Immigration and improvements in American life expectancy☆

Arun S. Hendi [a,*], Jessica Y. Ho [b]

[a] *Princeton University, United States*
[b] *University of Southern California, United States*

A B S T R A C T

Despite the immigrant mortality advantage and the increasing share of the population born abroad, relatively little is known about how immigration has impacted trends in US life expectancy. How immigrants contribute to national life expectancy trends is of increasing interest, particularly in the context of an unprecedented stagnation in American mortality. We find that immigration increases US life expectancy by 1.5 years for men and 1.4 years for women. Over half of these contributions occur at the prime working ages of 25–64. The difference between foreign-born and US-born mortality has grown substantially since 1990, with the ratio of US-born to foreign-born mortality rates nearly doubling by 2017. In that year, foreign-born life expectancy reached 81.4 and 85.7 years for men and women, respectively—7.0 and 6.2 years higher than their US-origin counterparts. These life expectancy levels are remarkable by most standards. Foreign-born male life expectancy exceeds that of Swiss men, the world leaders in male life expectancy. Life expectancy for foreign-born women is close to that of Japanese women, the world leaders in female life expectancy. The widening mortality difference between the US-born and foreign-born populations, coupled with an increase in the share of the population born abroad, has been responsible for much of the increase in national life expectancy in recent years. Between 2007 and 2017, foreign-born men and women were responsible for 44% and 60% of national life expectancy improvements. Between 2010 and 2017, immigrants experienced gains while the US-born experienced declines in life expectancy. Thus, nearly all of the post-2010 mortality stagnation is due to adverse trends among the US-born. Without immigrants and their children, national life expectancy in 2017 would be reduced to its 2003 levels. These findings demonstrate that immigration acts to bolster American life expectancy, with particularly valuable contributions at the prime working ages.

1. Introduction

Immigrants have long been viewed as problematic for their host countries. In the United States, for example, anti-immigrant sentiment was widespread even prior to the American Revolution, with many of the country's founding fathers expressing trepidation over the slow linguistic assimilation, foreign cultural practices, and swarthy complexions of continental and Nordic European immigrants (Franklin, 1751 (1970); Hamilton, 1802; Jefferson, 1854). By the late 19th century, these worries gave way to a new concern: the fear that immigrants were unhealthy and would bring disease, infirmity, and squalor to America (Kraut, 1995; Markel & Stern, 2002). This concern from over one century ago about what immigrants mean for America's vitality persists today in the national political discourse, narratives in the news

media, and everyday life. American immigrants are either blamed for or associated with infectious disease outbreaks, drug abuse, violent crime, and several other conditions linked to poor health and high mortality (Beirich, 2010; Bejarano, 2020; Santana, 2014). Since many of America's immigrants come from lower-income, less-developed nations, the concern is that these immigrants bring their home countries' high-mortality conditions with them and thus drag down America's national average longevity.

This narrative, however, is at odds with the evidence. A large body of literature reaching back over three decades has documented the substantial health advantage enjoyed by immigrants over their native-born counterparts. In the United States, this is manifested in immigrants' lower rates of heart and circulatory disease, respiratory illness, disability, cigarette smoking, and adult mortality (Blue & Fenelon, 2011;

Cunningham et al., 2008; Dupre et al., 2012; Elo et al., 2011; Guillot et al., 2018; Hallowell et al., 2019; Hendi et al., 2015; Huang et al., 2011; Mehta et al., 2016; Riosmena et al., 2017; Singh & Hiatt, 2006). Several studies have demonstrated that Hispanic and Asian ethnic groups tend to have mortality rates lower than or comparable to those of non-Hispanic whites (Elo & Preston, 1997; Lauderdale & Kestenbaum, 2002; Markides & Coreil, 1986; Markides & Eschbach, 2005; Singh & Miller, 2004; Singh & Siahpush, 2002). This mortality advantage is particularly pronounced among the foreign-born. Using linked Social Security Administration and Medicare records, one recent study showed that among people aged 65 in the 2000s, the foreign-born were expected to live 2.4 years longer than their US-born counterparts (Mehta et al., 2016).

Less is known about how immigration has contributed to national life expectancy trends, especially in the most recent period. The question of how immigrants are contributing to trends in American longevity is particularly relevant at this moment, given two contemporary social problems that emerged in the last decade: rising concern over immigration coupled with an increased appetite for immigration reform, and a sudden stagnation in US life expectancy that culminated in three consecutive year-over-year declines in longevity (Arias & Xu, 2019). While the prevailing trend for over a century has been for countries, including the US, to experience rapid improvements in life expectancy, America has deviated from this pattern in recent years (Ho & Hendi, 2018). US life expectancy barely changed between 2010 and 2014 and actually declined between 2014 and 2017. These trends have been linked to rising drug overdose mortality as well as diminishing rates of improvement in cardiovascular disease mortality (Ho, 2019; Mehta et al., 2020). Given the expectation of a mortality advantage among immigrants, it is possible that immigration is acting as a bulwark against further declines in life expectancy during this challenging period. Even prior to these recent mortality upticks, we might expect the contribution of immigration to life expectancy to have risen over time, since the number of immigrants in the country has grown and the selectivity of immigrants may also have increased.

In this study, we present estimates of life expectancy levels among the foreign-born, US-born, and total populations, and assess the contribution of immigration to improvements in national US life expectancy between 1990 and 2017. This paper makes three main contributions. First, we provide new, updated estimates of U.S. life expectancy by nativity for the post-2010 period. Second, we show that immigration has had a surprisingly large impact on life expectancy trends since 1990 and especially in the decade between 2007 and 2017. Immigrants are responsible for approximately half of recent gains in U.S. life expectancy. Our third contribution is to document a previously unidentified divergence in life expectancy between the US-born and foreign-born populations. The foreign-born life expectancy advantage has increased substantially since 1990, and foreign-born life expectancy is now close to or exceeds the life expectancies of the world leaders in life expectancy, Swiss men and Japanese women.

In the sections that follow, we use data from the National Vital Statistics System and the U.S. Census Bureau to construct age-specific mortality and life expectancy estimates between 1990 and 2017. The estimates presented correspond to four key populations: the total U.S. population, the foreign-born, the US-born, and the US-origin, the latter of which consists of US-born individuals with US-born parents (i.e., the "3rd + generation"). We use the term "second generation" to refer to US-born individuals with at least one foreign-born parent.

2. Data and methods

2.1. Data

To estimate the contribution of immigration to trends in US life expectancy, we use mortality records from the National Center for Health Statistics (NCHS). These data cover all recorded deaths occurring among people residing in the US for each year between 1990 and 2017. We tabulate the number of deaths by year and the age, sex, and nativity of decedents. We construct population counts by age, sex, and nativity for 1990, 2000, and 2006–2017 using data from the 1990 and 2000 US Censuses and the 1-year 2006–2017 American Community Survey (ACS) files, which are the largest available national samples representative of the entire resident US population. Together, these two types of data are used to produce age-sex-nativity-specific death rates for 1990, 2000, and each year in 2006–2017. In addition, we use data from the Current Population Survey (CPS) on parents' nativity to estimate the proportion of US-born individuals with foreign-born parents (the "second generation") in each age-sex group for 2000 and each year in 2006–2017. The analyses focus on four main populations: the total, the foreign-born (FB), the US-born (USB), and the US-origin population (USO), the latter of which includes only US-born individuals with US-born parents (the "3rd + generation"). The US-origin group is thus a subset of the US-born. We restrict our estimates to 1990, 2000, 2006, 2007, and each year in 2010–2017 since nativity-specific mortality data from Georgia for 2008 and 2009 were of insufficient quality to allow for production of reliable national estimates. All estimates from the 1990 and 2000 Censuses, ACS, and CPS are computed using the appropriate population weights supplied for the surveys.

The NCHS data used in this study are well-suited for analysis of foreign-born mortality and its contribution to overall life expectancy trends. The data cover 100% of the resident US population, allow for analysis of recent time periods, and include high-quality information on age, sex, and nativity. In other words, the NCHS and Census data constitute very high-quality data with the largest possible sample size available for the study of immigrant mortality. While other data are available for computing death rates among the foreign-born, they are subject to limitations. Social Security and Medicare data are of excellent quality but cover only the benefits-eligible population, which would exclude undocumented migrants and certain people with no work history. They also do not allow for computation of death rates at younger adult ages (typically below 65).

Survey data such as the National Health Interview Survey or the National Longitudinal Mortality Study are another potential source of data on immigrant mortality. While these studies include a large number of covariates that can be used to study the determinants of mortality, they offer a significantly smaller sample size and exclude the institutionalized and non-civilian populations. They may be subject to salmon bias. They also rely on linkages to the National Death Index that may not be as reliable as vital statistics data alone. The NCHS and Census data are not without their own limitations. Since the numerators and denominators of the death rates come from two separate sources, a misclassification error for nativity may bias death rate estimates by nativity. However, prior studies have shown that reporting on the place of birth on US death certificates matches at a rate of approximately 99.4% with prior survey-based self-reports of place of birth (Sorlie et al., 1992). This suggests a high degree of validity of nativity in the death certificate tabulations and thus a high degree of accuracy for nativity-specific death rates computed using vital statistics and Census data. Age misreporting is always a concern with any data source, including both vital statistics and survey-based estimates. We compute ancillary estimates that use stable population models to adjust for potential age misreporting at the older ages. These estimates suggest that our death rates are not greatly affected by age misreporting.

2.2. Analytic strategy

We use the following age groups: 1–4, 5–9, 10–14, …, 85–89, and 90+ years. Using standard life table methods and graduation to calculate $_na_x$ values, we compute life expectancy at age 1 by sex and year for the US-born, US-origin, foreign-born, and total populations (Preston et al., 2001). Life expectancy at age 1 (e_1) is the number of additional years a one-year-old can expect to live if he or she is subject to the period

mortality conditions for the remainder of their lives (see Supplementary Appendix for more details). For the remainder of the paper, we use e_1 interchangeably with life expectancy. We focus on the e_1 measure as opposed to life expectancy at birth because the latter is not a sensible measure for the foreign-born population. Since most infant deaths occur within 2 days of birth, recording a foreign-born infant death would typically require the child to be born outside the US, almost immediately immigrate to the US and then die, which is an extraordinarily unlikely scenario.

We use the e_1 values to compute the contribution of immigration to national life expectancy. The direct contribution of immigrants is computed as the difference between observed national life expectancy and the life expectancy of the US-born population.

$$\text{Effect of Immigrants} = e_1 - e_1^{USB}$$

In addition, since the second generation has lower mortality than the US-origin population, we also compute a measure of the contribution of

immigrants and their children, which equals the difference between observed national life expectancy and the life expectancy of the US-origin population.

$$\text{Effect of Immigrants and their Children} = e_1 - e_1^{USO}$$

We use Arriaga's decomposition of differences in life expectancy to ascertain the number of years each age group adds to the immigrant contribution to life expectancy (Arriaga, 1984).

3. Results

An initial examination of mortality schedules shows that immigrants have substantially lower mortality than the US-born population. Fig. 1 plots the ratio of US-born to foreign-born mortality rates as a function of age for each year in the analysis. The yellow line corresponds to the year 1990, the blue line to 2017, and the gray lines to the intervening years. At nearly all adult ages, immigrant mortality is lower than US-born
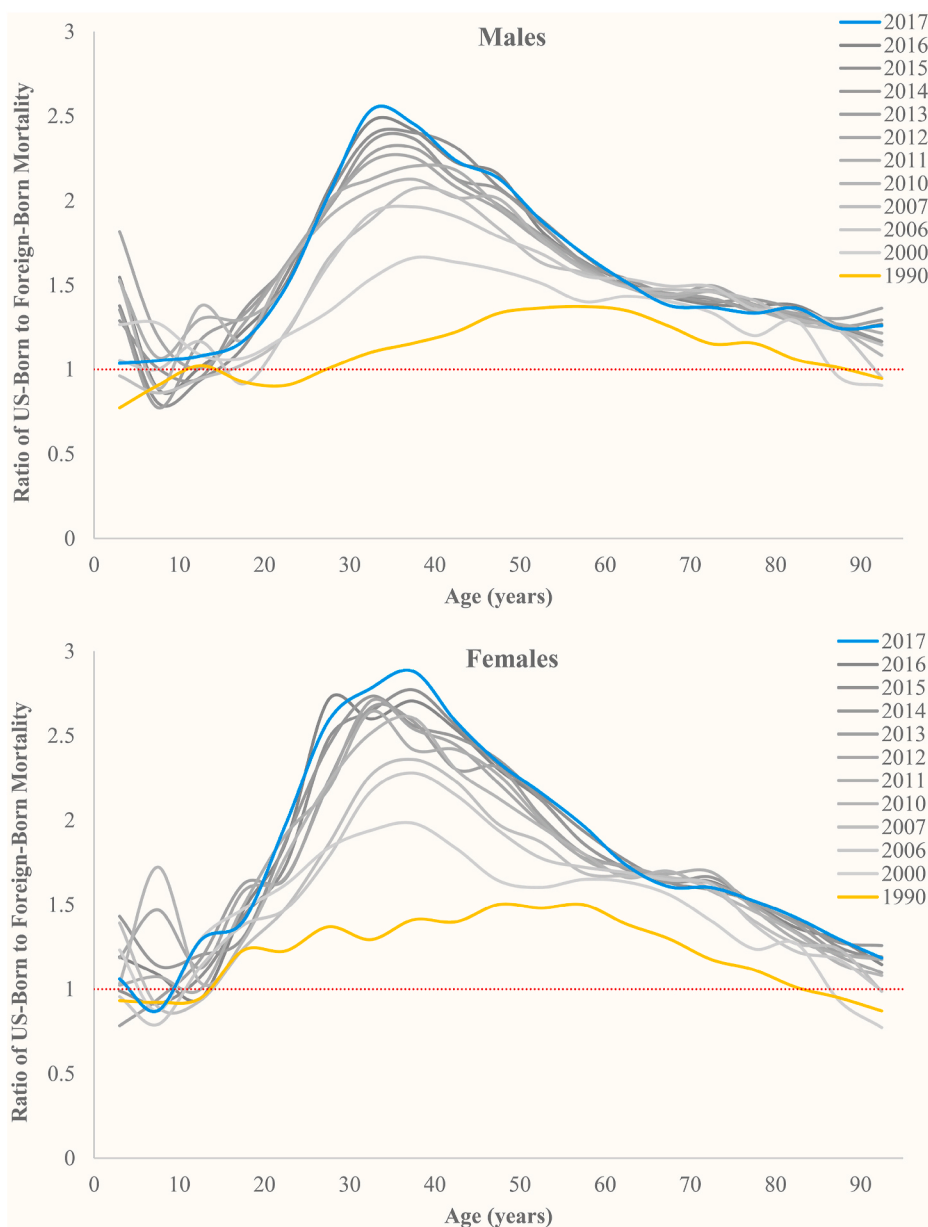

Fig. 1. Ratio of age-specific mortality rates of US-born to foreign-born population, 1990–2017. The dotted line at y = 1.0 indicates equality between US-born and foreign-born mortality.
Source: Authors' calculations based on NCHS, Census, and ACS data.

mortality. This difference is particularly pronounced at the prime adult ages of 25–64. In 1990, the ratio peaked at ages 55–59 for men, where natives had mortality rates that were 37% higher than their foreign-born peers. For women, the peak occurred at ages 45–49, where natives had 50% higher mortality than immigrants. While the immigrant advantage was already present in 1990, the difference between immigrants and the US-born has widened substantially over time. The mortality ratios have tended to shift significantly upwards in each subsequent period, and the 2017 ratios are far above their 1990 levels. For example, in 2017, the ratios peaked at 2.53 for men aged 30–34 and 2.88 for women aged 35–39. The corresponding ratios for those ages in 1990 were 1.10 and 1.41, respectively. While the upward shift in these curves is highly unusual and surprising, what is even more striking is that in 2017, the United States supported two such vastly different mortality schedules.

These relative differences in mortality translate into large absolute differences in life expectancy. Fig. 2 plots life expectancy for foreign-born and US-born men and women between 1990 and 2017. In 1990, US-born and foreign-born men had life expectancies of 71.3 and 75.3 years, respectively. US-born and foreign-born women had life expectancies of 78.3 and 81.3 years, respectively. Both immigrants and the US-born experienced improvements in longevity, albeit at a faster rate for the foreign-born. By 2017, life expectancy for US-born and foreign-born men reached 74.9 and 81.4 years, respectively. It was 80.0 and 85.7 years for US-born and foreign-born women. The life expectancy differential between the foreign-born and US-born increased from 3.0 to 5.7 years for women and from 4.0 to 6.5 years for men between 1990 and 2017. The gaps in the most recent years are substantial—they exceed the magnitude of the black-white life expectancy gap in the US and the gap in life expectancy between the US and nearly all other high-income countries (Arias & Xu, 2019; Harper et al., 2012; Ho, 2013).

The substantially lower mortality rates of immigrants relative to natives indicate the potential for immigration to bolster levels of and trends in national life expectancy. Table 1 documents life expectancy levels for the foreign-born, US-born, and total populations. We interpret the difference between total and US-born life expectancy as the contribution of immigrants to national life expectancy levels. In 1990, immigrant men contributed 0.32 years and immigrant women 0.26 years to national life expectancy. The contribution of immigrants increased monotonically over time, so that by 2017, foreign-born men and women contributed 0.94 years and 0.83 years, respectively, to national life

expectancy. Thus, there was an approximately threefold increase in the contribution of immigrants to life expectancy. We are particularly interested in whether immigrants contributed to changes over time in national life expectancy given the recent stagnation in US life expectancy. Between 1990 and 2017, immigrants were directly responsible for 15% of the life expectancy gain for men (0.61 years of the 4.22-year gain) and 25% of the life expectancy gain for women (0.58 years of the 2.31-year gain).

Age is an important dimension of contributions to life expectancy. While reductions in mortality at any age contribute to life expectancy gains, mortality reductions at the prime adult ages (25–64) are particularly helpful since those are the ages where individuals contribute most to labor market productivity, tax revenues, population growth through childbearing, and innovation (National Research Council, 2012). Fig. 3 shows that the bolstering effect of immigrants on life expectancy is concentrated at ages 25–64. This pattern holds for both men and women, for the years 1990 and 2017, and for the change over time between those periods. Immigrants increase US life expectancy primarily by reducing overall mortality at the prime adult or working ages. This is particularly relevant today because those are precisely the ages where the country is losing years of life due to drug overdose mortality and related causes of death.

In addition to its direct effects on US mortality, immigration has indirect effects on life expectancy. Like their parents, the US-born children of immigrants tend to be healthier and have lower mortality than their US-origin peers (Hendi et al., 2015; Jasso et al., 2004). While the second-generation mortality advantage is more muted than the foreign-born advantage, its existence suggests that immigration influences national life expectancy through the impact of both immigrants and their children. Table 1 shows "low variant" and "high variant" estimates of life expectancy for the US-origin population in 2000–2017. US-origin life expectancy in 2000 ranged from 72.61 to 73.15 years for men and 77.89–78.42 years for women, four to five years lower than life expectancy for foreign-born men and women. By 2017, foreign-born men and women lived approximately seven and six years longer than US-origin men and women, respectively. These gaps have widened because the foreign-born, who were already far ahead of the US-origin, experienced tremendous improvements in life expectancy (on the order of 3.66–3.76 years), while the US-origin population experienced only minor improvements (on the order of 1.21–1.79 years).
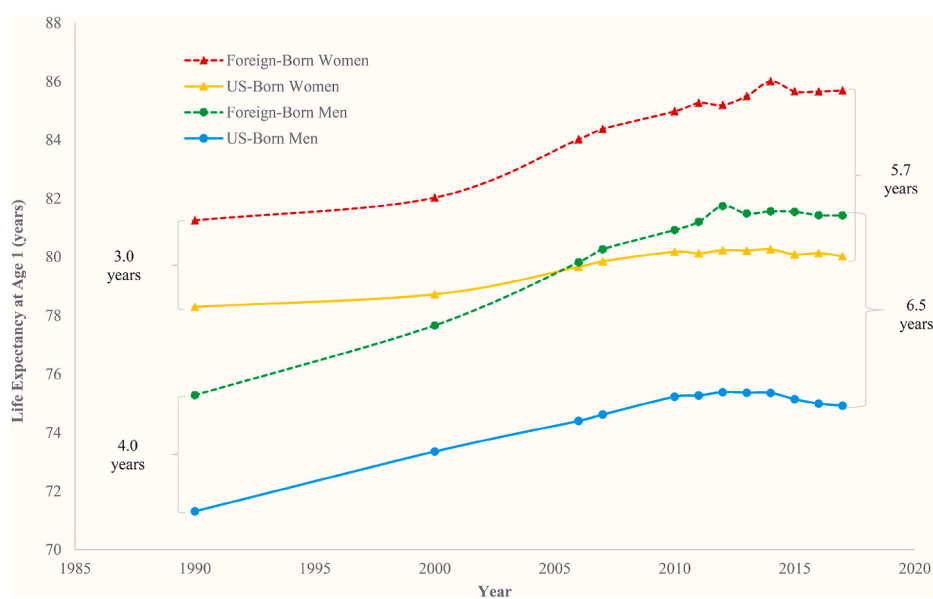

Fig. 2. Life expectancy at age 1 by sex and nativity, 1990–2017. The gaps between the foreign-born and US-born life expectancies in 1990 and 2017 are indicated by brackets, with gap values adjacent to the brackets.
Source: Authors' calculations based on NCHS, Census, and ACS data.

Table 1

Contribution of immigration to life expectancy trends, 1990–2017. FB=Foreign-Born, USB̿=US-Born, US-Origin = US-Born with US-Born parents, 2nd Generation = US-Born with Foreign-Born parents. Low and High Variants are scenarios where the US-Origin population has a relatively low or high life expectancy pattern. Rate of change is the average rate of life expectancy change per decade. All estimates correspond to life expectancy at age 1.

Men	Life Expectancy					Contribution to National Life Expectancy		
Year	FB	USB	US-Origin		Total	FB	FB+2nd Generation	
			Low Variant	High Variant			Low Variant	High Variant
1990	75.28	71.31	–	–	71.63	0.32	–	–
2000	77.66	73.35	72.61	73.15	73.81	0.46	1.20	0.65
2006	79.82	74.40	73.73	74.14	75.07	0.67	1.35	0.94
2007	80.26	74.61	73.96	74.40	75.31	0.70	1.36	0.91
2010	80.92	75.22	74.68	75.03	75.96	0.74	1.28	0.93
2011	81.20	75.26	74.80	75.03	76.03	0.77	1.23	1.00
2012	81.74	75.38	74.94	75.14	76.19	0.81	1.25	1.04
2013	81.48	75.36	74.94	75.11	76.17	0.81	1.23	1.06
2014	81.56	75.35	74.88	75.10	76.20	0.85	1.31	1.10
2015	81.54	75.14	74.68	74.84	76.03	0.89	1.35	1.19
2016	81.43	74.99	74.52	74.74	75.91	0.92	1.39	1.17
2017	81.42	74.91	74.40	74.63	75.85	0.94	1.45	1.22
Δ1990–2017	6.14	3.61	1.79[a]	1.48[a]	4.22	0.61	0.25[a]	0.56[a]
Rate of Change	2.27	1.34	1.05[a]	0.87[a]	1.56			

Women	Life Expectancy					Contribution to National Life Expectancy		
Year	FB	USB	US-Origin		Total	FB	FB+2nd Generation	
			Low Variant	High Variant			Low Variant	High Variant
1990	81.25	78.29	–	–	78.55	0.26	–	–
2000	82.03	78.72	77.89	78.42	79.09	0.37	1.20	0.67
2006	84.02	79.66	78.97	79.30	80.21	0.55	1.25	0.91
2007	84.38	79.85	79.16	79.48	80.42	0.57	1.26	0.94
2010	84.97	80.18	79.53	79.86	80.81	0.64	1.28	0.95
2011	85.26	80.12	79.58	79.84	80.80	0.68	1.22	0.96
2012	85.19	80.23	79.76	79.97	80.91	0.68	1.15	0.94
2013	85.50	80.22	79.74	79.90	80.94	0.72	1.19	1.03
2014	86.01	80.26	79.79	79.99	81.03	0.77	1.24	1.05
2015	85.66	80.08	79.59	79.76	80.87	0.79	1.29	1.11
2016	85.66	80.13	79.60	79.79	80.93	0.80	1.33	1.14
2017	85.69	80.02	79.51	79.63	80.86	0.83	1.35	1.23
Δ1990–2017	4.44	1.73	1.61[a]	1.21[a]	2.31	0.58	0.15[a]	0.56[a]
Rate of Change	1.64	0.64	0.95[a]	0.71[a]	0.86			

[a] These values indicate change since 2000 instead of 1990.
Source: Authors' calculations based on NCHS mortality data, the 1990 and 2000 US Censuses, and the 2006–2017 ACS and CPS data.

The gap in life expectancy between the total US population and the US-origin population is a measure of the contribution of immigrants and their children (i.e., both the first and second generation) to national life expectancy. Because of the second-generation population, the contribution of immigrants and their children exceeds the contribution of the foreign-born alone (Table 1). In 2000, immigrants and their children contributed 0.65–1.20 years to national life expectancy for men and 0.67–1.20 years for women. As the second-generation population grew in size, so did their contribution to national life expectancy levels. By 2017, immigrants and their children contributed 1.22–1.45 years to national life expectancy for men and 1.23–1.35 years for women. Between 2000 and 2017, immigrants and their children were responsible for up to 28% and 32% of the gains in national life expectancy for men and women, respectively.

4. Discussion

Immigration is clearly responsible for a large portion of American life expectancy gains over the last three decades. This is particularly evident in the most recent years when the US experienced a slowdown in the pace of life expectancy improvements (Arias & Xu, 2019; Elo et al., 2019; Ho & Hendi, 2018; Murphy et al., 2018). In the decade between 2007 and 2017, US life expectancy increased by 0.54 years for men and 0.44 years for women. Foreign-born men and women were responsible for 44% and 60% of those gains, respectively. Even as immigrants were

subject to the same deleterious, mortality-increasing social forces, like the drug overdose epidemic, as the US-born population, they continued to boost American life expectancy. Between 2010 and 2017, immigrants posted gains of 0.50 years for men and 0.72 years for women. Over that same period, the US-born experienced *declines* in life expectancy on the order of 0.31 years for men and 0.16 years for women. Our findings thus establish that the post-2010 life expectancy stagnation observed in the United States (Arias & Xu, 2019; Ho & Hendi, 2018) is almost entirely a result of adverse mortality trends in the US-born population. Had it not been for the foreign-born, this stagnation would have instead been a steep decline.

If American immigrants were a country, they would be among the world leaders in longevity. Foreign-born men in 2017 had a higher life expectancy at age 1 (81.42 years) than men in Switzerland (80.69 years), the current world leaders in male life expectancy. Their 0.73-year advantage over the Swiss is large by most standards, and particularly impressive given that there are approximately 23 million foreign-born men in the US, more than five times the total male population of Switzerland. Foreign-born women in 2014 had a higher life expectancy at age 1 (86.01 years) than Japanese women (85.98 years), the world leaders in female life expectancy. The population of foreign-born women in the US is also sizeable, exceeding 24 million. In fact, the US foreign-born population is larger than the total populations of all but 29 countries in the world. It is comparable to the total population of Spain and is larger by far than Canada or Australia (University of California Berkeley
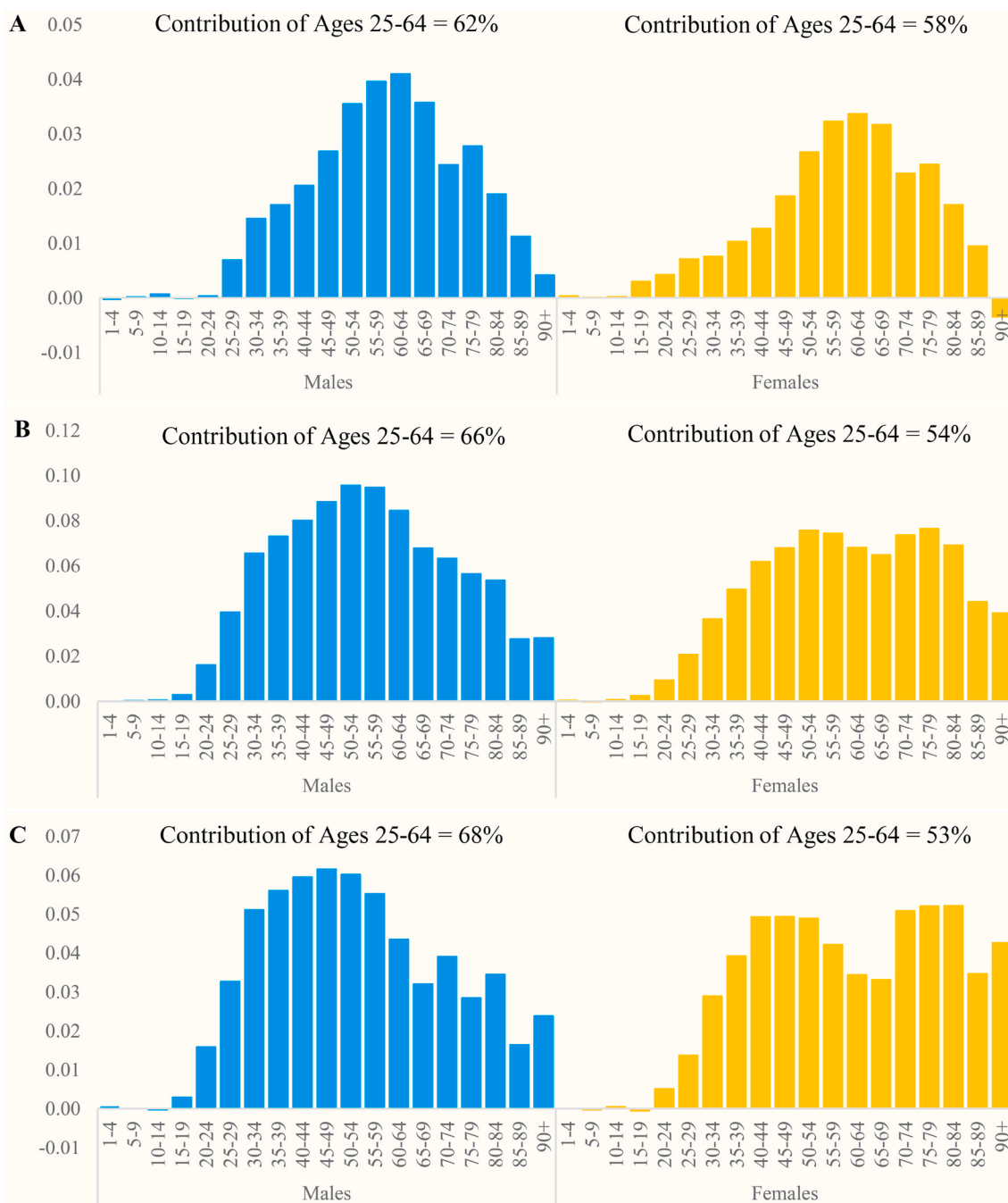
Fig. 3. Age decompositions of the immigrant contribution to life expectancy at age 1, males and females, 1990–2017. The three panels correspond to the immigrant contribution to (**A**) life expectancy at age 1 in 1990, (**B**) life expectancy at age 1 in 2017, and (**C**) the gain in life expectancy at age 1 between 1990 and 2017. Each decomposition sums across ages to the total immigrant contribution to these three measures. The y-axis is given in years and the x-axis shows the age groups in years. In each decomposition, ages 25–64, the prime working ages, account for the majority of the immigrant contribution to life expectancy or changes in life expectancy.
Source: Authors' calculations based on NCHS, Census, and ACS data.

& Max Planck Institute for Demographic Research, 2021). These high life expectancies are even more remarkable when one considers that the immigrant population is far less educated, on average, than the US-born, and less-educated people tend to have lower life expectancy (Elo, 2009; Hendi, 2015, 2017; Hendi et al., 2021; Ho, 2017). In 2016, 51% of immigrants had at most a high school education, compared to only 37% of the US-born, and the proportion with a college or postgraduate degree was similar for the two groups (Krogstad & Radford, 2018).

One way to contextualize the impact of immigration on US life expectancy is to consider how the country would fare if it had not allowed any immigration over the last century. If immigrants and their children were removed from the population, US life expectancy in 2017 would be substantially lower, at 74.4 years for men and 79.5 years for women. In other words, if it were not for immigration, American life expectancy in 2017 would be knocked back to its 2003 levels. Male life expectancy would be roughly that of modern-day Tunisia or China and female life expectancy would approximate that of Ecuador or Vietnam (United Nations, 2019).

While it is well-known that immigrants tend to be healthier than their US-born counterparts, our finding that immigrants have life

expectancies that rival the world leaders is surprising. We thus subject our estimates to additional scrutiny. We compared our estimates of foreign-born life expectancy at age 65 in 2005 to prior published estimates based on high-quality social security data and find that they are highly similar (Mehta et al., 2016). Our trend estimates for the foreign-born are also comparable to trends in high-income countries like the Netherlands and Norway. In addition, we examined different summary measures of mortality to assess the sensitivity of our findings to the use of life expectancy. We find that our conclusions are supported by the data whether the summary measure is life expectancy, median age at death in the life table, or person-years lived between ages 0 and 90.

What is the explanation for the increasing contribution of the foreign-born to improvements in US life expectancy? While part of the trend surely has to do with the increasing representation of the foreign-born in the total population—the immigrant share of the population increased from 8.7% to 14.6% between 1990 and 2017—the increasing contribution of immigrants is also being driven by above-average rates of improvement in foreign-born life expectancy. One potential reason for these improvements is that the makeup of the foreign-born population has changed over the past three decades. Two of the main dimensions along which the immigrant population has changed are country of origin and age at migration.

Fig. 4 shows age-specific changes in the distribution of the foreign-born population across countries of origin. Immigrants from Mexico, who are by far the largest immigrant origin group, have declined as a share of the foreign-born population, decreasing from 28% in 2000 to 24% in 2017. At the younger ages (0–30 years), the Mexican share of the foreign-born is being replaced by immigrants from India, China, and Central America, as well as by smaller numbers of immigrants from many other countries. At the older ages, the Mexican and Indian shares of the foreign-born are replacing immigrants from Canada and Europe. While we know of no ethnic-specific estimates of life expectancy for Asian immigrants, Indian Americans and Chinese Americans on the whole have very high life expectancies (Baluran & Patterson, 2021). Indian and Chinese immigrants to the United States are known to have lower rates of disability and lower prevalences of smoking than Mexican immigrants (Huang et al., 2011; Riosmena et al., 2017). Immigrants from Central America and Mexico tend to have similar levels of disability and mortality (Huang et al., 2011; Palloni & Arias, 2004). Together, these suggest that the changing ethnic composition of the foreign-born population at the younger ages may be part of the explanation behind why immigrant life expectancy is improving at above-average rates. Fig. 3 shows that most of the contribution of immigrants to the improvement in US life expectancy prevails at the prime

adult ages of 25–64. An informed hypothesis would thus suggest that the shifting ethnic composition of the immigrant population, while a potentially important factor in driving mortality trends at the younger ages, plays a small role in the immigrant contribution to improvements in US life expectancy.

Another possible explanation for the growing immigrant contribution to American life expectancy improvements is related to potential changes in the age at migration. There is a strong negative relationship between health and immigrant duration in the United States. Thus, if the average duration of residence in the US declined over time for the foreign-born, we would expect this to contribute to an increase in both foreign-born and national life expectancy. Since the change in the average duration of residence among the foreign-born is confounded by the changing age distribution of the foreign-born (see Fig. 5), we examine changes in the mean age at migration for each single year of age at survey. An increase in the mean age at migration for any given age at survey would imply a decrease in the mean duration of residence. However, as shown in Fig. 5, the foreign-born experienced a decrease in the mean age at migration for nearly every age between 15 and 80. In other words, changes in the age pattern of migration do not seem to be primarily responsible for the immigrant contribution to American life expectancy improvements.

Another class of explanations includes changes in the selectivity of immigration and emigration. One specific explanation for the migrant mortality advantage identified in past research is salmon bias, which is the phenomenon wherein sick, older immigrants leave the US, often to seek care and comfort in their countries of origin, and die abroad. Because the salmon bias mechanism has sick people leaving the country and healthy people staying, an increase in the intensity of salmon bias can lead to the phenomena observed in this article. While it is difficult to measure salmon bias directly, one proxy measure is the rate of out-migration among immigrants at the older ages. We do not find a significant increase in rates of outmigration among older immigrants (aged 75+ years) between 2006-2010 and 2015–2019 (see Supplementary Appendix for more details). This suggests that short of a dramatic increase in the selectivity of outmigration, salmon bias is unlikely to be driving the immigrant contribution to life expectancy improvements. Another reason salmon bias is unlikely to explain much of the immigrant contribution to improvements in national life expectancy is that, while salmon bias removes the unhealthy immigrants and leaves behind the healthy, it also decreases the proportion of the population that is foreign-born. If the proportion foreign-born decreases, then immigrants have less scope for influencing national mortality rates.

One possibility is that the degree to which immigrants are positively
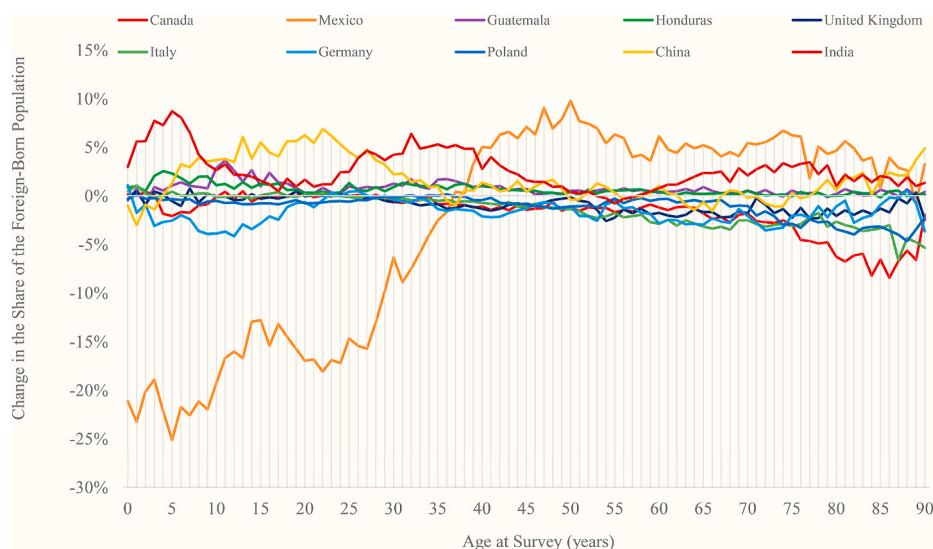

Fig. 4. Age-Specific Changes in the Country-of-Origin Distribution of the Foreign-Born Population, 2000–2017. Each line represents a particular sending country. For a given country, the value at a particular age represents the increase or decrease in the share of the foreign-born population at that age who come from the corresponding country. A value of zero indicates no proportionate change in that country's representation among the foreign-born. The ten countries represented in the figure are those that were responsible for changes in total proportionate representation that exceeded 0.5 percentage points between 2000 and 2017.
Source: Authors' calculations based on the 2000 US Census and 2017 ACS data.
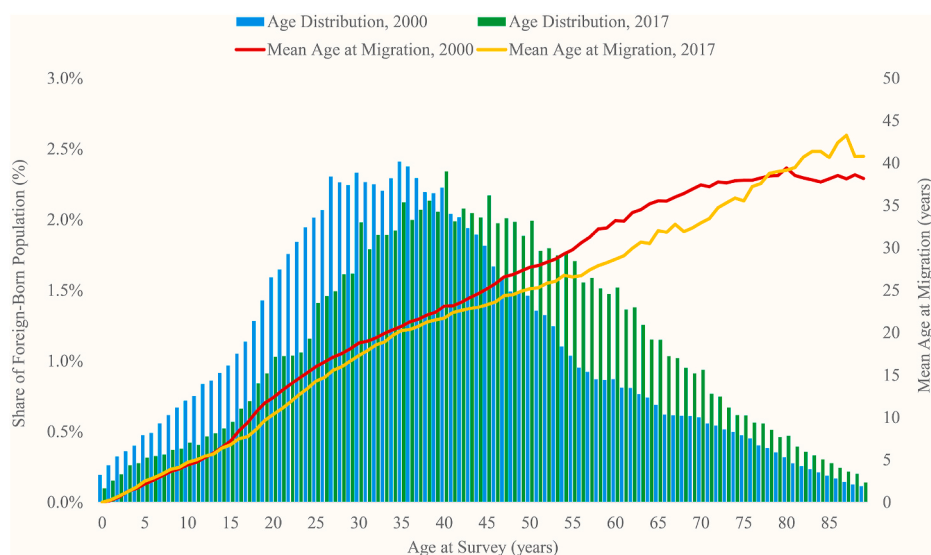
Fig. 5. Age Distribution and Mean Age at Migration of the Foreign-Born Population, 2000 and 2017 The age distributions (shown in blue and green) sum to 100% in each survey year. The mean age at migration is computed for each single year of age at survey for 2000 and 2017. The age distributions correspond to the left axis and the mean ages at migration correspond to the right axis. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)
Source: Authors' calculations based on the 2000 US Census and 2017 ACS data.

selected on factors relating to health has increased over time in response to the introduction of stricter migration policies, stricter enforcement of migration laws, and changes in the demands of the domestic labor market. During the study period, the number of deportations of undocumented migrants increased (Gramlich, 2020). In addition, while the number of legal entrants allowed into the country did not substantially change, the competition for visas among legal migrants increased sharply over time as American businesses, universities, and other institutions sought highly qualified immigrants to fill roles in their organizations. In short, it became more difficult for foreigners to gain entry to the United States, and it is possible that the successful entrants were more positively select on characteristics correlated with low mortality risk. Recent immigrants may also be healthier than past immigrants due to improvements in health conditions in the sending countries prior to immigration. If changes in the selectivity of immigration are behind the recent contributions of immigrants to US life expectancy improvements, then the interpretation of our findings shifts slightly. Rather than interpreting our results as immigrants experiencing increases in longevity, the increasing life expectancy of the foreign-born should instead be interpreted as the result of changes in the composition of the foreign-born population.

The flip side to this discussion is the US-born population. Our results show that the US-born population performed very poorly in terms of life expectancy improvements during the study period. While their poor performance may have enabled the foreign-born population to make a substantial contribution to improvements in national life expectancy, it cannot explain the relatively fast rates of improvement attained by immigrants over this time period. The pernicious period influences of the drug overdose epidemic and related phenomena observed among the US-born population had a more muted effect on the foreign-born. Because of immigrants' relatively robust gains in life expectancy, the country as a whole experienced faster rates of life expectancy improvement than otherwise would have been the case.

High-income countries around the world are currently struggling over the question of whether or not to admit more immigrants and are trying to understand how immigrants contribute to the culture, income, and health of their respective nations. On the last measure, the clear answer for the United States is that immigrants improve the health of the country by reducing mortality at the prime working ages and bolstering its national life expectancy.

Ethical statement

The authors declare no competing interests and certify that the

material in this manuscript is not published or under consideration for publication elsewhere.

Author statement

Arun S. Hendi: Conceptualization, Methodology, Formal Analysis, Investigation, Writing – Original Draft, Writing – Review & Editing, Visualization. **Jessica Y. Ho:** Conceptualization, Formal Analysis, Investigation, Data Curation, Writing – Review & Editing, Visualization.

Declaration of competing interest

The authors declare no competing interests.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ssmph.2021.100914.

References

Arias, E., & Xu, J. (2019). *United States life tables, 2017*.

Arriaga, E. E. (1984). Measuring and explaining the change in life expectancies. *Demography, 21*(1), 83–96.

Baluran, D., & Patterson, E. J. (2021). *Examining ethnic variation in life expectancy among Asians in the United States, 2012-2016*. Demography. October.

Beirich, H. (2010). *Getting immigration facts straight*. January 29, 2010. Retrieved May 25, 2021 from https://www.splcenter.org/fighting-hate/intelligence-report/2010/getting-immigration-facts-straight.

Bejarano, E. (2020). *Anti-immigrant movement has history of politicizing disease*. April 21, 2020. Retrieved May 25, 2021 from https://www.splcenter.org/hatewatch/2020/04/21/anti-immigrant-movement-has-history-politicizing-disease.

Blue, L., & Fenelon, A. (2011). Explaining low mortality among US immigrants relative to native-born Americans: The role of smoking. *International Journal of Epidemiology, 40*(3), 786–793. https://doi.org/10.1093/ije/dyr011

Cunningham, S. A., Ruben, J. D., & Narayan, K. M. V. (2008). Health of foreign-born people in the United States: A review. *Health & Place, 14*(4), 623–635. https://doi.org/10.1016/j.healthplace.2007.12.002

Dupre, M. E., Gu, D., & Vaupel, J. W. (2012). Survival differences among native-born and foreign-born older adults in the United States. *PLoS One, 7*(5), 1–8. https://doi.org/10.1371/journal.pone.0037177

Elo, I. T. (2009). Social class differentials in health and mortality: Patterns and explanations in comparative perspective. *Annual Review of Sociology, 35*, 553–572.

Elo, I. T., Hendi, A. S., Ho, J. Y., Vierboom, Y. C., & Preston, S. H. (2019). Trends in non-hispanic white mortality in the United States by metropolitan-nonmetropolitan status and region, 1990-2016. *Population and Development Review, 45*(3), 549–583. https://doi.org/10.1111/padr.12249

Elo, I. T., Mehta, N. K., & Huang, C. (2011). Disability among native-born and foreign-born blacks in the United States. *Demography, 48*(1), 241–265. https://doi.org/10.1007/s13524-010-0008-x

Elo, I. T., & Preston, S. H. (1997). Racial and ethnic differences in mortality at older ages. In L. G. Martin, & B. J. Soldo (Eds.), *Racial and ethnic differences in the health of older Americans* (pp. 10–42). National Academies Press.

Franklin, B. (1751). Observations concerning the increase of mankind, peopling of countries, Etc (1970) *Perspectives in Biology and Medicine, 13*(4), 469–475.

Gramlich, J. (2020). *How border apprehensions, ICE arrests and deportations have changed under Trump*. Pew Research Center. Retrieved July 15, 2021 from pewresearch.org/fact-tank/2020/03/02/how-border-apprehensions-ice-arrests-and-deportations-have-changed-under-trump/.

Guillot, M., Khlat, M., Elo, I. T., Solignac, M., & Wallace, M. (2018). Understanding age variations in the migrant mortality advantage: An international comparative perspective. *PLoS One, 13*(6), Article e0199669.

Hallowell, B. D., Endeshaw, M., McKenna, M. T., Senkomago, V., Razzaghi, H., & Saraiya, M. (2019). Cancer mortality rates among US and foreign-born individuals: United States 2005-2014. *Preventive Medicine, 126*, Article 105755. https://doi.org/10.1016/j.ypmed.2019.105755

Hamilton, A. (1802). *The examination number VIII, [12 January 1802]*. Founders Online National Archives. https://founders.archives.gov/documents/Hamilton/01-25-02-0282.

Harper, S., Rushani, D., & Kaufman, J. S. (2012). Trends in the black-white life expectancy gap, 2003-2008. *JAMA: The Journal of the American Medical Association, 307*(21), 2257–2259.

Hendi, A. (2015). Trends in U.S. Life expectancy gradients: The role of changing educational composition. *International Journal of Epidemiology, 44*(3), 946–955. https://doi.org/10.1093/ije/dyv062

Hendi, A. S. (2017). Trends in education-specific life expectancy, data quality, and shifting education distributions: A note on recent research. *Demography, 53*(3), 1203–1213.

Hendi, A. S., Elo, I. T., & Martikainen, P. (2021). The implications of changing education distributions for life expectancy gradients. *Social Science & Medicine, 272*. https://doi.org/10.1016/j.socscimed.2021.113712

Hendi, A. S., Mehta, N. K., & Elo, I. T. (2015). Health among black children by maternal and child nativity. *American Journal of Public Health, 105*(4), 703–710. https://doi.org/10.2105/AJPH.2014.302343

Ho, J. Y. (2013). Mortality under age 50 accounts for much of the fact that US life expectancy lags that of other high-income countries. *Health Affairs, 32*(3), 459–467. https://doi.org/10.1377/hlthaff.2012.0574

Ho, J. Y. (2017). The contribution of drug overdose to educational gradients in life expectancy in the United States, 1992-2011. *Demography, 54*(3), 1175–1202.

Ho, J. Y. (2019). The contemporary American drug overdose epidemic in international perspective. *Population and Development Review, 45*(1), 7–40. https://doi.org/10.1111/padr.12228

Ho, J. Y., & Hendi, A. S. (2018). Recent trends in life expectancy across high income countries: Retrospective observational study. *BMJ, 362*. https://doi.org/10.1136/bmj.k2562. k2562.

Huang, C., Mehta, N. K., Elo, I. T., Cunningham, S. A., Stephenson, R., Williamson, D. F., & Narayan, K. M. V. (2011). Region of birth and disability among recent U.S. Immigrants: Evidence from the 2000 Census. *Population Research and Policy Review, 30*(3), 399–418. https://doi.org/10.1007/s11113-010-9194-x

Jasso, G., Massey, D. S., Rosenzweig, M. R., & Smith, J. P. (2004). Immigrant Health: Selectivity and Acculturation. In N. B. Anderson, R. A. Bulatao, & B. Cohen (Eds.), *Critical Perspectives on Racial and Ethnic Differences in Health in Late Life* (pp. 227–266). National Academies Press.

Jefferson, T. (1854). *The Writings of Thomas Jefferson: Being his Autobiography, Correspondence, Reports, Messages, Addresses, and other Writings, Official and Private (Vol. VII)*. Taylor & Maury.

Kraut, A. M. (1995). In Johns Hopkins paperbacks (Ed.), *Silent travelers : Germs, genes, and the "immigrant menace"*. Johns Hopkins University Press.

Krogstad, J. M., & Radford, J. (2018). *Education levels of U.S. immigrants are on the rise*. September 14, 2018 https://www.pewresearch.org/fact-tank/2018/09/14/education-levels-of-u-s-immigrants-are-on-the-rise/.

Lauderdale, D. S., & Kestenbaum, B. M. (2002). Mortality rates of elderly Asian American populations based on medicare and social security data. *Demography, 39*, 529–540.

Markel, H., & Stern, A. M. (2002). The foreignness of germs: The persistent association of immigrants and disease in American society. *The Milbank Quarterly, 80*(4), 757–788. https://doi.org/10.1111/1468-0009.00030

Markides, K. S., & Coreil, J. (1986). The health of hispanics in the southwestern United States: An epidemiologic paradox. *Public Health Reports, 101*(3), 253–265. https://www.ncbi.nlm.nih.gov/pubmed/3086917.

Markides, K. S., & Eschbach, K. (2005). Aging, migration, and mortality: Current status of research on the hispanic paradox. *Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 60*, S68–S75. https://doi.org/10.1093/geronb/60.special_issue_2.s68 (Special Issue 2).

Mehta, N. K., Abrams, L. R., & Myrskylä, M. (2020). US life expectancy stalls due to cardiovascular disease, not drug deaths. *Proceedings of the National Academy of Sciences of the United States of America, 117*(13), 6998–7000. https://doi.org/10.1073/pnas.1920391117

Mehta, N. K., Elo, I. T., Engelman, M., Lauderdale, D. S., & Kestenbaum, B. M. (2016). Life expectancy among U.S.-born and foreign-born older adults in the United States: Estimates from linked social security and medicare data. *Demography, 53*(4), 1109–1134. https://doi.org/10.1007/s13524-016-0488-4

Murphy, S. L., Xu, J., Kochanek, K. D., & Arias, E. (2018). *Mortality in the United States, 2017* (Vol. 328). NCHS Data Brief.

National Research Council. (2012). *Aging and the macroeconomy: Long-term implications of an older population*. National Academies Press. https://doi.org/10.17226/13465

Palloni, A., & Arias, E. (2004). Paradox lost: Explaining the hispanic adult mortality advantage. *Demography, 41*(3), 385–415. https://doi.org/10.1353/dem.2004.0024

Preston, S. H., Heuveline, P., & Guillot, M. (2001). *Demography: Measuring and modeling population processes*. Blackwell.

Riosmena, F., Kuhn, R., & Jochem, W. C. (2017). Explaining the immigrant health advantage: Self-selection and protection in health-related factors among five major national-origin immigrant groups in the United States. *Demography, 54*(1), 175–200. https://doi.org/10.1007/s13524-016-0542-2

Santana, M. (2014). *Ebola fears spark backlash against Latino immigrants*. October 10, 2021. Retrieved May 25, 2021 from https://www.cnn.com/2014/10/10/politics/ebola-fears-spark-backlash-latinos/index.html.

Singh, G. K., & Hiatt, R. A. (2006). Trends and disparities in socioeconomic and behavioural characteristics, life expectancy, and cause-specific mortality of native-born and foreign-born populations in the United States, 1979-2003. *International Journal of Epidemiology, 35*(4), 903–919. https://doi.org/10.1093/ije/dyl089

Singh, G. K., & Miller, B. A. (2004). Health, life expectancy, and mortality patterns among immigrant populations in the United States. *Canadian Journal of Public Health, 95*(3), I14–I21. https://www.ncbi.nlm.nih.gov/pubmed/15191127.

Singh, G. K., & Siahpush, M. (2002). Ethnic-immigrant differentials in health behaviors, morbidity, and cause-specific mortality in the United States: An analysis of two national data bases. *Human Biology, 74*(1), 83–109. https://doi.org/10.1353/hub.2002.0011

Sorlie, P. D., Rogot, E., & Johnson, N. J. (1992). Validity of demographic characteristics on the death certificate. *Epidemiology, 3*(2), 181–184. https://doi.org/10.1097/00001648-199203000-00018

United Nations. (2019). *Department of economic and social affairs, & population division*. August 28, 2019 https://population.un.org/wpp/Download/Standard/Mortality/.

University of California Berkeley, & Max Planck Institute for Demographic Research. (2021). *Human mortality database*. May 25, 2021. Retrieved May 25, 2021 from www.mortality.org.