



FAST TRACK

Effect of the covid-19 pandemic in 2020 on life expectancy across populations in the USA and other high income countries: simulations of provisional mortality data

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ABSTRACT

OBJECTIVE

To estimate changes in life expectancy in 2010-18 and during the covid-19 pandemic in 2020 across population groups in the United States and to compare outcomes with peer nations.

DESIGN

Simulations of provisional mortality data.

SETTING

US and 16 other high income countries in 2010-18 and 2020, by sex, including an analysis of US outcomes by race and ethnicity.

POPULATION

Data for the US and for 16 other high income countries from the National Center for Health Statistics and the Human Mortality Database, respectively.

MAIN OUTCOME MEASURES

Life expectancy at birth, and at ages 25 and 65, by sex, and, in the US only, by race and ethnicity. Analysis excluded 2019 because life table data were not available for many peer countries. Life expectancy in 2020 was estimated by simulating life tables from estimated age specific mortality rates in 2020 and allowing for 10% random error. Estimates for 2020 are reported as medians with fifth and 95th centiles.

RESULTS

Between 2010 and 2018, the gap in life expectancy between the US and the peer country average increased from 1.88 years (78.66 v 80.54 years, respectively) to 3.05 years (78.74 v 81.78 years). Between 2018 and 2020, life expectancy in the US

decreased by 1.87 years (to 76.87 years), 8.5 times the average decrease in peer countries (0.22 years), widening the gap to 4.69 years. Life expectancy in the US decreased disproportionately among racial and ethnic minority groups between 2018 and 2020, declining by 3.88, 3.25, and 1.36 years in Hispanic, non-Hispanic Black, and non-Hispanic White populations, respectively. In Hispanic and non-Hispanic Black populations, reductions in life expectancy were 18 and 15 times the average in peer countries, respectively. Progress since 2010 in reducing the gap in life expectancy in the US between Black and White people was erased in 2018-20; life expectancy in Black men reached its lowest level since 1998 (67.73 years), and the longstanding Hispanic life expectancy advantage almost disappeared.

CONCLUSIONS

The US had a much larger decrease in life expectancy between 2018 and 2020 than other high income nations, with pronounced losses among the Hispanic and non-Hispanic Black populations. A longstanding and widening US health disadvantage, high death rates in 2020, and continued inequitable effects on racial and ethnic minority groups are likely the products of longstanding policy choices and systemic racism.

Introduction

In 2020, covid-19 became the third leading cause of death in the United States¹ and was thus expected to substantially lower life expectancy for that year (box 1). The US had more deaths from covid-19 than any other country in the world and among the highest per capita mortality rates.⁵ This surge in deaths prompted speculation that the US would have a larger decrease in life expectancy in 2020 than peer nations, but empirical evidence has not been published. Americans entered the pandemic at a distinct disadvantage relative to other high income peer nations: improvements in overall life expectancy have not kept pace with those in peer countries since the 1980s,⁶ and in 2011, life expectancy in the US plateaued and then decreased for three consecutive years, further widening the gap in mortality with peer nations.⁷

The effect of the pandemic on life expectancy extends beyond deaths attributed to covid-19.⁸ Studies have found an even larger number of excess deaths during the pandemic, inflated by undocumented deaths from covid-19 and by deaths from non-covid-19 causes resulting from disruptions by the pandemic (eg, reduced access to healthcare, economic pressures, and mental health crises).⁹⁻¹² Some racial

WHAT IS ALREADY KNOWN ON THIS TOPIC

Because of systemic factors in the United States, the gap between life expectancy in the US and other high income countries has been widening for decades

In 2020, the US had more deaths from the covid-19 pandemic than any other country, but no study has quantified how the year's large number of deaths affected life expectancy in the US or the gap with peer countries

WHAT THIS STUDY ADDS

Between 2018 and 2020, largely because of the covid-19 pandemic, life expectancy in the US decreased by 1.87 years, 8.5 times the average decrease in peer countries, widening the gap in life expectancy with peer countries to 4.69 years

In the US, decreases in life expectancy in Hispanic and non-Hispanic Black people were about two to three times greater than in the non-Hispanic White population, reversing years of progress in reducing racial and ethnic disparities, and lowering the life expectancy of Black men to 67.73 years, a level not seen since 1998

Box 1: Meaning of life expectancy during a pandemic

Life expectancy is a widely used statistic for summarizing a population’s mortality rates at a given time.² It reflects how long a group of people can expect to live were they to experience at each age the prevailing age specific mortality rates of that year.³ Estimates of life expectancy are sometimes misunderstood. We cannot know the future age specific mortality rates for people born or living today, but we do know the current rates. Computing life expectancy (at birth, or at ages 25 or 65) based on these rates is valuable for understanding and comparing a country’s mortality profile over time or across places at a given point in time. Estimates of life expectancy during the covid-19 pandemic, such as those reported here, can help clarify which people or places were most affected, but they do not predict how long a group of people will live. This study estimated life expectancy for 2020. Life expectancy for 2021 and subsequent years, and how quickly life expectancy will rebound, cannot be calculated until data for these years become available. Although life expectancy is expected to recover in time to levels before the pandemic, past pandemics have shown that survivors can be left with lifelong consequences, depending on their age and other socioeconomic circumstances.⁴

and ethnic populations and age groups have been disproportionately affected.¹³⁻¹⁵ Research on how the pandemic has affected life expectancy is only just emerging.^{16 17} Few studies have examined reductions in 2020 life expectancy across racial and ethnic groups, and none has compared the decline in the US with other countries.

Methods

We estimated life expectancy at birth and at ages 25 and 65, examining the US population (in aggregate and by sex, and by race and ethnicity) and the populations of 16 high income countries (in aggregate

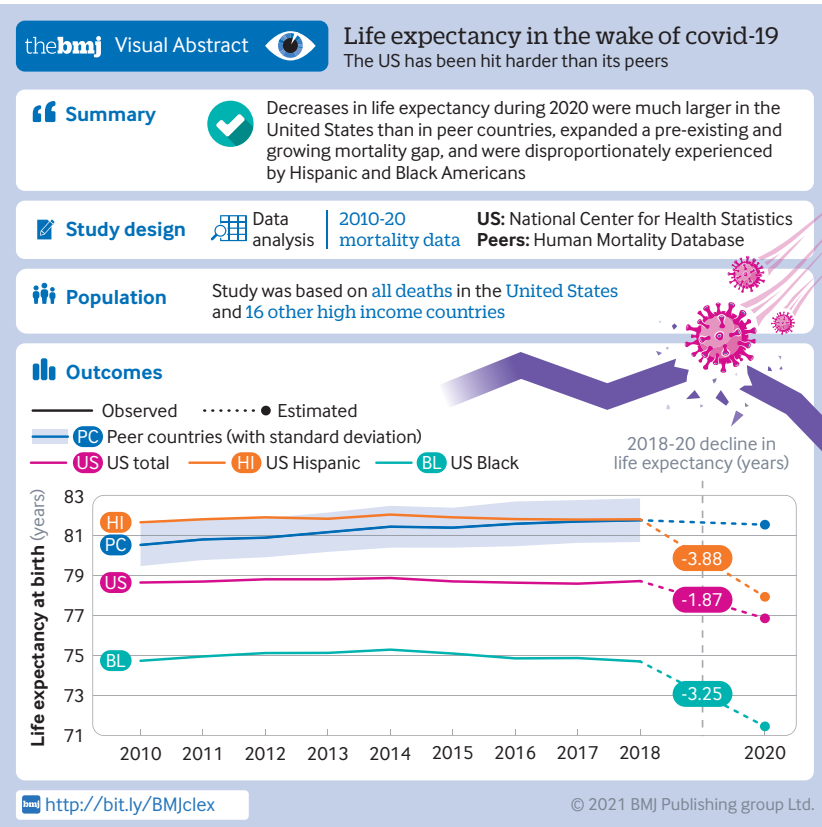
and by sex). Estimates of life expectancy for 2010-18 were calculated from official life tables and were modeled for 2020. Estimates for 2019 would have been preferable to determine the effect of the covid-19 pandemic but life table data were unavailable for many peer countries. Life expectancy in the US is estimated to have increased by only 0.1 years between 2018 and 2019,¹⁸ however, and therefore the changes seen in life expectancy between 2018 and 2020 are largely attributable to the events of 2020.

Data for peer countries did not include information on race or ethnicity. US data were examined for three racial and ethnic groups that constitute more than 90% of the total population: Hispanic, non-Hispanic Black, and non-Hispanic White populations. Although many US individuals self-identify as Latino or Latina, we used Hispanic to maintain consistency with data sources. White and Black populations in this study refer to people in these racial groups who do not identify as Hispanic or Latinx.¹⁹ Estimates for other important racial groups, such as Asian, Pacific Islander, and Native American (American Indians and Alaskan Natives) could not be calculated because the National Center for Health Statistics does not provide official life tables for these populations.

US life tables for 2010-18 were obtained from the National Center for Health Statistics.²⁰⁻²⁸ Weekly age specific death counts for all men and women in the US and for Black, White, and Hispanic men and women in the US for the years 2018 and 2020 were obtained from the National Center for Health Statistics’ AH (ad hoc) Excess Deaths by Sex, Age, and Race file.²⁹ Mid-year population estimates by age, sex, and race and ethnicity for men and women in the US for 2015-19 were obtained from the US Census Bureau.³⁰ Population counts for 2020 were estimated from age specific trends in US population estimates for 2015-19. The National Center for Health Statistics and US Census data were merged at ages 0-14, 15-19, . . . 80-84, ≥85 to calculate age specific death rates (m_x) for 2018 and 2020 for men and women in the US in aggregate and by race and ethnicity.

Peer countries included 16 high income democracies with adequate data for analysis: Austria, Belgium, Denmark, Finland, France, Israel, Netherlands, New Zealand, Norway, South Korea, Portugal, Spain, Sweden, Switzerland, Taiwan, and the United Kingdom. Taiwan was treated as a country for our analysis although many countries do not recognize it as an independent country. Australia, Canada, Germany, Italy, and Japan were not included because of incomplete mortality data. To estimate life expectancy in these countries, five year abridged life tables for male and female populations of the peer countries were obtained for 2010-18 from the Human Mortality Database³¹ (direct sources^{32 33} were used for Israel and New Zealand because current data were lacking in the Human Mortality Database). Weekly death counts in 2018 and 2020 by country for ages 0-14, 15-64, 65-74, 75-84, and ≥85 were obtained from the Human Mortality Database Short Term Mortality Fluctuations files.

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To calculate life expectancy estimates for 2020, we used data from the National Center for Health Statistics and US Census Bureau to estimate rate ratios between the age specific mortality rates of 2018 (2018 m_x) and 2020 (2020 m_x) for US populations. For populations in peer countries, values for 2018 m_x and 2020 m_x , taken from data in the Human Mortality Database Short Term Mortality Fluctuations files, were estimated for ages 0-14, 15-64, 65-74, 75-84, and ≥ 85 . Age specific mortality rate ratios between 2020 m_x and 2018 m_x data in the Human Mortality Database Short Term Mortality Fluctuations were estimated for each peer country in aggregate and by sex. Age specific probabilities of death in 2020 (q_x), for ages 0-1, 1-4, 5-9, . . . 90-94, 95-99, ≥ 100 , were estimated separately for men and women in the US and for men and women in specific race and ethnic group populations by multiplying 2018 m_x ²⁸ by the 2020-18 rate ratio estimates derived from data from the National Center for Health Statistics and US Census Bureau, and calculating $q_x = (m_x \times n) / (1 + m_x \times a_x)$, where q_x is the age specific probability of death, m_x is the age specific mortality rate, n is the width of the age interval, and a_x is the age specific person years lived by the deceased.³⁴ Probabilities of death for each peer country in 2020 were estimated by multiplying q_x in the Human Mortality Database life tables by the 2020-18 rate ratios in the Human Mortality Database Short Term Mortality Fluctuations data.

We used Python (version 3.9.1) to simulate 50 000 five year abridged 2020 life tables for each US subpopulation, with the estimated q_x for 2020, a_x derived from 2018 official life tables,²⁸ and random 10% error in the q_x estimate. For each peer country population, 50 000 five year abridged 2020 life tables were simulated with the estimated 2020 q_x and 2018 a_x values in the Human Mortality Database 2018 life tables, and random 10% error in the q_x estimate. We present median estimates of 2020 life expectancy at birth and at ages 25 and 65; fifth and 95th centiles are presented in the tables. The supplementary material provides further details on methods.

Patient and public involvement

Involving patients or the public in the design, conduct, reporting, or dissemination plans of our research was not possible because of the urgency of the analysis and its focus on decedents.

Results

United States

After a small increase of 0.08 years between 2010 and 2018, life expectancy in the US at birth decreased by an estimated 1.87 years (or 2.4%) between 2018 and 2020 (fig 1 and supplementary fig 1). The proportional decrease in life expectancy at ages 25 and 65 was even greater (3.4% and 5.7%, respectively) (table 1). US men had a larger decrease in overall life expectancy than women, in both absolute (2.16 years *v* 1.50 years) and relative (2.8% *v* 1.8%) terms.

Between 2018 and 2020, life expectancy in the US decreased disproportionately among Black

and Hispanic populations (table 2). In the Black population, life expectancy decreased by 3.25 years (4.4%), 2.4 times the decrease in the White population (1.36 years, 1.7%), with larger reductions in men (3.56 years, 5.0%) than women (2.65 years, 3.4%). In 2020, life expectancy in Black men was only 67.73 years. The decrease in life expectancy among Hispanic individuals was even larger (3.88 years, 4.7%), 2.9 times the decrease in White people, with larger reductions in men (4.58 years, 5.8%) than women (2.94 years, 3.5%).

The disproportionate decrease in life expectancy in the US Black population during 2018-20 reversed years of progress in reducing the gap in mortality between Black and White populations. Although the gap in life expectancy between Black and White populations decreased from 4.02 years in 2010 to 3.54 years in 2014, the gap increased to 3.92 years in 2018, and to 5.81 years in 2020. Historically, the US Hispanic population has had a longer life expectancy than the White population.^{35 36} Although that advantage widened between 2010 and 2017, from 2.91 years to 3.30 years, the gap decreased to 3.20 years in 2018 and then decreased sharply to 0.68 years in 2020 (table 2); the advantage reversed entirely in Hispanic men (from 2.88 years in 2018 to -0.20 years in 2020).

United States versus peer countries

Figure 1 presents estimates of life expectancy for 2010-18 and 2020 for the US and the average for 16 high income countries. The US began the decade with a 1.88 year deficit in life expectancy relative to peer countries. This gap increased over the decade, reaching 3.05 years in 2018. Between 2018 and 2020, the gap widened substantially to 4.69 years: the 1.87 year decrease in life expectancy in the US was 8.5 times the average decrease in peer countries (0.22 years). Table 3 presents the estimates of life expectancy for peer countries at birth, and at ages 25 and 65 in 2010, 2018, and 2020.

Changes in life expectancy varied substantially across peer countries. Six countries (Denmark, Finland, New Zealand, Norway, South Korea, and Taiwan) had increases in life expectancy between 2018 and 2020. Among the other 10 peer countries, decreases in life expectancy ranged from 0.12 years in Sweden to 1.09 years in Spain, but none approached the 1.87 year loss seen in the US.

Figure 2 (and supplementary fig 2) contrasts changes in life expectancy in the US in 2010-18 and 2018-20 with those of peer countries, based on sex, and on race and ethnicity. Figure 3 (and supplementary fig 3) shows how these changes contributed to the gap between the US and peer countries. For example, figure 2 shows that life expectancy for US women increased by 0.21 years in 2010-18, but because life expectancy in women in the peer countries increased even more (0.98 years), the gap increased by 0.77 years (fig 3). The gap increased by another 1.36 years during 2018-20, largely because of the pandemic. Overall, the gap between the US and peer countries for women

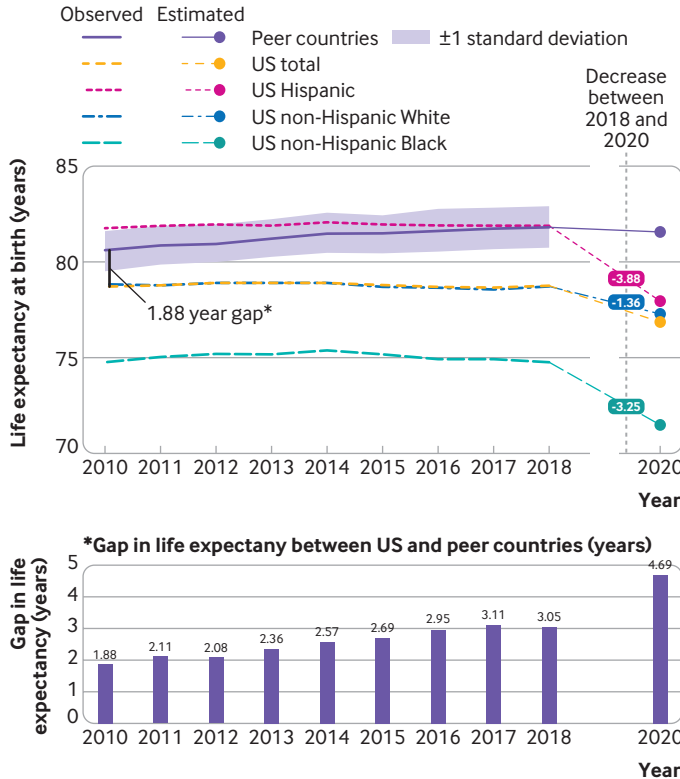


Fig 1 | Life expectancy at birth in the United States, by race and ethnicity, and in peer countries, for years 2010-18 and 2020. Data obtained from the National Center for Health Statistics, US Census Bureau, and Human Mortality Database. Data for 2019 could not be calculated because life table data were unavailable for many peer countries

increased by 2.14 years (fig 3), from 1.97 years in 2010 (81.04 v 83.01 years) to 4.11 years (79.75 v 83.86 years) in 2020 (table 1 and table 3). The gap between the US and peer countries for men increased even more (3.37 years) (fig 3). In 2020, life expectancy for US men was 5.27 years (74.06 v 79.33 years) shorter than the peer country average for men.

The demographic composition and ethnic inequities of peer countries varied considerably, making it difficult to identify analogous reference populations

to compare with the US racial and ethnic groups. But the peer country average provides a useful benchmark for showing the disproportionately large decreases in life expectancy in Black and Hispanic populations in the US (fig 1, fig 2, and fig 3). For example, among Black men and women in the US, the decrease in life expectancy between 2018 and 2020 was 12.3 times and 20.3 times greater, respectively, than the average decrease for men and women in peer countries. The corresponding values were even larger for the Hispanic population in the US, with estimated declines in life expectancy 15.9 times and 22.5 times higher among men and women, respectively, compared with their counterparts in peer countries.

Discussion

Long before covid-19, the US was at a disadvantage relative to other high income nations in terms of health and survival.^{6 37-41} In 2013, a report by the National Research Council and Institute of Medicine showed that from the 1980s, the US had higher rates of morbidity and mortality for multiple conditions relative to other high income countries.⁶ A recent report by the National Academies of Sciences, Engineering, and Medicine found that this gap widened further through 2017 and that the greatest relative increase in mortality in the US occurred in young and middle aged adults (aged 25-64). Increased mortality in this age group was largely because of deaths from drug use, suicide, cardiometabolic diseases, and other chronic illnesses and injuries.⁴² Between 2014 and 2017, whereas life expectancy continued to increase in other countries, life expectancy in the US decreased by 0.3 years,⁷ a three year decline that generated considerable public concern⁴³ but is now overshadowed by the large 2020 declines reported here. Even countries with much lower per capita incomes outperform the US.⁴⁴⁻⁴⁷ According to data for 36 member countries of the Organization for Economic Cooperation and Development (OECD), the gap in life expectancy between the US and the OECD average increased from 0.9 to 2.2 years between 2010 and 2017.^{48 49}

This study shows that the gap in life expectancy in the US increased markedly between 2018 and 2020. The decrease in life expectancy in the US was 8.5 times the average loss seen in 16 high income peer nations and the largest decrease since 1943 during the second world war.⁵⁰ The conditions that produced a US health disadvantage before the arrival of covid-19 are still in place, but the predominant cause for this large decline was the covid-19 pandemic: in 2020, all cause mortality in the US increased by 23%.¹²

We found large differences in the reductions in life expectancy during the covid-19 pandemic based on race and ethnicity. Decreases in life expectancy among Black and Hispanic men and women were about two to three times greater than in White people, and far larger than those in peer countries. Decreases in life expectancy of US Black and Hispanic men were 12-16 times greater than those in men from other high income countries. Corresponding decreases in life

Table 1 | Life expectancy in the United States at birth, and at ages 25 and 65, by sex, for years 2010, 2018, and 2020

	Life expectancy (years)			Change in life expectancy (years, P ₅ , P ₉₅)	
	2010	2018	2020 (years, P ₅ , P ₉₅)	2018 v 2010	2020 v 2018
Life expectancy at birth					
Total	78.66	78.74	76.87 (76.70 to 77.04)	0.08	-1.87 (-2.04 to -1.70)
Women	81.04	81.25	79.75 (79.59 to 79.92)	0.21	-1.50 (-1.66 to -1.33)
Men	76.20	76.22	74.06 (73.88 to 74.24)	0.02	-2.16 (-2.34 to -1.98)
Life expectancy at age 25					
Total	54.71	54.76	52.91 (52.74 to 53.09)	0.05	-1.84 (-2.02 to -1.67)
Women	56.87	57.04	55.54 (55.37 to 55.71)	0.17	-1.51 (-1.67 to -1.34)
Men	52.44	52.43	50.32 (50.14 to 50.50)	-0.01	-2.12 (-2.29 to -1.93)
Life expectancy at age 65					
Total	19.13	19.47	18.37 (18.19 to 18.55)	0.34	-1.11 (-1.28 to -0.93)
Women	20.33	20.69	19.67 (19.50 to 19.84)	0.36	-1.02 (-1.19 to -0.85)
Men	17.70	18.10	16.93 (16.75 to 17.12)	0.40	-1.16 (-1.34 to -0.98)

P₅, P₉₅=5th and 95th centiles of 50 000 simulated life expectancies with 10% random uncertainty around the estimated probability of death for 2020. Data derived from the National Center for Health Statistics, US Census Bureau, and Human Mortality Database. Sums might differ from text because of rounding.

Table 2 | Life expectancy in the United States at birth, and at ages 25 and 65, by sex, race, and ethnicity, for years 2010, 2018, and 2020

	Life expectancy (years)			Change in life expectancy (years, P ₅ , P ₉₅)	
	2010	2018	2020 (P ₅ , P ₉₅)	2018 v 2010	2020 v 2018
Life expectancy at birth					
Total					
Hispanic	81.68	81.83	77.95 (77.78 to 78.12)	0.15	-3.88 (-4.05 to -3.71)
Non-Hispanic Black	74.75	74.71	71.46 (71.27 to 71.65)	-0.04	-3.25 (-3.44 to -3.06)
Non-Hispanic White	78.76	78.63	77.27 (77.10 to 77.44)	-0.13	-1.36 (-1.53 to -1.19)
Women					
Hispanic	84.26	84.32	81.38 (81.22 to 81.54)	0.06	-2.94 (-3.10 to -2.78)
Non-Hispanic Black	77.70	77.99	75.34 (75.16 to 75.52)	0.29	-2.65 (-2.83 to -2.47)
Non-Hispanic White	81.12	81.10	79.99 (79.83 to 80.16)	-0.02	-1.11 (-1.27 to -0.94)
Men					
Hispanic	78.84	79.08	74.50 (74.33 to 74.68)	0.24	-4.58 (-4.75 to -4.40)
Non-Hispanic Black	71.51	71.29	67.73 (67.54 to 67.93)	-0.22	-3.56 (-3.75 to -3.36)
Non-Hispanic White	76.35	76.20	74.70 (74.52 to 74.87)	-0.15	-1.50 (-1.68 to -1.33)
Life expectancy at age 25					
Total					
Hispanic	57.57	57.71	53.85 (53.68 to 54.03)	0.14	-3.86 (-4.03 to -3.68)
Non-Hispanic Black	51.42	51.43	48.34 (48.15 to 48.53)	0.01	-3.09 (-3.28 to -2.90)
Non-Hispanic White	54.72	54.54	53.16 (52.99 to 53.33)	-0.18	-1.38 (-1.55 to -1.21)
Women					
Hispanic	59.97	60.06	57.12 (56.96 to 57.29)	0.09	-2.94 (-3.10 to -2.77)
Non-Hispanic Black	54.00	54.28	51.69 (51.51 to 51.87)	0.28	-2.59 (-2.77 to -2.41)
Non-Hispanic White	56.86	56.80	55.66 (55.49 to 55.82)	-0.06	-1.14 (-1.31 to -0.98)
Men					
Hispanic	54.88	55.11	50.62 (50.44 to 50.80)	0.23	-4.49 (-4.67 to -4.31)
Non-Hispanic Black	48.47	48.33	44.99 (44.79 to 45.19)	-0.14	-3.34 (-3.54 to -3.14)
Non-Hispanic White	52.50	52.29	50.77 (50.59 to 50.95)	-0.21	-1.52 (-1.70 to -1.34)
Life expectancy at age 65					
Total					
Hispanic	21.15	21.44	18.85 (18.67 to 19.03)	0.29	-2.59 (-2.77 to -2.41)
Non-Hispanic Black	17.71	18.02	16.13 (15.93 to 16.32)	0.31	-1.89 (-2.09 to -1.70)
Non-Hispanic White	19.11	19.38	18.50 (18.33 to 18.68)	0.27	-0.88 (-1.05 to -0.70)
Women					
Hispanic	22.62	22.70	20.54 (20.38 to 20.72)	0.08	-2.16 (-2.32 to -1.98)
Non-Hispanic Black	19.15	19.52	17.76 (17.57 to 17.94)	0.37	-1.76 (-1.95 to -1.58)
Non-Hispanic White	20.28	20.58	19.77 (19.60 to 19.94)	0.30	-0.81 (-0.98 to -0.64)
Men					
Hispanic	19.23	19.73	16.86 (16.68 to 17.05)	0.50	-2.87 (-3.05 to -2.68)
Non-Hispanic Black	15.79	16.11	14.24 (14.04 to 14.44)	0.32	-1.87 (-2.07 to -1.67)
Non-Hispanic White	17.72	18.06	17.16 (16.98 to 17.34)	0.34	-0.90 (-1.08 to -0.72)

P₅, P₉₅=5th and 95th centiles of 50 000 simulated life expectancies with 10% random uncertainty around the estimated probability of death for 2020. Data derived from the National Center for Health Statistics, US Census Bureau, and Human Mortality Database. Sums might differ from text because of rounding.

expectancy among US Black and Hispanic women were 20-23 times greater than those for women in peer countries. Progress made between 2010 and 2018 in reducing the gap in life expectancy between Black and White populations in the US was erased between 2018 and 2020. Life expectancy in Black men fell to 67.73 years, a level not seen since 1998.⁵¹ The US Hispanic life expectancy advantage was erased in men and nearly disappeared in women.

Strengths and limitations of this study

Our study estimated the effect of the covid-19 pandemic on life expectancy in the US for 2020, and compared life expectancy in the US with other high income countries. The study used a new method for these calculations, detailed in the supplementary appendix. The study also had several limitations. First, life expectancies for 2020 were simulated with preliminary mortality data, which are subject to errors (eg, undercounting, and mismatching between death

and population counts) and often vary across racial and ethnic populations and countries. Second, the 2020 q_x values used to generate life tables for peer populations could have been biased by the wide age ranges used in the Human Mortality Database Short Term Mortality Fluctuations files. Third, definitions for peer countries vary; our list differs from the 16 high income countries used in several cross national comparisons.^{6 37 38} Five large high income democracies (Australia, Canada, Germany, Italy, and Japan) were excluded because of incomplete data. Fourth, we compared life expectancy in 2020 with 2018 values; the effect of the pandemic would be better determined by comparisons with life expectancy in 2019, but data for many peer countries were unavailable for this calculation. Fifth, for reasons explained in the supplementary material, data on race and ethnicity for the US population and for 2020 deaths were incomplete,⁵² likely underestimating racial inequalities. Reports suggest that covid-19 and all cause mortality in 2020 were very high in American

Table 3 | Average life expectancy in peer countries at birth, and at ages 25 and 65, by sex, for years 2010, 2018, and 2020

	Life expectancy (years)			Change in life expectancy (years, P ₅ , P ₉₅)	
	2010	2018	2020 (P ₅ , P ₉₅)	2018 v 2010	2020 v 2018
Life expectancy at birth					
Total	80.54	81.78	81.56 (81.40 to 81.71)	1.24	-0.22 (-0.38 to -0.07)
Women	83.01	83.99	83.86 (83.71 to 84.01)	0.98	-0.13 (-0.28 to 0.02)
Men	78.10	79.62	79.33 (79.17 to 79.49)	1.52	-0.29 (-0.45 to -0.13)
Life expectancy at age 25					
Total	56.21	57.35	57.08 (56.93 to 57.24)	1.14	-0.27 (-0.42 to -0.11)
Women	58.56	59.47	59.29 (59.14 to 59.44)	0.91	-0.18 (-0.33 to -0.03)
Men	53.86	55.26	54.94 (54.78 to 55.10)	1.40	-0.32 (-0.48 to -0.16)
Life expectancy at age 65					
Total	19.53	20.31	20.05 (19.89 to 20.21)	0.78	-0.26 (-0.42 to -0.10)
Women	21.00	21.69	21.50 (21.35 to 21.66)	0.69	-0.19 (-0.34 to 0.03)
Men	17.88	18.82	18.53 (18.36 to 18.69)	0.94	-0.29 (-0.46 to -0.13)

P₅, P₉₅=5th and 95th percentiles of 50 000 simulated life expectancies with 10% random uncertainty around the estimated probability of death for 2020.
 Data derived from the National Center for Health Statistics, US Census Bureau, and Human Mortality Database.
 Sums might differ from text because of rounding.

Indian and Alaskan Native populations.⁵³ Finally, we used the average for peer countries; values for individual countries varied.

Comparisons with other studies

This study aligns closely with previous research. An analysis of deaths between January and June 2020 found that US life expectancy decreased by 1.0 years between 2019 and 2020, including reductions of 0.8 years in White people and reductions of 2.7 years

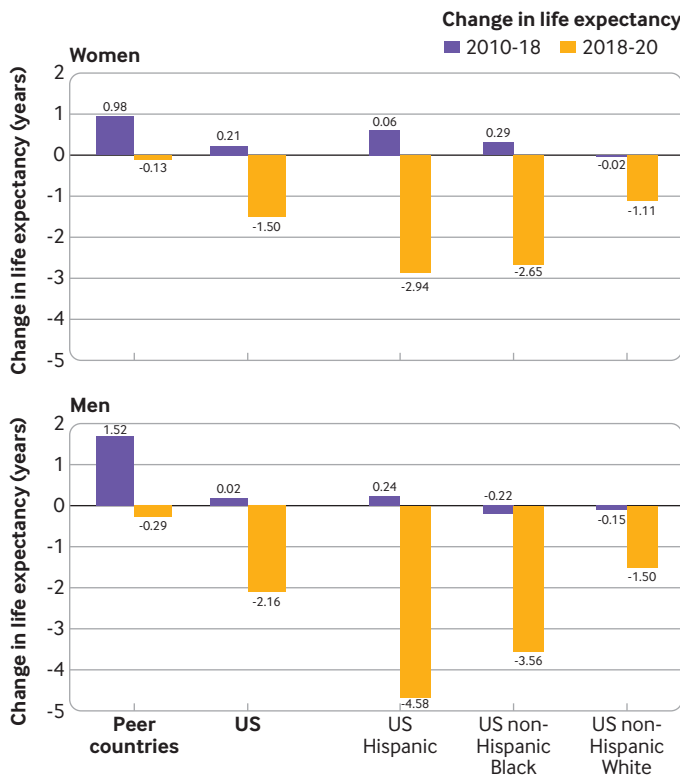


Fig 2 | Changes in life expectancy at birth in US populations and peer country average, for years 2010-18 and 2018-20. For example, life expectancy in the US for women increased by 0.21 years in 2010-18 and then decreased by 1.50 years in 2018-20. Data derived from the National Center for Health Statistics, US Census Bureau, and Human Mortality Database

and 1.9 years in Black and Hispanic individuals, respectively.¹⁷ Andrasfay and Goldman estimated that life expectancy from January to mid-October 2020 was 1.1 years below expected values, including a reduction of 0.7 years in White populations and reductions of 2.1 and 3.1 years in Black and Hispanic populations, respectively.¹⁶ Neither study examined changes in life expectancy in other countries or estimated life expectancy in the US for the whole of 2020.

Policy implications

The decreases in life expectancy that we found and the excess deaths reported in several studies of 2020 death counts⁹⁻¹² could reflect the combined effects of deaths attributed to covid-19, deaths where SARS Co-V-2 infection was unrecognized or undocumented, and deaths from non-covid-19 health conditions, exacerbated by limited access to healthcare and by widespread social and economic disruptions produced by the pandemic (eg, unemployment, food insecurity, and homelessness).^{8 54} These adverse outcomes are products of national, state, and local policy decisions, and actions and inactions that influenced viral transmission and management of the pandemic.⁵⁵⁻⁶⁰ These policies span healthcare, public health, employment, education, and social protection systems. Many organizations are tracking these decisions internationally for ongoing research and development.⁶¹⁻⁶⁴

The large number of covid-19 deaths in the US reflects not only the country's policy choices and mishandling of the pandemic⁵⁵⁻⁶⁰ but also deeply rooted factors that have put the country at a health disadvantage for decades.^{6 7 65 66} For much of the public, it was the pandemic itself that drew attention to these longstanding conditions, including major deficiencies in the US healthcare and public health systems, widening social and economic inequality, and stark inequities and injustices experienced by Black, Hispanic, Asian, and Indigenous populations and other systematically marginalized and excluded groups. Many studies have reported that rates of covid-19 infections, admissions to hospital, and deaths are substantially higher in Black and Hispanic populations compared with White people, because of greater exposure to the virus, a higher prevalence of comorbid conditions (eg, diabetes), and reduced access to healthcare and other protective resources.^{67 68}

Evidence of disproportionate reductions in life expectancy among racial and ethnic groups in the US, such as the disparities reported here, draws attention to the root causes of racial inequities in health, wealth, and wellbeing. Foremost among these root causes is systemic racism; extensive research has shown that systems of power in the US structure opportunity and assign value in ways that unfairly disadvantage Black, Hispanic, Asian, and Indigenous populations, and unfairly advantage White people.⁶⁹⁻⁷⁵ Many of the same factors placed these populations at greater risk from covid-19.^{13-15 76-80} The higher prevalence of comorbid conditions in many racial or marginalized

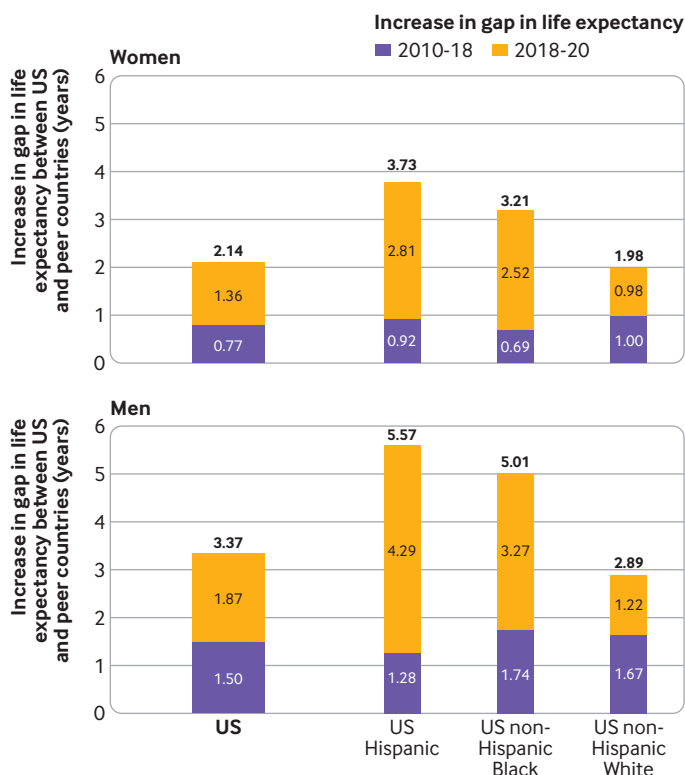


Fig 3 | Increasing gap in life expectancy between the United States and peer country average, for years 2010-18 and 2018-20. For example, the gap between life expectancy for men in the US men and the average life expectancy for men in peer countries increased by 1.50 years in 2010-18 and by a further 1.87 years in 2018-20. Data derived from the National Center for Health Statistics, US Census Bureau, and Human Mortality Database. Sums might differ because of rounding

groups is a reflection of unequal access to the social determinants of health (eg, education, income, and justice) and not their race, ethnicity, or other socially determined constructs. Low income communities and women have also been disproportionately affected by the social, familial, and economic disruptions of the pandemic.^{81 82} Reduced access to covid-19 vaccines, and vaccine hesitancy rooted in a community's distrust of systems that have mistreated them, might exacerbate these disparities. Structural factors affect not only Black and Hispanic populations but other marginalized people and places. American Indians and Alaskan Natives, for example, have some of the worst health outcomes of any group in the US, but data limitations precluded separate calculations for these important populations.

Conclusions

The mortality outcomes examined in this study, in the research literature, and in the daily news represent only part of the burden of covid-19; for every death, a larger number of infected individuals experience acute illness, and many face long term health and life complications.⁸³ Whether some of these long term complications will affect how quickly life expectancy in the US will rebound in the coming years is unclear. Morbidity and mortality during the pandemic have wider effects on families, neighborhoods, and

communities. One study estimated that each death leaves behind an average of nine bereaved family members.⁸⁴ The pandemic will have short and long term effects on the social determinants of health, changing living conditions in many communities, and altering life course trajectories across age groups. Fully understanding the health consequences of these changes poses a daunting but important challenge for future research.

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The lead author (SHW) affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

Dissemination to participants and related patient and public communities: Print, broadcast, and social media will be used to disseminate the results of this study to journalists and the public, and summaries will be shared with policy makers, social justice organizations, and other relevant stakeholders.

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Ethical approval: Not required.

Data sharing: Requests for additional data and analytic scripts used in this study should be emailed to RKM (Ryan.Masters@colorado.edu).

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Web appendix: Supplementary material

Web figure: Supplementary figure 1

Web figure: Supplementary figure 2

Web figure: Supplementary figure 3