Low Birthweight among Immigrants to the United States:

Cohort and Duration Effects

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Abstract

Immigrants in the U.S. tend to be healthier and live longer than both individuals who remain in their countries of origin and natives of their host countries who are of the same race or ethnicity. This immigrant health advantage appears to diminish with duration of residence in the U.S., a scenario consistent with theorized acculturation processes. However, there is also some evidence that immigrant health improves, rather than deteriorates, in the first few years after arrival. A major limitation of virtually all studies of immigrant heath by duration of residence is that estimated duration effects may be confounded by changes in the health selectivity of immigrant cohorts over time. We use the 1998 to 2009 waves of the National Health Interview Survey to: (1) investigate cohort changes in birth outcomes of immigrants who came to the U.S. between 1950 and 2009 and (2) estimate duration effects net of cohort effects. We find evidence of deteriorating immigrant health over time—that is, rates of low birthweight increase across successive immigrant cohorts. We also find that duration effects appear to be curvilinear when adjusting for cohort effects, with initial improvements in infant health upon arrival followed by subsequent deterioration. These general findings hold for some groups of immigrants more than for others.

Introduction

Most existing studies of adult immigrants find a negative association between duration of residence and health; specifically, the longer individuals have been in the U.S., the worse their health (e.g., e.g., Cho et al., 2004; Goel et al., 2004; Uretsky & Mathiesen, 2007). However, Jasso et al. (2004) found evidence of a curvilinear association, suggesting improvements in health soon after arrival to the U.S. followed by steady deterioration after about five years. A handful of studies have investigated associations between mothers' duration of residence and the birth outcomes of their U.S.-born infants. Most have found evidence of worse outcomes with longer duration (Ceballos & Palloni, 2010; Landale, Oropesa, & Gorman, 2000; Urquia et al., 2010), although a recent article based on data from three national birth cohort studies revealed curvilinear patterns in birthweight akin to those found by Jasso for adult health (Teitler, Hutto & Reichman, 2012).

A limitation of virtually all of the existing studies on immigrant duration of residence and health is that they have not taken into account potential cohort effects. In other words, observed associations between duration and health could be confounded by differences in health across immigration cohorts. To our knowledge, almost no research has investigated the extent to which the health of immigrants varies by cohort or the extent to which differences across cohorts explain associations between immigrant duration of residence and health. An exception is a study by Antecol and Bedard (2006), which controlled for four immigration periods when estimating effects of duration intervals on body weight and other adult health outcomes. The authors concluded that health differences across cohorts did not substantially bias duration effects, at least for the groups and duration intervals they examined.

In this paper, we systematically investigate (1) cohort differences in birth outcomes among children born to immigrant mothers arriving in the U.S. between 1950 and 2009, and (2) patterns in birth outcomes by maternal duration of residence in the U.S., controlling for cohort differences. We also conduct stratified analyses by region of origin and age at arrival. The focus on infant health is important because (1) some of the key behaviors thought to be affected by acculturation (e.g. diet and smoking) are important predictors of birth outcomes (in particular, birthweight), (2) the maternal-child link is potentially important for understanding patterns in immigrant health across generations, and (3) the share of children in the U.S. born to immigrant mothers is very large, with one quarter of births in the U.S. in 2008 taking place to women born outside of the 50 U.S. states or DC (Martin et al., 2008).

Background

Acculturation theory—operationalized in much of the empirical literature with measures of language acquisition, generational status, and age of arrival, all of which are highly associated with duration of residence in the host country—assumes a path of gradual acceptance of the new culture with the protective effects of the country of origin dissipating over time (see Jasso et al., 2004). That is, the process is generally assumed to be monotonic and assimilative in nature. The process is thought to operate largely through individuals' health behaviors, particularly drug use, alcohol abuse, cigarette smoking, and unhealthful dietary patterns (see Lara et al., 2005). Specifically, the longer immigrants reside in the U.S., the more likely they are to engage in those behaviors, which in turn compromise their health.

Changes in behaviors are not the only process that could shape immigrants' health trajectories. Passive exposures to discrimination or other potentially health-compromising social contexts could also take a toll on immigrants' health (Nazroo, 2001; Singh & Siahpush, 2002;

Reijneveld, 1998; Uretsky & Mathiesen, 2007). Cumulative insults of this nature may also lead to monotonic declines in health. However, better economic opportunities or healthcare in the host country than in the country of origin and could result in improved health. Thus, the country of origin and the circumstances surrounding the decision to migrate may play a role.

Duration of U.S. residence and adult health

Studies on health declines among immigrants have focused primarily on adults, and those have focused primarily on Hispanics who represent the largest immigrant subgroup in the U.S. Dey et al. (2006) reported that Hispanic immigrants living in the U.S. for fewer than five years have lower rates of obesity, hypertension, diabetes, and cardiovascular disease than Hispanic immigrants living in the U.S. for more than five years. Antecol and Bedard (2006), in a study of 20–64 year old immigrants, found similar patterns for self-reported general health and activity limitations among Hispanics, even when controlling for socioeconomic status; the patterns they observed were less consistent among whites and not apparent among blacks. As mentioned earlier, this study partially accounted for cohort effects; specifically, the authors controlled for arrival to the U.S. in 1980 or earlier, 1981–1985, 1986–1990, and 1991–1996. Both of these studies used data from the National Health Interview Survey (NHIS), a large nationally-representative study of the U.S. population.

Findings from the above studies and others are consistent with acculturation theory and suggest a monotonic association between duration of residence in the U.S. and poor health; that is, the longer immigrants have been in the host country (almost always the U.S., in studies to date), the worse their health. However, Jasso et al. (2004) uncovered a curvilinear association using the NHIS and considering self-rated health as well as seven different chronic conditions. Jasso and colleagues' finding, which is also consistent with acculturation theory in its general

formulation, suggests that improvements in health occur among immigrants soon after arrival followed by steady deterioration after five years in the U.S. The authors found that the initial improvements in adult health do not appear to reflect language acquisition or changes in reference frames (i.e., initially comparing oneself to individuals in the country of origin but eventually using U.S. residents as the comparison).

Age at immigration

There is strong evidence that decisions about whether to engage in health related behaviors (including those related to birth outcomes), such as smoking, are made during adolescence (Elders et al., 1994; Kandel et al., 1998). The critical period for take-up of smoking appears to be narrow and a fairly universal phenomenon (World Bank, 1999). This line of research suggests that the age at which immigrants arrive to the U.S. may moderate effects of duration on birth outcomes. In fact, many studies have shown that age at arrival is associated with a wide range of outcomes, including language proficiency (Bleakley & Chin, 2010), cognitive development (Glick et al., 2009), and obesity (Kaushal, 2009; Roshania et al., 2008), and that duration effects on acculturation are important, but only for young immigrants (Cheung et al., 2011).

Duration of U.S. residence and birth outcomes

As far as we know, only four studies to date have investigated associations between mothers' duration of residence and the health of their U.S.-born (or in one case, Canadian-born) infants.

Landale, Oropesa, and Gorman (2000), using pooled origin/destination data from the Puerto Rican Maternal and Infant Health Study, found that maternal duration of residence in the mainland U.S. is positively associated with infant mortality, controlling for an extensive set of

individual and family characteristics. The authors imposed a linear functional form on the association between duration of residence and infant mortality in their analyses (i.e., they included a continuous variable for years in U.S. in their model), potentially obscuring non-monotonic relationships between duration and infant mortality.

Urquia et al. (2010) found that, controlling for socioeconomic status, duration of residence (in 5-year increments) was associated with increases in preterm birth, but not in small-for-gestational age, in metropolitan areas of Ontario, Canada. Recent immigrants were at lower risk of preterm birth compared to a mostly Canadian-born population, but immigrants became at higher risk after 10 years of stay in Canada. The authors referred to sensitivity analyses that adjusted for arrival cohort and that produced similar duration effects. However, the results from a sample of immigrants acquiring permanent residence in metropolitan Ontario between 1985 and 2000 may not be generalizable to other contexts, cohorts, and duration intervals.

Ceballos and Palloni (2010), in a study of two urban community samples of Mexican-origin mothers, found a curvilinear association between duration and adverse birth outcome (defined as the birth being less than 2500 grams *and* small for gestational age *and* less than 37 weeks gestation). Having spent 3 or fewer years or 13 or more years in the U.S. was associated with less favorable birth outcomes compared to having spent 4 to 12 years in the U.S. The authors were able to replicate the general finding using the National Survey of Family Growth (NSFG) Cycle V, for slightly different duration intervals (0–6 and 11+ years).

Teitler, Hutto, and Reichman (2012) used three contemporary national datasets to describe patterns in infant birthweight by maternal duration of residence in the U.S. Using the Early Childhood Longitudinal Study-Birth Cohort (ECLS–B), Early Childhood Longitudinal Study–Kindergarten Class of 1998–99 (ECLS–K), and Fragile Families and Child Wellbeing

(FF) studies, the authors found that for both immigrants overall and Hispanic immigrants in particular, rates of low birthweight appeared to decline over the first few years in the U.S. and increase thereafter. This curvilinear association was robust across the three datasets, two of which are nationally representative (ECLS–B and ECLS–K) and the other of which is representative of births in large U.S. cities (FF).

Cohort differences in immigrant health

A limitation of all of the above studies of the effects of duration of residence on immigrants' health, with the exception of Antecol and Bedard and to some extent Jasso et al., is that they did not take into account potential cohort differences in immigrant health. In particular, observed associations between duration and health could be confounded by differences in immigration health across cohorts. To our knowledge, no study has comprehensively investigated cohort differences in immigrant health or the extent to which cohort differences may explain associations between duration and health. The incomplete existing evidence on this issue, from the studies discussed below, suggests that the health of new immigrants to the U.S. has been declining over time. However, the literature is far from complete. Additionally, none of the relevant studies explicitly considered potential interactions of duration of residence with age at arrival to the U.S. or with region of origin.

Jasso et al. (2004), using data from the NHIS, compared the self-rated health of two arrival cohorts and found that the health in the earlier cohort (1991) is better than that in the later cohort (1996).Antecol and Bedard (2006), also using data from the NHIS, examined various indicators of self-rated health, health conditions, and activity limitation from the NHIS and found evidence of cohort deterioration in health across the following arrival cohorts of individuals aged 20–64 years, particularly for women: 1980 or earlier, 1981–1985, 1986–1990, and 1991–1996.

They looked separately at Hispanics, whites, and blacks, but only for broad age groups, and did not disaggregate by region of origin or age at arrival. Hamilton and Hummer (2011), using data from the 1996–2010 Current Population Surveys, presented evidence indicating no clear pattern of cohort differences in self-rated health among blacks aged 25–62 years.

Of these studies, only Antecol and Bedard specifically investigated cohort effects. Jasso et al. looked descriptively at two close-together years, and Hamilton and Hummer focused on duration and country of origin among blacks and presented information that allows the reader to make general inferences about cohort changes over time. As far as we know, no study has systematically investigated cohort differences in immigrant health (that is, by narrow duration intervals spanning multiple decades and for immigrants from different sending countries or regions of the world who arrived at different ages) and no study has looked at cohort differences in birth outcomes of children born to immigrant mothers. If the health of new immigrants has been declining over time, as has been found by Antecol and Bedard (2006) for all immigrant adults—particularly women—for at least the past few decades, then previously estimated duration effects could be biased downward.

Disentangling duration and cohort effects in immigrant health in the U.S. requires repeated cross-sectional data over a large period of time with granular duration and year-of-arrival intervals, as well as the ability to restrict analyses to age ranges within which health outcomes are not age-graded. In this study, we use 1998 to 2009 waves of the NIHS study to systematically investigate changes in birth outcomes across cohorts of immigrants arriving in the U.S. between 1950 and 2009, document patterns in birth outcomes by maternal duration of U.S. residence conditional on immigration cohort, and stratify analyses by region of origin and age at arrival. Disaggregating immigrants as much as possible is important, as there is evidence of

heterogeneity in health and behaviors within the U.S. immigrant population (e.g., Zsembik and Fennell, 2005).

Data

We use the 1998 to 2009 waves of the National Health Interview Survey (NHIS) to examine the relationship between maternal duration of residence in the United States, year of arrival, and low birthweight. The NHIS is the largest household health survey in the U.S. and is widely used to monitor health trends. The restricted version of the NHIS is used for the analyses in this study because year of arrival is available only in that version of the data. Using all available years of the restricted NHIS that include the requisite variables provides us with a unique data source for disentangling effects of duration and year of arrival. Because (1) 1998 was the first year that the NHIS asked about year of arrival and (2) year of birth was available only for (randomly-selected) children under age 18 residing with their mother at the time of the interview, our analysis sample consists of 20,822 mothers who gave birth in the U.S. between 1980 and 2009. The NHIS uses a multistage probability sample so we weight the data accordingly, using the svy commands in Stata SE 11.

Measures

Low birthweight

We focus on low birthweight (< 2500 grams) as the outcome. Low birthweight is a widely used, well-measured, and reliably reported marker of poor health at birth. It is the second leading cause of infant mortality in the U.S. after birth defects and is associated with long-term health and developmental problems among infants who survive (Reichman, 2005). In the NHIS, mothers report their children's birthweight. Maternal reports of birthweight are known to be

reliable even after 15 or more years (McCormick & Brooks-Gunn, 1999; O'Sullivan, Pearce, & Parker, 2000).

Year of arrival

We use the mother's actual year of arrival to create a year-of-arrival measure in 5-year increments in order to comply with the restricted NHIS protocol on publishing small cell sizes. Sensitivity analyses and regression analyses conducted using narrower intervals (and even individual years) produced results consistent with those presented here.

Duration in the United States

Duration of residence in the U.S. is calculated by subtracting the year of arrival in the U.S. from the year of the focal child's birth. Only births that took place when the mother was living in the U.S. are included in the sample. Following Teitler, Hutto, and Reichman (2012), we use the following duration categories in our graphical analyses: 0–2, 3–5, 6–10, 11–15, and 16+ years.

Methods

The primary questions we address in this paper are: (1) To what extent has low birthweight of immigrants changed across arrival cohorts over the past 50 years? (2) To what extent does low birthweight vary by duration of residence in the U.S.? Since year of arrival and duration in the U.S. are correlated, we calculate rates of low birthweight for 5-year arrival cohorts within specific duration intervals and regress percent low birthweight on arrival cohort controlling for duration in the U.S. in order to estimate the per year change in the likelihood of low birthweight. We then calculate duration effects adjusted for the cohort effects estimated in the first step.

Two important sources of potential confounding in the above analyses are maternal age at the time of the birth and period effects in low birthweight. To address the former, we estimate supplemental models restricting the sample to women who gave birth at ages 20–34 years. Although the association between maternal age and low birthweight has a distinct "U" shape, with high rates among teenagers and mothers age 35+, rates of low birthweight are level within the 20–24 year range (Reichman & Pagnini, 1997). To explore the issue of period effects and how consequential those might be for our analyses, we consider the pattern of low birthweight over time in the U.S. during the observation period.

Finally, we consider differences in cohort and duration effects by age at arrival to the U.S. and by region. In particular, we conduct separate analyses for women who arrived in the U.S. as minors (age <18) and as adults (age >=18), and by region of origin where sample size is sufficient.

Results

Before proceeding to the analyses outlined above, we provide relevant historical context regarding the characteristics of immigrants to the U.S. Figures 1 and 2 present data on the composition of legal immigrants admitted to the U.S., by world region, from 1950 to 2010. Because these data do not include illegal immigrants, they may disproportionately underrepresent individuals arriving from Mexico, Central, and Latin America. Still, it is noteworthy that, with the exception of a huge peak in the number of legal immigrants from Mexico between 1988 and 1992 coinciding with the Legally Authorized Worker (LAW) and Specialized Agricultural Worker (SAW) amnesty programs under the Road to the Immigration Reform and Control Act (Durand, Massey, & Parrado, 1999), the proportions of immigrants to the U.S. from Asia, all Spanish speaking countries, and Europe have remained fairly constant

since the 1970s (Figure 1). The proportion has increased notably only for immigrants from Africa, but this group remains small in comparison to other sending regions. It was only during the first half of the observation window (1950 to 1975) that region-of-origin patterns changed dramatically, with very large increases in the number of Hispanics, and even more so, Asians (Figure 2). The absolute numbers of immigrants from Europe and Canada have remained relatively stable since the 1950s, but as the total number of immigrants has risen, their proportional representation has greatly diminished.

The stability in the proportions of immigrants from different sending regions does not mean that the composition of immigrants has otherwise not changed. Importantly, immigrant cohorts have become less educated over time. For example, the proportion of immigrant mothers with less than a high school degree has more than doubled in 20 years and is now about 50% (Teitler, Hutto, & Reichman, 2012). The decreasing level of education among immigrants is likely to be associated with declines in maternal and reproductive health, which can confound estimates of duration of residence in the U.S. and birth outcomes when not adjusting for cohort differences.

Arrival cohorts and birth outcomes

Figure 3 shows rates of low birthweight among U.S.-born children of immigrant women by year of arrival in 5-year bands. We plot associations for different ranges of duration in the U.S. in order to minimize confounding between duration and year of arrival. It is clear that there has been a substantial deterioration in infant health (based on the low birthweight measure) among immigrant cohorts over time. For example, among women giving birth 1–2 years after arrival to the U.S., low birthweight increased from 7.6% in 1985–90 to 9.6% in 2005–10. Similar increases in low birthweight over time are evident in the other duration categories as well and

most appear relatively linear. A notable exception is that among women having children 16 years or more after arrival, rates of low birthweight declined substantially in the latest period they are observed (1985–1990). The decline may be an artifact of the absence of a cap for that duration interval in concert with the 2009 truncation of our observation window. In other words, among mothers in the U.S. for 16+ plus years in 1998–2009, those who arrived between 1985 and 1990 are constrained to the lower end of the 16+ year duration range (16–25 years) whereas those from earlier cohorts could have been in the U.S. for their entire lives. If there are large negative duration effects (as we subsequently show there are for long-term residents), the censored composition of this group could result in suppressed rates of low birthweight.

Regression estimates confirm that year-of-arrival effects are large and highly significant. The risk of low birthweight increases by 1.1% per year controlling for duration of residence in the U.S. in single years. In order to adjust for cohort effects in graphical analyses of effects of duration on low birthweight, we also estimated regressions using the aggregated data and found that the percentage point increase in low birthweight, controlling for duration, was .0986. That is, low birthweight among U.S.-born children of immigrants increased by approximately 1 percentage point every 10 years during the latter half of the 20th and first decade of the 21st century.

The increased risk of low birthweight with later arrival to the U.S. is reduced by half, but is still highly significant, when maternal age at the time of the birth is restricted to ages 20–34 (as discussed earlier, age effects on low birthweight are small-to-nonexistent in this range). The relative risk of low birthweight increases by .6% per year and the aggregate level Ordinary Least Squares coefficient is 0.0576, meaning that the percent low birthweight increases by just over a half percentage point every 10 years net of duration effects (see Figure 4).

Figure 5 presents rates of low birthweight in the U.S. from 1950 through 2009, compiled from U.S. natality statistics. This figure makes clear that there are no substantial period effects in LBW during the observation period.

Effects of duration in U.S.

To estimate the effect of duration of residence on low birthweight net of cohort effects, we adjust duration differences using the aggregate level OLS regression coefficient standardized to the 1990 level. The adjusted proportions are plotted in Figures 6 and 7, for the entire sample and for the subsample of women who were 20–34 years old when the child was born, respectively. The association between duration of residence and low birthweight is curvilinear. For the entire sample, rates of low birthweight appear to decrease over the first 6–10 years in the U.S. and increase thereafter. The risk of low birthweight very soon after arrival is similar to that after 16 years in the U.S. Among the age-restricted group, rates decrease for the first 11–15 years and subsequently increase.

The U-shaped association between duration and low birthweight is consistent with findings from an earlier study using the ECLS–B, ECLS–K, and Fragile Families datasets that did not adjust for cohort effects (see Teitler, Hutto, & Reichman 2012). However, the failure to adjust for cohort effects in the NHIS results in monotonically decreasing rates of low birthweight across duration categories for the full sample, and only a very slight uptick for the age-restricted sample (results not shown). The fact that, regardless of specification and across 4 different nationally representative datasets, there is evidence of improvements in birth outcomes, at least over the initial years in the U.S., runs counter to much of the immigrant health literature, which posits declines in health over time.

Region of origin

Sufficient sample sizes existed for analyses of 3 subgroups: Hispanic mothers born in Mexico, Central, and South America; mothers born in Mexico; and mothers born in Asia (including East Asians, Southeast Asians, and immigrants from the Indian sub-continent). The increasing rate of low birthweight among immigrant cohorts over time is apparent for Asians (relative risk = 1.007) but not Hispanics (RR = 1.002) or Mexicans (RR= .994). Of the three subgroups, the curvilinear pattern of cohort-adjusted duration effects observed in the overall sample holds only for Asians. There is no clear pattern in low birthweight by duration for all Hispanic immigrant mothers and there is a monotonic decline among mothers born in Mexico (Figures 8-10).

Maternal age at arrival

Based on the age-of-arrival literature discussed earlier, we speculated that the U-shaped association between duration in the U.S. and birthweight reflects two different phenomena – a positive effect of duration on health among immigrants who came to the U.S. as adults, and a negative effect of duration on health among immigrants who came as children. To test this hypothesis, we conducted stratified analyses by age at arrival. It turns out that the data do not support our hypothesis (Figures 11 and 12). The curvilinear association is apparent for both groups, though somewhat less pronounced than in the full sample for mothers who arrived as children, and even less pronounced among immigrants who arrived as adults.

Discussion

The deteriorating health across successive immigrant cohorts is consistent with available data on educational attainment across cohorts. It strongly appears that over time, immigrants have been arriving in the U.S. with decreasing levels of human capital. However, important regional variations exist. Deteriorating birth outcomes are observed for Asian immigrants but

much less so for Hispanic immigrants and not at all for Mexican immigrants, who, if anything, have been arriving healthier over time. The overall pattern with dramatic between-group differences suggest that studies of immigrant health need to be cognizant of and adjust for changes in the profile of immigrants over time and also that disaggregation across groups is important. Failure to do both of these things can produce seriously erroneous results.

The observed curvilinear effects of duration of U.S. residence are consistent with some recent studies but not with the dominant acculturation paradigm, which more often than not assumes monotonic deterioration of health with time residing in the U.S. The finding that among Mexican immigrants—the group that has perhaps been the most studied—there actually appear to be improvements in birth outcomes with duration in the U.S. when taking a proper look at good data, is of particular note.

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Figure 1—Proportion of Legal Immigrants to U.S. by Region of Origin and Year of Arrival

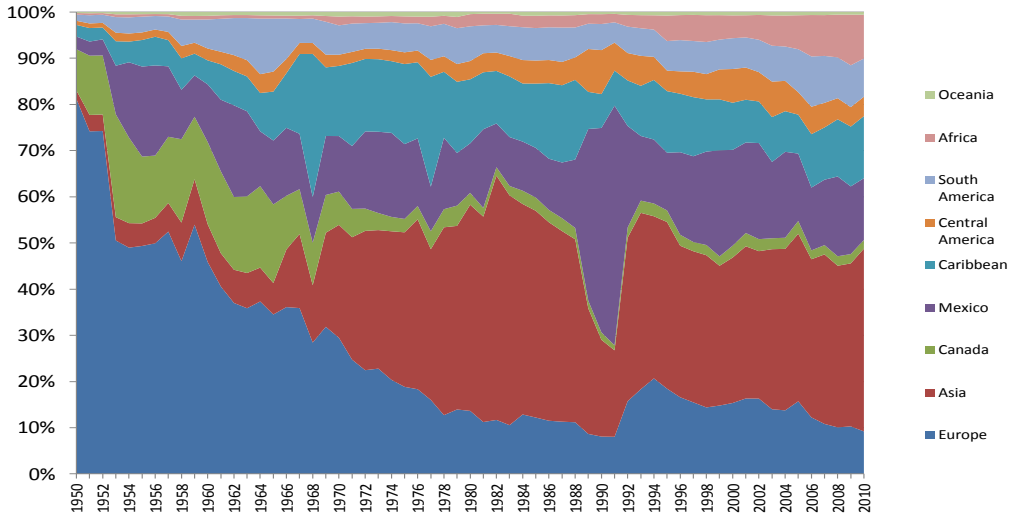
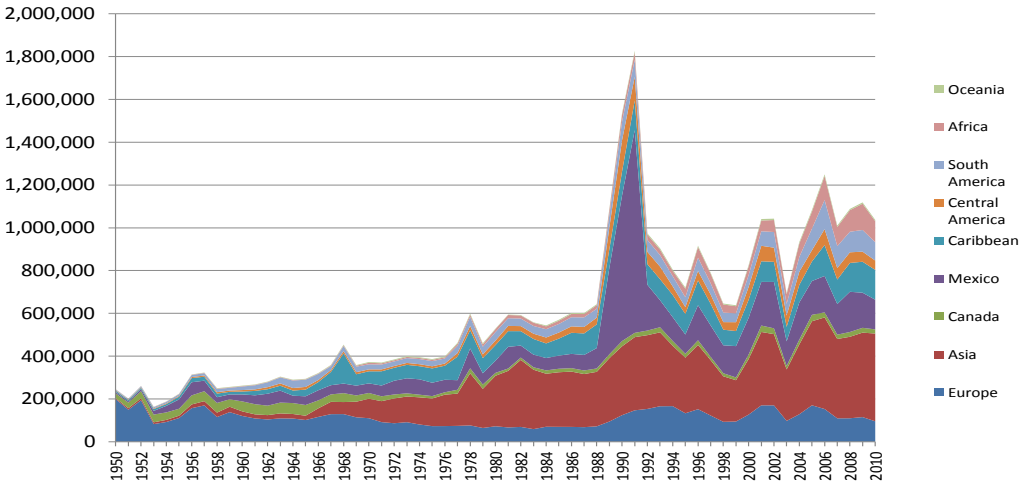


Figure 2: Legal Immigrant Inflows to the U.S. By Region of Origin and Year of Arrival



Sources for Figures 1 and 2: Various U.S. government reports.

Figure 3—Low Birthweight by Immigrant Cohort
Within Duration Intervals
All Immigrant Mothers

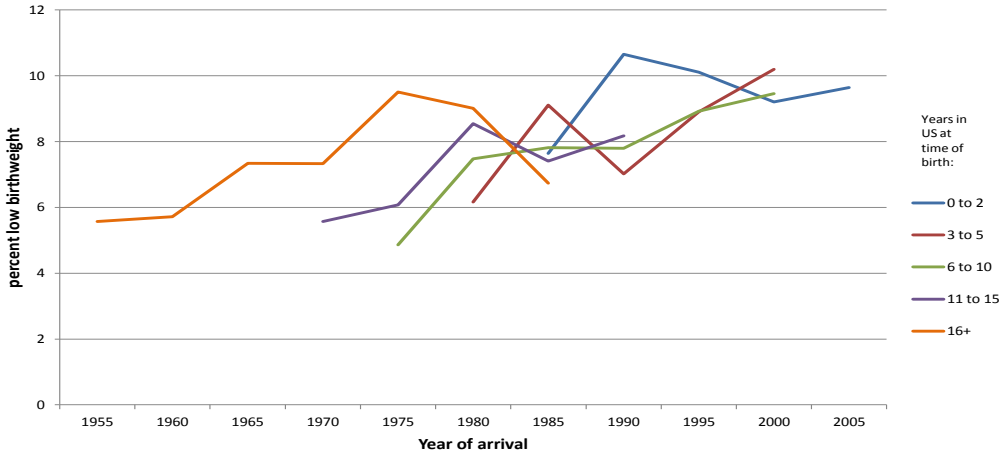


Figure 4—Rates of Low Birthweight by Immigrant Cohort
Within Duration Intervals
Immigrant Mothers Age 20-34

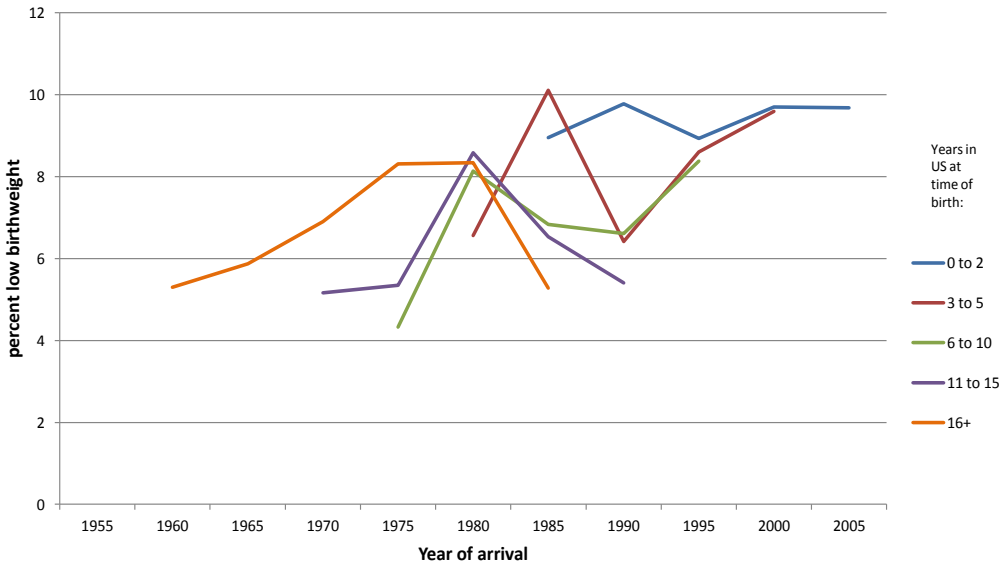


Figure 5--% Low Birthweight in the U.S.
1950-2009

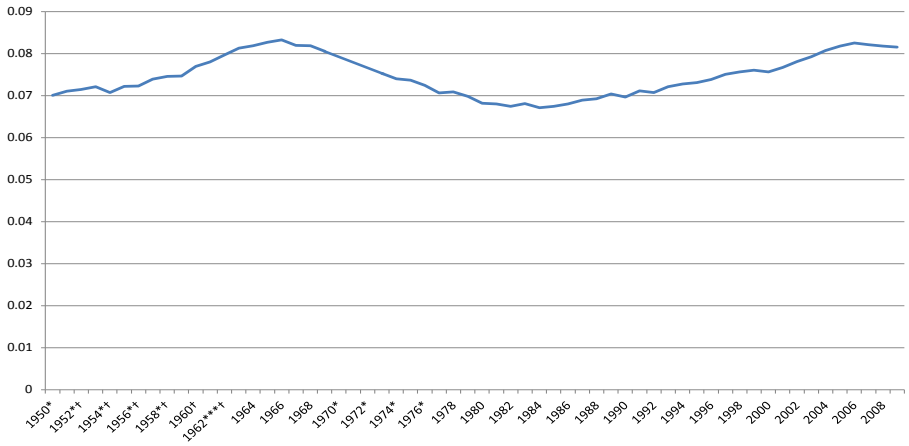
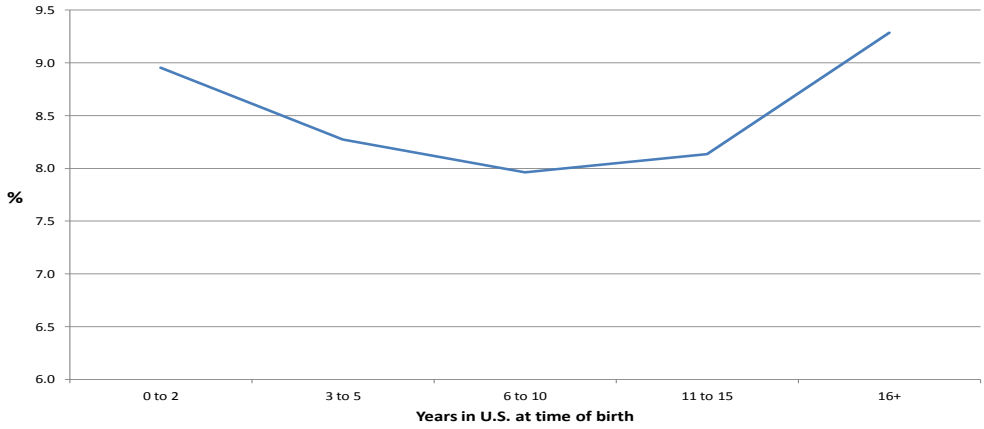


Figure 6--% Low Birthweight by Duration
of U.S. Residence
All Immigrant Mothers



Source for Figure 5: U.S. natality files

Figure 7--% Low Birthweight by Duration of U.S. Residence
Immigrant Mothers Age 20-34 when Child was Born

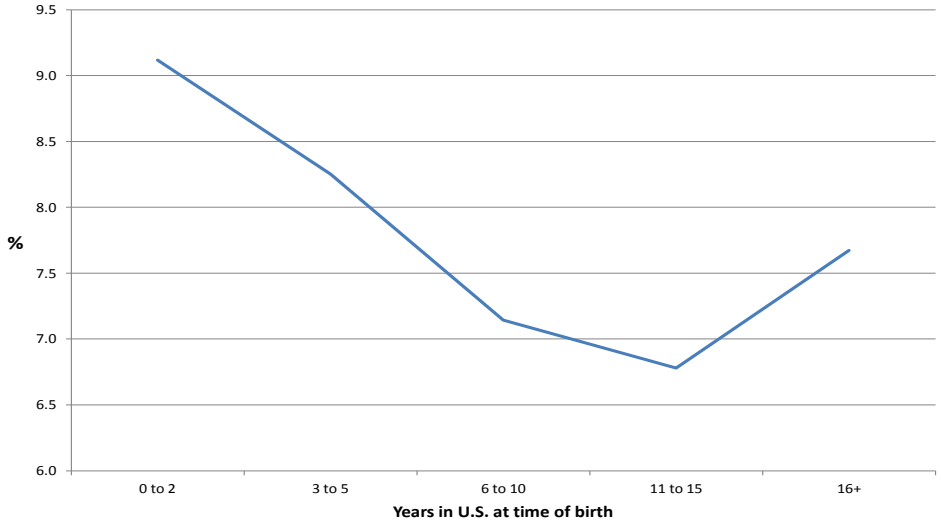


Figure 8--% Low Birthweight by Duration of U.S. Residence
Hispanic Immigrant Mothers

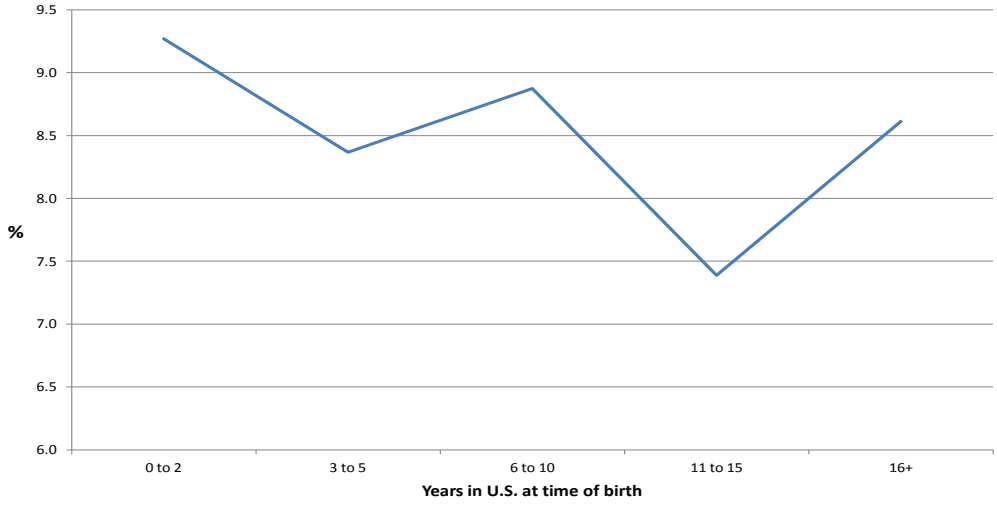


Figure 9--% Low Birthweight by Duration of U.S. Residence
Mothers Born in Mexico

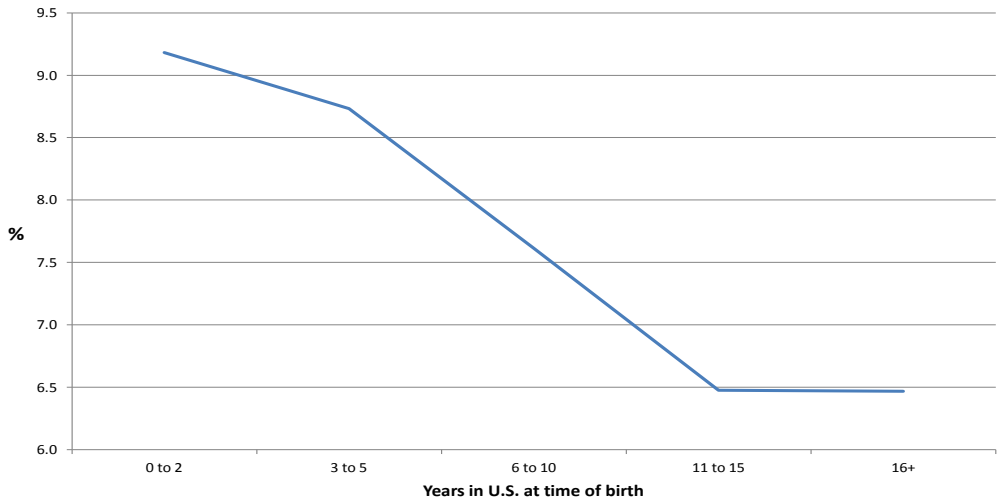


Figure 10--% Low Birthweight by Duration of U.S. Residence
Mothers Born in Asia

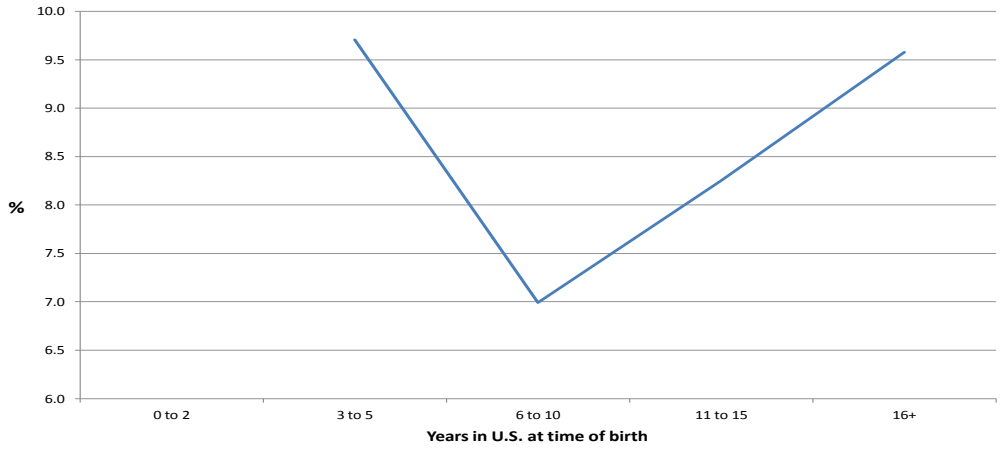


Figure 11--% Low Birthweight by Duration of U.S. Residence
Immigrants Who Arrived as Adults

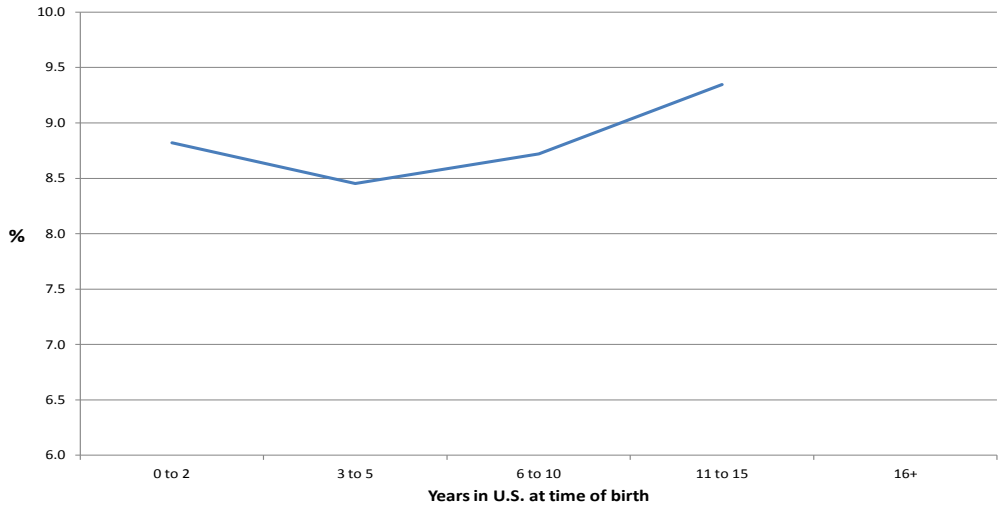


Figure 12--% Low Birthweight by Duration of U.S. Residence
Immigrants Who Arrived as Minors