Trends in Quality-Adjusted Life Expectancy in the US Population

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Changes in population health have not been in a uniform direction over time. In the past 20 years, infant mortality has declined, mortality rates for non-elderly adults have stagnated, and in some cases increased, and mortality for the elderly has fallen. Quality of life trends are not systematically tracked, but more people are reporting pain and some mental illnesses have increased in prevalence as well. Diagnoses of mental health impairments in children have increased. Quality of life has improved in the elderly.

At the same time, there are large differences in health across demographic groups. In many age groups, Black health has improved relative to White health. Mortality has increased for non-Hispanic White men in late working ages ("deaths of despair"), especially those with fewer years of education. and yet mortality rates have continued to fall in the elderly. With so many different trends in health, it is challenging to develop a picture of the overall population, and how it varies for different groups.

The goal of this paper is to systematically examine the health of the US population, overall and for different sociodemographic groups. In addition, we will consider how these trends in health correspond to changes in medical spending. We wish to ask questions such as: has increased medical spending for certain sociodemographic groups led to improvements in health? Or have health decrements coincided with increases in medical spending? We will not answer these casual questions in this paper, but it motivates our analysis. In this paper, we focus on measuring trends in health.

With respect to health, the conceptual measure we take as our goal is quality-adjusted life expectancy, which we denote QALE. QALE at any age is the product of the probability that an individual will survive to any future age times the quality of life of survivors to that age. It is conceptually similar to life expectancy but weights surviving years by the quality of those years.

QALE can be formed as of any age, just as life expectancy can. The most common metric is QALE at birth, and that forms the bulk of our analysis. However, we also consider QALE at other ages: 25, 45, and 65. Older ages are particularly important in forming QALE for different education groups. In estimating health trends by education, for example, we take as our standard QALE at age 25. As is standard, we form QALE using a life table concept: QALE for a person born today is calculated by assuming that mortality and quality of life measured for each age today remains constant into the indefinite future.

We measure QALE for the US population as a whole and also for 24 distinct sociodemographic groups in the population: gender (male and female); race/ethnicity (non-Hispanic White, non-Hispanic black, Hispanic), and education (a high school degree/GED or less, some college but no four year degree, college degree). We form QALE for each of the subgroups, though in practice some of the subgroups have sufficiently small populations at any age that the estimates of QALE are quite noisy, for example Hispanics with a college degree at older ages).

Our ultimate goal is to estimate QALE for each sociodemographic group in every year from 2000 to 2019. We start in this paper with years 2000 and 2019. Work for other years is in progress.

Estimating QALE requires estimating mortality rates at each age, for each sociodemographic group, in each year. A good deal of this data is available from vital statistics. For example, the National Center for Health Statistics (NCHS) gives overall mortality and mortality by gender for most years. Mortality by race and ethnicity is available for most years, although rates for Hispanics have not been calculated in each year and may vary over time as Hispanic reporting changes.

The most complex mortality component of our research is mortality by education. Education is recorded in death certificates, but studies show that the accuracy of death certificate recording of education is not great; for example an NCHS comparison of self-reports in survey data to subsequent death certificates found a discrepancy on the order of 28 percent (Rostron, Boies & Arias, 2010). We adjust for this using unpublished tabulations from NCHS (Hatfield et al., 2023). Using the National Longitudinal Mortality Study (NLMS), we have information on what share of people with various self-reports of education have different reports of educational attainment on death records. We use this to adjust total deaths by education in the Vital Statistics.

There's no single detailed metric of quality of life that can be pulled from a survey or official statistics. Rather, to form quality of life, we follow the methodology developed in our previous work (Cutler et al., 2022). We start with data from the 2002 Medical Expenditure Panel Study, which asks people about a variety of symptoms and impairments that they experience and also asks people to rate their overall health on 100 point scale. We relate the self-reported measure of overall health to the full set of symptoms and impairments the individual reports. We interpret the coefficients on symptoms and impairments as the decrement in quality of life associated with each one. For example, if people with severe pain report that their quality of life is on average 20 points lower on the 100 point scale, controlling for other symptoms and impairments, the disutility associated with severe pain would be -0.20. We use the weights derived from this analysis to evaluate quality of life over time using data on different symptoms and impairments reported in national surveys.

The data for quality of life are from a combination of the Medical Expenditure Panel Study and the Medicare Current Beneficiary Survey. Together, these data sets give us coverage

of the entire population in each year of the sample, including those in long-term care institutions. Though the samples in MEPS and MCBS are weighted to represent the full population, the sample sizes are sufficiently small (~30,000 per year in MEPS and ~10,000 per year in MCBS) that we smooth them across ages within each sociodemographic group and year, using splines with knots at ages 25, 45, and 65.

In practice, the symptoms and impairments that are relevant for adults and the elderly are not always relevant for children (for example, difficulty lifting 10 lbs). Thus, we estimate a separate model of disutility rates for children, corresponding to questions that are asked of that group.

Having estimated mortality using Vital Statistics, we combine this with quality of life to form QALE in 2000 and 2019. The heart of our paper is an empirical analysis of the trends that emerge from these tabulations.

Our first analysis considers health for the population as a whole, pooling across gender, race/ethnicity, and education categories. Overall, QALE increased by 2.6 years between 2000 and 2019. A good deal of this increase is a result of reductions in mortality (80 percent). However, quality of life improved as well, especially for the non-elderly population.

While overall mortality has declined, that is not true in all ages. In particular, overall mortality increased between ages 24 and 39. Mortality has declined most in two age groups: children (≤15) and the elderly, especially in the 70s. These two changes have been noted in the literature, although their importance to overall population health has not been noted as highly. The decline in child mortality may be partly a result of medical technology (especially for premature infants), along with environmental changes such as reduced exposure to pollutants. Reduced mortality among the elderly is likely a function of reduced cardiovascular disease and

some reduction in cancer, although the composition of mortality change in this age group has not been examined as closely.

There are essentially no differences in QALE increase by gender over this time period. For both men and women, QALE at birth increased by 2.6 years. For men, 87 percent of this was due to mortality improvement vs. 78 percent for women. Women live longer than men, and the gap between health for the two groups remains constant.

One of our most important findings is that there has been a marked reduction in racial differences in health between non-Hispanic Whites and non-Hispanic Blacks. Between 2000 and 2019, QALE at birth for non-Hispanic Whites rose by only 1.8 years, while QALE at birth for non-Hispanic Blacks rose by 3.1 years. This implies that the gap in QALE between non-Hispanic Whites and non-Hispanic blacks fell by 29 percent (from 4.6 to 3.3).

By age, the largest age group where QALE disproportionately increased for Blacks compared to Whites is at working ages, from the late 20s to the late 50s. There was also a greater reduction in infant mortality for non-Hispanic Blacks. Most of the differential change in QALE for non-Hispanic Blacks and Whites is due to greater reductions in mortality for non-Hispanic Blacks. Quality of life changes were relatively similar by race.

QALE for Hispanics increased by 4.2 years, larger even than the QALE increase for non-Hispanic Blacks. Combined with the fact that Hispanic QALE was already above that of non-Hispanic Whites implies that the 'Hispanic paradox' (e.g. Shor et al. 2017) grew over this time period. One point to note about this is that Hispanic attribution on death certificates is difficult and may change over time, so that some of this may reflect changes in attribution of people to Hispanic ethnicity. That said, one might guess that Hispanic attribution increased over time on death certificates, which would have increased reported mortality.

While QALE for different races/ethnicities has converged over time, QALE for different education groups has diverged markedly. Our estimates are that QALE at age 25 for people with a high school degree or less fell by 0.7 years between 2000 and 2019. In contrast, QALE for people with some college, but no four-year degree increased by 1.2 years, and QALE for people with a four-year college degree increased by 3.8 years. Some of this change may reflect changes in the education distribution over time. In particular, as the share of the population going on to some college has increased, the sample of people with a high school degree or less may contain more of those whose health would have been worse. In future work, we intend to adjust for these population changes using the methods of Novosad et al. (2022) and Kowalski (2023).

The gap between QALE improvements for those with different levels of education is apparent at virtually all ages. The gap is biggest for people in their 30s and in their 70s, likely reflecting different factors for the two groups – so-called "deaths of despair" for people in their 30s and cardiovascular disease for people in their 70s. Decomposing QALE into mortality and quality of life reveals that both are important. Quality of life increased at all ages for people with a college degree, but only for people in their 30s for those with a high school degree or less, and for that group there was also a large increase in mortality – making one suspect positive selection of survivors.

The differences in QALE trends by race and education are worthy of several notes. One reason why QALE for Blacks may have increased more than QALE for Whites is if education increased by more for Blacks than for Whites. However, the change in educational attainment is not that different across races. Between 2000 and 2019, the share of non-Hispanic Black Americans ages 25 and older with a high school degree fell by 12 percentage points while the share among non-Hispanic White Americans fell by 14 percentage points. To examine the

impact of education changes more systematically, we formed a simulated non-Hispanic Black (non-Hispanic White) QALE in 2019 assuming the education shares in the population in 2019 matched the education shares in 2000. Had education shares not changed, the increase in QALE at birth for Blacks would have been 1.7 years (compared to the observed increase of 2.8 years), and the increase in QALE for Whites would have been 0.8 years (compared to the observed increase of 1.5 years). This differential change thus explains 31 percent of the differential growth in QALE for blacks (simulated growth = 0.9 percentage points compared to actual growth of 1.3 years).

Similarly, the change in the education gap in QALE is not particularly due to changes into racial mix of the population. Had the racial mix of the population stayed the same in 2019 as in 2000, QALE for people with a high school degree or less would have fallen by 0.6 years, and QALE for people with a College degree would have increased by 3.0 years. This gap – 3.6 years – is 80 percent of the gap observed without adjusting for changing mixes by race.

There's an important difference between race/ethnicity and education that is worth pointing out: education is modifiable, while race is not. To the extent that the bigger issue to worry about now is health differences by education rather than by race, this is a topic that society is perhaps better able to address. Of course, by itself this does not indicate what policy is optimal. For example, health differences by race are not necessarily due to race itself, but rather to the confluence of economic and social factors that are associated with race. Thus, one must understand more about why race and education are associated with health to understand what policies would be most effective in alleviating them.

Finally, we note that these results are all descriptive, and we have not identified a causal mechanism. There are many economic and social mechanisms that underlie these results. These

include changes in the medical care system along with social changes such as the nature of work and peoples' relationships to communities. Understanding the causal mechanisms behind these findings will clearly be an important task for future research.

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