Chapter 7
Babies No Longer: Projecting the 100+ Population

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7.1 Introduction and Background

As the "babies" of the Baby-Boom continue to age, the oldest will reach age 100 in 2046, which is less than 30 years from now. Just as the number of teenagers grew rapidly in the 1960s, and the number of retirees in the 2010s, we expect that the 100+ population will grow substantially in the 2040s and thereafter. While we know that the aging of the baby boomers will contribute to the future growth in the centenarian population, we do not know exactly how much growth to anticipate. Larger cohorts moving into this age group will inevitably increase the size of this population. However, other factors such as immigration and improvements in survivorship will ultimately determine how much growth we will see in the future 100+ population.

In the last two series of the U.S. Census Bureau's National Population Projections, concerns have been voiced over the large projected increases in the centenarian population. In the 2012 series, the Census Bureau projected that the 100+ population would increase from 65,000 in 2012 to 690,000 in 2060. In the 2014 series, the Census Bureau projected that the 100+ population would grow from 70,000 in 2014 to 604,000 in 2060. For each of these series, staff at the Census Bureau conducted additional analyses to evaluate the plausibility of the results. Findings, based on comparisons of National Center for Health Statistics (NCHS) and projections life tables, along with time series analyses of the 100+ population, generally suggested

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that these projections of the 100+ population are conceivable. Yet, these projections were questioned internally for the rapid growth in the 100+ population.

In anticipation of this issue arising once more for the 2017 National Projections, we conducted additional research to determine the extent to which our projections of the centenarian population are really cause for concern. Specifically, we have done the following:

1. Conducted a literature review focused on the issue of maximum life expectancy, including the consideration of classic works debating the biological limits to the human life span, as well as more recent studies evaluating the impact of factors such as smoking and obesity on projected life expectancy.
2. Evaluated Census Bureau projections of life expectancy against those of other agencies producing similar products for the United States and for other developed nations.
3. Examined the 2014 mortality inputs and the resulting population projections for potential factors contributing to the increase of centenarians. For instance, is the timing of the increase associated with the entry of the baby boomers into the 100+ ages?
4. Explored historic changes in the centenarian population to provide context for the projected changes; we specifically addressed how the population in this age group changed over time based on the Decennial Census and in the postcensal and intercensal estimates.
5. Tested alternative methods for projecting mortality, comparing these against the results from the 2014 National Projections to evaluate the reasonableness of our current assumptions.

Regarding some of the background of our work, we now note that the debates surrounding projections of the oldest old (i.e., those 85 years and older) and old-age mortality are not unique to the Census Bureau's population projections. Though historical increases in life expectancy over the past two centuries are well documented (life expectancy at birth in developed countries has more than doubled since 1800), there is an ongoing dialogue in the literature regarding the continued pace of improvement in human mortality. Until the mid-twentieth century, the majority of improvements in mortality occurred to children and in the younger adult populations. Given that there is little room for continued reductions to mortality in these ages, the majority of future improvements to mortality will occur at the older ages. Some researchers have suggested that there is no reason to believe that we are approaching a biological limit to human life expectancy (Oppen and Vaupel 2002), and that humans will continue to evolve for longer life (Zhang 2017). Others have argued that substantial increases in life expectancy are unlikely (Carnes and Olshansky 2007).

7.2 Review of Past and Current Projections

Similar methods were used to project mortality rates in the Census Bureau's 2012 and 2014 National Projections. Both series used NCHS-compiled death registration data in conjunction with intercensal estimates produced at the Census Bureau to produce a roughly 20-year time series of mortality rates by age and sex for the following three race and Hispanic origin groups: (1) non-Hispanic Whites and Asians or Pacific Islanders (API), (2) non-Hispanic Blacks and American Indians or Alaska Natives (AIAN), and (3) Hispanics (of any race).

Mortality was projected based on projections of life expectancy at birth (e_0) by sex. Changes in life expectancy at birth by sex were modeled assuming that the complement of the life expectancy (the difference between an upper bound value, A, and the life expectancy values) would decline exponentially. Mortality rates by age were then produced using the most recent observed rates by sex and race-origin group, the trajectory of life expectancy values, and an ultimate life table. To get an ultimate age pattern of mortality by sex, the United Nations' single age versions of the extended Coale and Demeny model life tables were used (United Nations 2010, 2012). The West model mortality rates with life expectancy values of 87 years for males and 91 years for females were selected.

Using the Coale-Demeny West model, age-specific central death rates were then projected for each of the three race-origin groups by sex employing the Census Bureau's Rural-Urban Projection (RUP) program. The RUP algorithm creates life tables for years that have intermediate life expectancy estimates by finding the interpolation factors for the most recent and next death rate inputs that would result in the desired life expectancy at birth value (Arriaga and Associates 2003). The interpolation is done using the logarithms of the death rate values.

For the 2014 series, we made an additional adjustment to the mortality component in response to continued unease about the number of centenarians in the projections. The projections team developed a method to ensure that projections of the 100+ population were not inflated by individuals being allowed to survive to unrealistic ages (i.e., ages older than 115). This method, which assumed an exponential decline in survivorship ratios from age 100 to a value of zero at age 115, was incorporated into the 2014 National Projections.

Looking at the changes in the size of the centenarian population over time shows how this population has increased over time and is projected to continue increasing into the future. Fig. 7.1 presents the centenarian population from the 1980, 1990, 2000, and 2010 Decennial Censuses and from the 2014 National Projections. It shows the number of people in this age group each decade for the years 1980 through 2060 and the proportion of the total population in the age group (per 10,000 people).

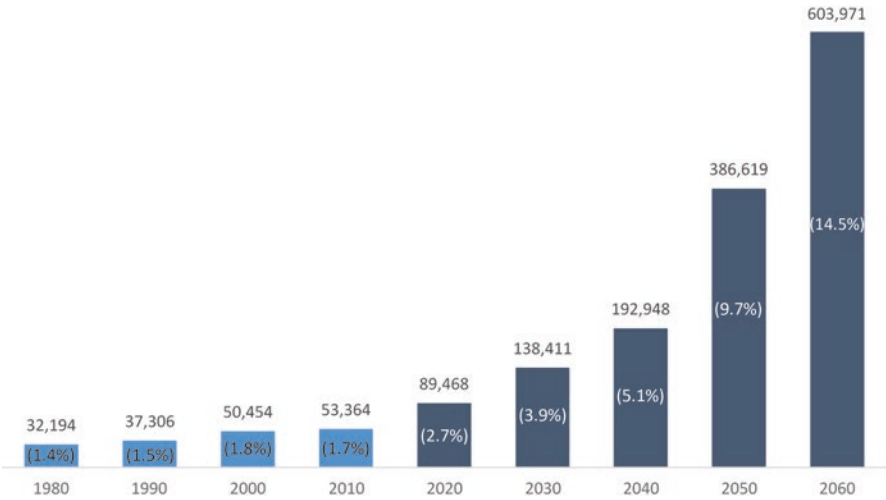

Fig. 7.1 Estimated and projected centenarian population: cohort size and share of total population

Comparisons of census data show that the 100+ population has grown, especially between 1990 and 2000, and that the share of the total population in this age group has increased slightly during this time from 1.4 in 1980 to 1.7 in 2010.

Growth is projected to continue throughout the projection period, with the population of centenarians increasing from 53,364 in 2010 to 603,971 in 2060 in the 2014 series. By the end of the projection period, the proportion of the population aged 100+ per 10,000 people in the population will be 14.5 up from 2.7 in 2020. A decade-by-decade examination shows that the largest increases are projected to occur between 2040 and 2050. During this decade, the 100+ population is projected to double.

Research conducted by the Projections Branch at the Census Bureau suggested that the growth in the 100+ population in the projected years is largely associated with the aging of the Baby Boom cohort. Figure 7.2 shows a line graph of the projected 100+ population through 2060 (left axis) with the size of the associated birth cohorts shown in the bars (right axis). Though the projections of the 100+ population are shown to increase in all the projected years, there is a notable increase expected in 2046, the first year that baby boomers will enter this age group. Because the goal of the research reported in this chapter was to assess the reasonableness of the Census Bureau's projections, we also include projections of the 100+ population from the United Nations (shown with square markers) as reference. The UN projections resemble those of the Census Bureau throughout the projection period.

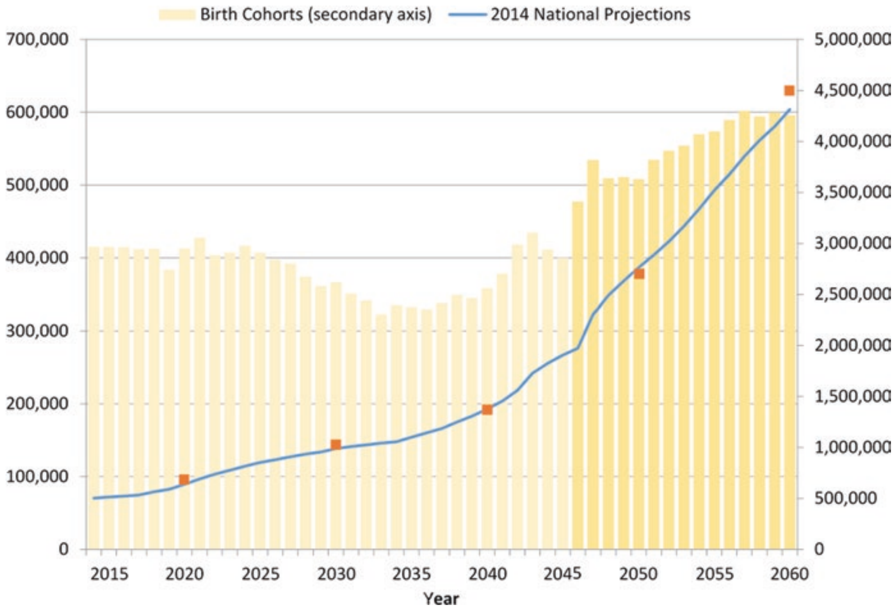

Fig. 7.2 Projected centenarian population in the United States: 2014–2060

7.3 Alternate Research Projections

The projected size of the population of centenarians in 2060 depends fundamentally on three assumptions: (1) the size and composition of the starting population, that is, the population 56 and older in 2014; (2) the size and composition of immigration; and (3) the survivorship ratios for the population 56 and over.

In the following sections, we project the 100 plus population under different assumptions about each of these three components to see which assumptions are key to driving the projected 100 plus population. Each is a based on the 2014 projections for the total population, and is compared with those projections as a benchmark.

7.3.1 Alternate Base Populations

We used the following three scenarios in the projections: (1) zero future net immigration; (2) zero immigration, that is, native-born population only; and (3) no baby boom.

The first two assumptions are largely self-explanatory. However, it is important to note that the zero net immigration assumption allows for the difference between future immigration and future emigration. The zero immigration scenario allows for past emigration of the native-born population. It also includes the native-born children of past immigrants. However, for our illustrative purposes, these are minor limitations.

We test our assumptions on the total projected population by age, but not separately by sex, race, or ethnic group. The same analysis was run separately for females only and yielded similar results (not shown here).

The no baby-boom scenario tests whether the surge in the centenarian population after 2046 can be accounted for by the surge in births in 1946. It is based on a simple geometric interpolation of the 2014 population age 50 with the population age 68, corresponding to the birth cohorts. This tends to smooth out the bump, and reduces the population for those cohorts. Note that very few children born to the baby-boom generation (i.e., the echo-boom) would be born in time to reach age 100 by 2060.

As one can tell from Fig. 7.3 and Table 7.1, the assumptions about future net immigration play only a minor role in the projections of the 100+ population. Zero future net immigration would decrease the projected population by only 3%. Past immigration plays a bigger role. The 100+ projected native population accounts for only 82% of the total number projected, that is a 23% decrease. Assuming no baby boom, however, does decrease the projected number by a similar amount, 23%.

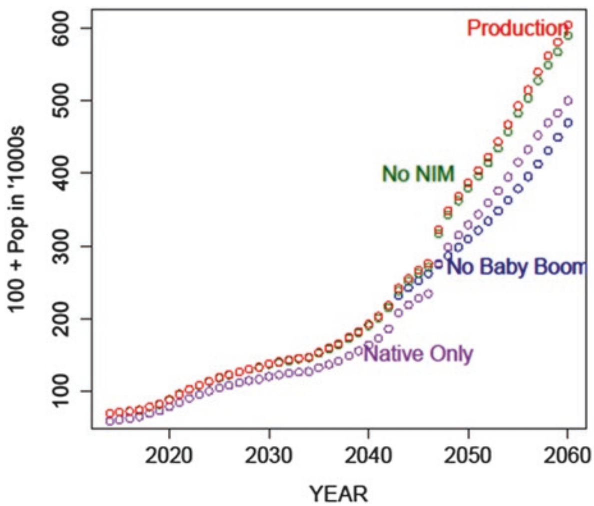

Fig. 7.3 Projections of the centenarian population with alternative assumptions of population base and future net immigration

Table 7.1 Alternative projections of the centenarian population

Series	Projection ('000)	Percent of production	Percent decrease	Incremental decrease
Production estimate	433.7	100	0	
No new net immigration	420.9	97	3	
Native born only	356.5	82	18	
No baby boom	333.0	77	23	
Constant survival 99+	366.2	84	16	16
Constant survival 85+	201.2	46	54	38
Constant survival 75+	182.3	42	58	4
Constant survival 65+	176.7	41	59	1
Constant survival	175.4	40	60	0

7.3.2 Alternate Survivorship Projections

The driver of population projections is, of course, the assumptions about the future survival ratios. In our case, the driver is the assumptions about the increase in survivorship. These are easily tested by holding the survivor ratios constant above certain ages. For example, to look at the importance of the assumption of increased survivorship among the oldest population, we hold the ratios constant at the 2014 levels for ages 99 and over. We then hold them constant for ages 85 and over, 75 and over, and finally, 65 and over.

The results are given in Fig. 7.4 and Table 7.1. The assumption of no improvement in survivorship for those 99 and over has only a modest effect. It would lower the projected number by 16%, comparable with the assumptions about the baby boom.

However, assuming no improvement in survivorship for those over 85 has a dramatic effect, decreasing the projected number by an additional 38%. Assuming constant survival for those over 75, over 65, or for all ages has only a small incremental effect on the projected 100+ population.

Of the scenarios considered, three stand out, namely, no baby boom, no past immigration, and no improvement in survivorship 85 and over. Of these, two are counter factual: there was a baby boom and there was past immigration. Therefore, the key assumption to assess is the survivorship for those 85 and over. How reasonable is this assumption?

The projections assume that female survivorship from 85 to 100 will reach 0.16 by the end of the period. This projection may be assessed against the recent experience of other low mortality countries.[1] The survival ratios are plotted in

[1] The low mortality countries we considered are Australia, Austria, Belgium, Canada, Denmark, Finland, Iceland, Japan, Norway, Sweden, Switzerland, Taiwan, UK. We used data for these countries from the Human Mortality Database.

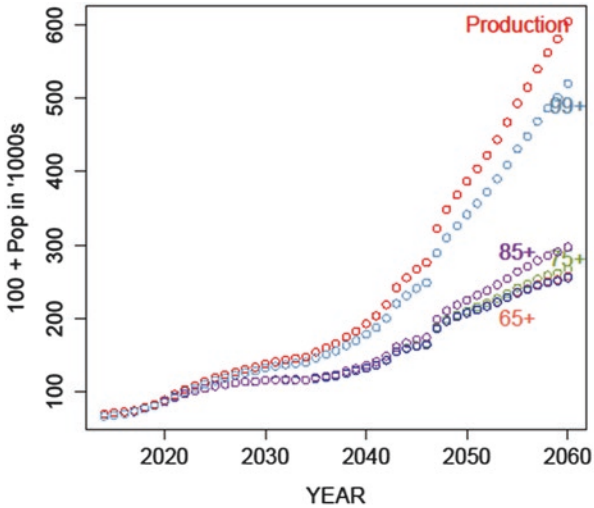

Fig. 7.4 Projections of the centenarian population with alternative assumptions of older age survivorship

Fig. 7.5. The plot is in log-base-2 scale. The horizontal reference line indicates the projected level of survivorship for the end of the period. The vertical line indicates 2014. The United States is plotted in solid triangles; Japan is plotted in hollow circles. All the other countries are plotted with a plus. The plotted data indicate that although it is far from certain that survivorship will reach the projected level by 2020, the trends in our graph give us no indication that this level constitutes an unreasonable assumption.

7.4 Summary and Conclusion

Any projection of what will happen 45 years into the future is almost certainly going to be wrong, perhaps in unexpected ways. Given changes in standards of living, health care, the environment and even human evolution make projections of the centenarian population especially difficult. However, the various sets of projections reported in this chapter all make clear that there will be a substantial increase in the size of the centenarian population. Given the special needs of this population, 45 years is certainly not too far in advance for us to start thinking and planning.

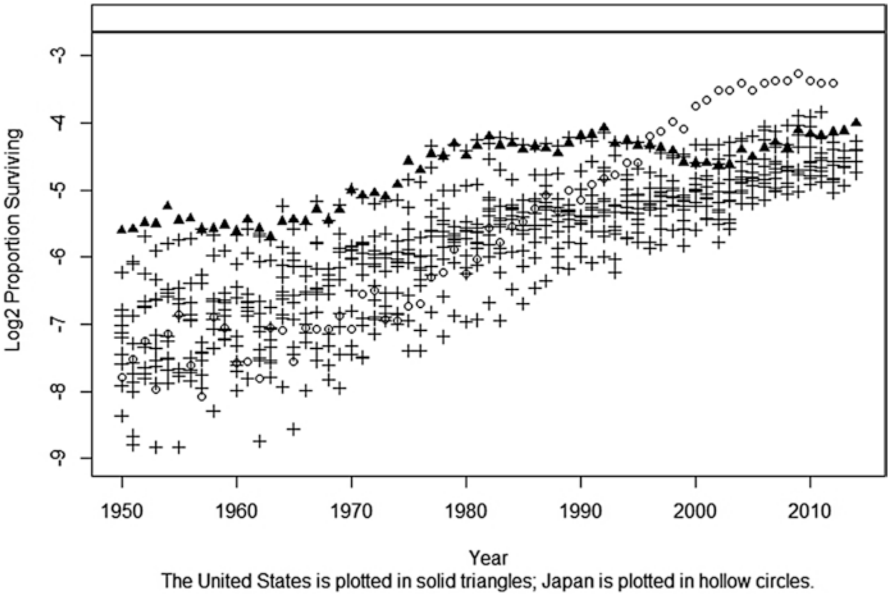

Fig. 7.5 Comparison of trends in other advanced countries

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