The twentieth century has witnessed remarkable declines in older-age mortality in Western Europe, Japan, and the US. The first documented 111-year-old died in 1932, and the first verified 122-year-old died in 1997. Not only has the maximum age of death increased, but the number of people living beyond 100 has increased as well, calling into question whether an upper limit to the length of human life is anywhere in sight and whether such an upper limit even exists. Rising longevity has strained pay-as-you-go social security systems and health care systems financially. More individuals have been living to retirement age, and these individuals have been collecting benefits over more years without working more years. Although prevalence rates for elderly disability and functional limitations have declined since the 1980s, the evidence on recent chronic disease rate trends is mixed.

This paper will use a new, longitudinal data set on veterans of the Union Army (US Civil War, 1861-5) who lived to at least age 95. These data provide a rich source of information on men’s early, young adult, and mid-life experiences, including detailed health records. Because of the possibility of age confirmation across different sources, the paper will establish the mortality level, the rate of increase in mortality rates, whether a mortality plateau is reached at older ages, and if so, at what age such plateau is reached. The paper also will investigate how health, as measured by chronic conditions and functional limitation rates, changes over time for these long-lived men. Only the Union Army data can provide detailed information on the health of a historical elderly population in the early 20th century. Finally, the paper also will examine some of the determinants of mortality at age 95+, including current conditions (e.g., the weather), early life conditions (e.g., characteristics of the year and place of birth), and young adult conditions (e.g., wartime experiences and SES status). Because of the rich data, much of the unobserved heterogeneity in studies of centenarians thus becomes observable.

Data

The sample of Union Army veterans who lived to age 95+ has been drawn from disparate sources. These include collections of gravestones, obituaries, Grand Army of the Republic membership and reunion lists, and the 1930 and 1940 censuses. One potential concern is that records such as gravestones, obituaries, or veteran organization lists may bias the sample toward those of higher socioeconomic status. This is unlikely because the US Pension Bureau provided gravestones, news accounts of long-lived veterans were popular in the culture of Civil War commemoration that began to develop after the 1890s, and because the pride men felt in Civil War service and the close ties that men maintained with each other (e.g., men from the same companies were parts of chain migrations) led them to join veterans’ organizations. Preliminary analyses suggest that socioeconomic differences between men drawn from these sources and self-identified veterans in a random sample of the 1930 census were small.

Civil War veterans were then linked to their military records, their pension records, and the available 1850-1940 censuses. The first age verification was performed by the US Pension Bureau, both to verify identity and because age was considered a disability. The records of men
whose pensions showed that they did not live to age 95+ were not collected. The Pension Bureau first checked the service records which had been transcribed for this purpose. However, men and boys eager to enlist lied about their age (with boys adding years and older men subtracting years). To prove age, men would send to the Pension Bureau a page ripped from the family bible with their birth recorded in it or would send a notarized affidavit of date of birth as recorded in the family bible. Instructions to claimants from the Pension Bureau state,

“If there is a public, church, or family record of your birth, you should forward a verified copy of such record.

If there is no public or church record, and a verified copy of the family record is furnished, the officer certifying to the same should state in what year the Bible, or other book in which the record appears, was printed; whether the record bears any marks of erasure or alteration; and whether, from the appearance of the writing, he believes the entries to have been made about the dates given.

If you are unable to furnish any of the evidence indicated, you should state that fact, and the reason why you are unable to furnish it, under oath.”

In some cases, the Pension Bureau would order a search of the manuscript census schedules to determine age. The Pension Bureau would also send investigators to distant towns to question neighbors and members of the same company. Because roughly 85 percent of all veterans were on the rolls by 1900 and 90 percent on the rolls by 1910 (men who served for less than 90 days and deserters were not eligible), age confirmation occurs when men still were relatively young. Additional age confirmation comes from the military records and from the census records (men are linked to records from 1850, 1860, 1870, 1880, 1900, 1910, 1920, and 1930). However, unlike the pension records, the census records show evidence of age heaping.

The second age verification was done after all records were collected and consisted of examining all sources (e.g., early censuses, military service records, and pension records) to determine if they were consistent. Three different quality codes were assigned, with the highest indicating consistency across records and the second highest consistency across the pension records and either the military service records or the early census records. Preliminary analyses suggest that mortality rates for men with the two highest quality codes were similar.

Thus far 1,027 men have been age-verified. Men for whom age verification failed tended to be the older cohorts (born in the 1820s or earlier). By the end of October, I expect to obtain the records of more than 500 additional men which will need to be age verified. This sample will include men obtained from the 1940 census.

One issue that arises in the empirical analysis is when the period of risk begins. For example, men whose records were obtained from a reunion list or from the 1930 or 1940 census cannot be considered at risk to die before the date of the record. In contrast, men whose records were obtained from gravestones or obituaries or death lists, are considered to be at risk beginning at age 95.

The logical comparison group with the Union Army sample of men age 95+ is the original Union Army sample of 39,000 men, most of whom did not live to such an advanced age.

Mortality Trajectories

The oldest age of death at death in the Union Army data was 109 for a man born in 1830. This upper limit is similar to that of 110 found in a 1955 study of 210 Union Army veterans alive between 1945 and 1955. An upper age of 109 is not seen in Swedish data until the 1853 birth cohort. A preliminary comparison of the Union Army data with the Swedish cohort of 1830-39 reveals that veterans had considerably lower mortality rates (see Figure 1). The graph is truncated at age 104 but will be extended with the additional data and both logistic and gompertz functions will be used to fit the data.
The lower mortality rates of Union Army veterans at all ages compared to their Swedish counterparts are consistent with the historical record on the health of Americans at younger ages. The United States was unusually healthy in terms of the life expectancy and height of its population compared to the rest of the world in this period but then experienced convergence.

One aim is to examine whether there is any hint of a mortality plateau in the larger sample. Three principal explanations have been advanced for mortality plateaus. Heterogeneity may cause the frail to die at younger ages and leave survivors with favorable health endowments. This can be tested by examining health outcomes. Alternatively, the rate of aging may slow down at advanced ages for a variety of reasons, including a slowdown in fundamental senescence. Finally, mortality plateaus may simply result from bad data. This can be investigated within the Union Army data by including the men whose ages could not be confirmed and by comparing the mortality experience of Union Army veterans with those of the general population (unreliable in this time period because of the absence of birth registration).

Health Trajectories

Studies of modern day centenarians show that longer life is not necessarily accompanied by worse health. Among centenarians living in Massachusetts, the mean age at which independence was first noted to be compromised was 97 years. A study of 602 Italian centenarians found that 20 percent had normal values for the independent index of daily living (ADL). The Heidelberg Centenarian Study shows that although only one quarter of centenarians was cognitively intact, centenarians’ cognitive performance was stable over the year and a half that they were followed.

The aim will be to examine how healthy were the men who survived to age 95+ and how their health compares with those of Union Army veterans who were not as long-lived (e.g. those who died between age 65 and 74) and how health declines among men who survived to age 95+. Health comparisons will include chronic conditions (heart and circulatory, respiratory, and musculoskeletal) and functional limitations. Because the long-lived are the select survivors, they may be healthier than their shorter-lived counterparts.

Mortality and Health Determinants
Preliminary work has investigated which Union Army veterans survived to age 95. Veterans who survived to age 95+ were more likely at enlistment to have been farmers rather than laborers or artisans or professionals and proprietors. Surprisingly, controlling for occupation, they were more likely to have been from large cities even though among younger men those who had enlisted in larger cities died at younger ages. They also were from wealthier families in 1850 or 1860. Finally, there is a suggestion that they were less likely to have been born in the dangerous spring (when maternal vitamin levels were low after the winter months) and summer quarters (when diarrheal diseases were high). Future work will investigate the effects of wartime experiences and of socioeconomic status at other points of the life cycle.

Preliminary work looking within the sample of men who survived to age 95+ shows that the odds of dying were 1.2 times greater for those born in the spring and summer rather than the other months, 0.8 times lower for those who were artisans or professionals or proprietors at enlistment relative to laborers, 1.5 times greater for those who enlisted in one of the 13 largest cities in the US in 1860 rather a smaller city, and 1.3 times greater for those who developed respiratory problems during their military service, controlling for state of enlistment fixed effects. (Results are for a gompertz model using months lived.)

Additional work will use not only the expanded sample but also will investigate health outcomes and will introduce additional variables such as contemporaneous measures of temperature within the county (or measures of severe heat and cold) to control for period effects, more detailed information on military service (e.g., length of service and severity of the experience), and more detailed information on early life effects such as county health characteristics (e.g., an index of malaria) and year characteristics (e.g., recession years).