groups in our analyses—found no difference in their use of the scale (Erosheva, Walton, and Takeuchi 2007).

The obesity results offer an interesting contrast: we saw no differences in obesity across cohorts. Given the global increase in obesity, why did we not see higher levels of obesity at arrival among the more recent cohorts? Albrecht et al. (2013) similarly found little difference in obesity prevalence at arrival for Mexican immigrants between 1998 and 2008, a finding that they attributed to selective migration. The healthy migrant effect suggests that migrants are in better health than their nonmigrating counterparts in their countries of origin, because healthier individuals are more mobile and stand to benefit the most from migration (Jasso et al. 2004). Although Asian countries may be experiencing an increase in obesity overall, migrants may represent a healthier subset that does not reflect the rising obesity trend. Supplemental analyses revealed that men's obesity prevalence increased over cohorts, however. Future research could probe potential gender differences in health selection, especially as obesity rates continue to climb in Asian countries.

We also hypothesized that self-rated health would worsen with duration, but the data did not support this. After controlling for cohort differences, we found an unexpected pattern: self-rated health improved slightly with duration. Prior research has been mixed with regard to self-rated health and duration, but our results are distinct in that we account for potential cohort confounding. While the trend was only marginally significant, it poses interesting questions about immigrants' changing views of their health compared to their premigration circumstances and in light of longer U.S. residence. Self-rated health reflects subjective perceptions of health that depend on external cues and internal responses (Jylha 2009). Perhaps the United States represented an improvement in life quality for immigrants compared with their native countries, driving their better self-reported health with longer residence. Other researchers who have similarly found improving maternal health with duration have suggested that cultural differences and exposures in the host country are experienced differently over time (Teitler, Hutto, and Reichman 2012). Our findings suggest that cohorts may also play a role in determining such differential exposures.

In contrast, duration was consistently correlated with higher obesity. This is purportedly explained by the adoption of new behaviors, such as those related to diet and exercise (Satia-Abouta et al. 2002). Although we did not have data for dietary behavior, it is interesting that the coefficients for obesity were essentially unchanged after inclusion of exercise, tobacco use, and alcohol use. This suggests that future research should fully explore not only diet, but also nonbehavioral factors such as stress. A study of Mexican immigrants found that allostatic load (stress-mediated health deterioration) increased with longer duration in the United States, net of health behaviors (Kaestner et al. 2009). Another study found that only Asian Americans who reported encounters with racial discrimination experienced duration-related obesity (Gee et al. 2008). This suggests that stressful experiences may partially contribute to the rise in obesity among immigrants over time, and that these stressful experiences may affect health indirectly through behavioral factors and directly though physiological responses (Jackson, Knight, and Rafferty 2010).

A previous study of cohort and duration effects in the NHIS did not find an association between years in the United States and obesity among Asian immigrants (Kaushal 2009). Our analyses included a larger duration range; Kaushal's study truncated length of stay by limiting the maximum age to 60 and did not include the longest-term duration category of 15-plus years. Furthermore, Kaushal's study included earlier waves of the NHIS that may not have fully captured the growing obesity trend. These are not merely methodological differences, but substantive ones; by changing the time frame, we also change the social

circumstances that affect a population's health outcome. Thus, some of the discrepancies seen in the broader literature on duration and health may be related to differences in the construction of the sample and observation period.

Taken together, immigrants' self-rated health improved slightly with duration while their obesity rates increased. Differences in the interpretation of the health measures may explain this contrast. If immigrants primarily relied on pre- and postmigration comparisons for self-rated health, they may have placed a lower priority on weight in assessing their well-being. Some researchers have suggested that immigrants who experience improvement in food availability may actually feel favorably toward weight gain in the United States (Hamilton, Teitler, and Reichman 2011; Van Hook and Baker 2010). Other research has found that BMI has little bearing on self-rated health assessments among certain groups, but it is as yet unclear whether this is also the case for Asian immigrants (Zajacova and Burgard 2010).

Finally, we hypothesized an interaction between duration and cohort, such that the association between duration and illness would be stronger among older cohorts compared to recent cohorts. We found no such interaction for obesity, but we did find an interaction for self-rated health. Contrary to expectation, we found that older cohorts reported improved self-rated health with duration. One potential explanation for this finding is related to mortality. The older cohorts were also the oldest in age; perhaps the sickest individuals died with longer duration. The improving self-rated health patterns could thus be a reflection of healthy survivorship. A second potential explanation could be that members of the oldest cohort may have experienced the biggest improvement in their quality of life after migrating, which may explain why they had the strongest pattern of improving self-rated health with duration. It is important to note, however, that other cohorts also displayed improving health with duration, but this pattern was only significant among the oldest cohort. We cannot rule out the possibility that all cohorts shared a common duration pattern such that reports of fair/poor self-rated health decreased with longer U.S. residence, but that smaller sizes reduced statistical power.

The cohorts exhibited little difference from one another in their obesity patterns. All cohorts had rising obesity with duration, although the trend only reached significance in the most recent cohort. Again, this could have been due to smaller sample sizes in the stratified cohorts.

In sum, our findings show that the role of cohorts varies across health outcomes. The different patterns for obesity and self-rated health support Aneshensel, Rutter, and Lachenbruch's (1991) observation that we can leverage different health outcomes to understand broader social phenomena. Cohorts had unique baseline self-rated health patterns that aligned with changes in their sending countries and compositional differences. However, these differences in baseline health did not fully account for the duration patterns. In fact, controlling for cohorts revealed a counterintuitive finding in which self-rated health improved with duration. In contrast, accounting for cohort differences in the association between duration and obesity did not change the significant and positive relationship. Despite the global rise in obesity, selective migration may have limited the differences in obesity across cohorts. Cohorts may also contend with common postmigration factors, which could explain their similar patterns in the relationship between obesity and duration.

These analyses contain limitations. First, we could not distinguish cohorts beyond year of entry in the NHIS. Identifying cohorts by year of entry and country of origin or Asian ethnicity would have made the analysis more precise, but the NHIS does not collect country of origin information and only makes limited ethnicity information available for the waves we included in the analysis. As a result, some year-of-entry cohorts may have encompassed

more than one unique group, reducing differences across them. Future research could better identify cohorts through country of origin and visa status. This could better connect cohorts to specific immigration policy eras or periods of migration history.

Further, out-migration may have biased our duration results, although the relatively constant size between the 0–4-, 5–9-, and 10–14-year duration groups across the cohorts indicate that out-migration may not pose a serious bias (the open-ended 15-plus-year group is considerably larger and cannot be compared in this regard). Other research has found that out-migration among Asian immigrants is relatively low compared to other groups (Kritz and Gurak 2001).

Our findings suggest that future studies of immigrant health should examine possible cohort differences. More broadly, cohort differences can reflect differences in immigration policy and contexts of reception, all of which can be topics for future inquiry. These findings provide the basis for future work that can more directly consider such contextual effects.

References

Acevedo-Garcia, D., L. M. Bates, T. L. Osypuk and N. McArdle. 2010. The effect of immigrant generation and duration on self-rated health among US adults 2003–2007. *Soc Sci Med* 71(6):1161–1172.

Albrecht, S. S, A. V. Diez Roux, A. E Aiello, A. J. Schulz, and A. F Abraido-Lanza. 2013. Secular trends in the association between nativity/length of US residence with body mass index and waist circumference among Mexican-Americans, 1988–2008. *Int J Public Health* 58(4):573–581.

Aneshensel, C. S., C. M. Rutter, and P. A. Lachenbruch. 1991. Social structure, stress, and mental health: competing conceptual and analytic models. *Am Sociol Rev* 56(2):166–178.

Antecol, H., and K. Bedard. 2006. Unhealthy assimilation: why do immigrants converge to American health status levels? *Demography* 43(2):337–360.

Banister, J., and K. Hill. 2004. Mortality in China 1964–2000. *Popul Stud* 58(1):55–75.

Borjas, G. J. 1985. Assimilation, changes in cohort quality, and the earnings of immigrants. *J Labor Econ* 3(4):463–489.

Caballero, B. 2007. The global epidemic of obesity: an overview. *Epidemiol Rev* 29(1):1–5.

Cho, Y. T., W. P. Frisbie, and R. G. Rogers. 2004. Nativity, duration of residence, and the health of Hispanic adults in the United States. *Int Migr Rev* 38(1):184–211.

Cho, Y. T., and R. A. Hummer. 2001. Disability status differentials across fifteen Asian and Pacific Islander groups and the effect of nativity and duration of residence in the U.S. *Soc Biol* 48(3–4):171–195.

Dey, A., and J. Wilson Lucas. 2006. Physical and mental health characteristics of U.S. and foreign-born adults: United States 1998–2003. *Adv Data* 369.

Erosheva, E., E. C. Walton, and D. T. Takeuchi. 2007. Self-rated health among foreign- and US-born Asian Americans—a test of comporobility. *Med Care* 45(1):80–87.

Frisbie, W. P., Y. T. Cho, and R. A. Hummer. 2001. Immigration and the health of Asian and Pacific Islander adults in the United States. *Am J Epidemiol* 153(4):372–380.

Gee, G. C., and C. L. Ford. 2011. Structural racism and health inequities. *Du Bois Rev Soc Sci Res Race* 8(1):115–132.

Gee, G. C., A. Ro, A. Gavin, and D. T. Takeuchi. 2008. Disentangling the effects of racial and weight discrimination on body mass index and obesity among Asian Americans. *Am J Public Health* 98(3):493–500.

Goel, M. S., E. P. McCarthy, R. S. Phillips, and C. C. Wee. 2004. Obesity among US immigrant subgroups by duration of residence. *JAMA* 292(23):2860–2867.

Hamilton, E. R., J. B. Cardoso, R. A. Hummer, and Y. Padilla. 2011. Assimilation and emerging health disparities among new generations of U.S. children. *Demogr Res* 25(25):783–818.

Hamilton, E. R., J. O. Teitler, and N. E. Reichman. 2011. Mexican American birthweight and child overweight: unraveling a possible early life course health transition. *J Health Soc Behav* 52(3):333–348.

Hamilton, T. G., and R. A. Hummer. 2011. Immigration and the health of U.S. black adults: does country of origin matter? *Soc Sci Med* 73(10):1551–1560.

Hawkes, C. 2006. Uneven dietary development: linking the policies and processes of globalization with the nutrition transition, obesity and diet-related chronic diseases. *Glob Health* 2:4.

Ihara, E. S. 2011. Exploring the socioeconomic and immigration health contexts of Asian Americans. *J Hum Behav Soc Environ* 21(5):521–539.

Jackson, J. S., K. M. Knight, and J. A. Rafferty. 2010. Race and unhealthy behaviors: chronic stress, the HPA axis, and physical and mental health disparities over the life course. *Am J Public Health* 100(5):933–939.

Jang, Y., G. Kim, and D. A. Chiriboga. 2005. Health, healthcare utilization, and satisfaction with service: barriers and facilitators for older Korean Americans. *J Am Geriatr Soc* 53(9):1613–1617.

Jasso, G., D. Massey, M. Rosenzweig, and J. Smith. 2004. Immigrant health: selectivity and acculturation. In *Critical perspectives on racial and ethnic differences in health in late life*, ed. N. Anderson, N. Bulatao, and B. Cohen, 227–266. Washington, DC: National Academies Press.

Jylha, M. 2009. What is self-rated health and why does it predict mortality? Towards a unified conceptual model. *Soc Sci Med* 69(3):307–316.

Kaestner, R., J. A. Pearson, D. Keene, and A. T. Geronimus. 2009. Stress, allostatic load, and health of Mexican immigrants. *Soc Sci Q* 90(5):1089–1111.

Kandula, N. R., D. S. Lauderdale, and D. W. Baker. 2007. Differences in self-reported health among Asians, Latinos, and non-Hispanic whites: the role of language and nativity. *Ann Epidemiol* 17(3):191–198.

Kaushal, N. 2009. Adversities of acculturation? Prevalence of obesity among immigrants. *Health Econ* 18(3):291–303.

Kritz, M. M., and D. T. Gurak. 2001. The impact of immigration on the internal migration of natives and immigrants. *Demography* 38(1):133–145.

Lauderdale, D. S. 2001. Education and survival: birth cohort, period, and age effects. *Demography* 38(4):551–561.

Lauderdale, D. S., and P. J. Rathouz. 2000. Body mass index in a US national sample of Asian Americans: effects of nativity, years since immigration and socioeconomic status. *Int J Obes Relat Metab Disord* 24(9):1188–1194.

Oza-Frank, R., and K. M. Venkat Narayan. 2010. Overweight and diabetes prevalence among US immigrants. *Am J Public Health* 100(4):661–668.

Park, E., and J. Park. 2005. *Probationary Americans*. New York: Routledge.

Park, Y., K. M. Neckerman, J. Quinn, C. Weiss, and A. Rundle. 2008. Place of birth, duration of residence, neighborhood immigrant composition and body mass index in New York City. *Int J Behav Nutr Phys Act* 5:19.

Portes, A., and M. Zhou. 1993. The new second generation: segmented assimilation and its variants. *Ann Am Acad Polit Soc Sci* 530:74–96.

Ro, A., and G. C Gee. 2012. Disability status differentials among Asian immigrants in the United States: the added dimensions of duration and age. *Race Soc Probl* 4(2):83–92.

Roshania, R., K. M. Venkat Narayan, and R. Oza-Frank. 2008. Age at arrival and risk of obesity among US immigrants. *Obesity* 16:2669–2675.

Ruggles, S., J. T. Alexander, K. Genadek, R. Goeken, M. B. Schroeder, and M. Sobek. 2010. *Integrated public use microdata series: version 5.0* [machine-readable database]. Minneapolis: University of Minnesota.

Rumbaut, R. G. 2004. Ages, life stages, and generational cohorts: decomposing the immigrant first and second generations in the United States. *Int Migr Rev* 38(3):1160–1205.

Saikia, N., D. Jasilonis, F. Ram, and V. Shkolnikov. 2009. Trends in geographical mortality differences in India. Working Paper 2009-013. Rostock, Germany: Max Planck Institute for Demographic Research.

Sanchez-Vaznaugh, E. V., I. Kawachi, S. V. Subramanian, B. N. Sanchez, and D. Acevedo-Garcia. 2008. Differential effect of birthplace and length of residence on body mass index (BMI) by education, gender and race/ethnicity. *Soc Sci Med* 67(8):1300–1310.

Satia-Abouta, J., R. E. Patterson, M. L. Neuhouser, and J. Elder. 2002. Dietary acculturation: applications to nutrition research and dietetics. *J Am Diet Assoc* 102(8):1105–1118.

Singh, G. K., and M. Siahpush. 2002. Ethnic-immigrant differentials in health behaviors, morbidity, and cause-specific mortality in the United States: an analysis of two national data bases. *Hum Biol* 74(1):83–109.

Teitler, J. O., N. Hutto, and N. E. Reichman. 2012. Birthweight of children of immigrants by maternal duration of residence in the United States. *Soc Sci Med* 75(3):459–468.

Uretsky, M. C., and S. G. Mathiesen. 2007. The effects of years lived in the United States on the general health status of California's foreign-born populations. *J Immigr Minor Health* 9(2):125–136.

Van Hook, J., and E. Baker. 2010. Big boys and little girls. *J Health Soc Behav* 51(2):200–214.

Wolf, C., S. Dalal, J. DaVanzo, E. V. Larson, A. Akhmedjonov, H. Dogo, M. Huang, and S. Montoya. 2005. *China and India, 2025: a comparative assessment*. Monograph MG1009. Santa Monica, CA: RAND.

Yoon, K-H., J-H. Lee, J-W. Kim, J. H. Cho, Y-H. Choi, S-H. Ko, P. Zimmet, and H-Y. Son. 2006. Epidemic obesity and type 2 diabetes in Asia. *Lancet* 368(9548):1681–1688.

Zajacova, A., and S. A. Burgard. 2010. Body weight and health from early to mid-adulthood: a longitudinal analysis. *J Health Soc Behav* 51(1):92–107.

Zhang, W., H. McCubbin, L. McCubbin, Q. Chen, S. Foley, I. Strom, and L. Kehl. 2010. Education and self-rated health: an individual and neighborhood level analysis of Asian Americans, Hawaiians, and Caucasians in Hawaii. *Soc Sci Med* 70(4):561–569.

Zhang, W., and V. M. Ta. 2009. Social connections, immigration-related factors, and self-rated physical and mental health among Asian Americans. *Soc Sci Med* 68(12):2104–2112.