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Changes in the Relationship Between Income and Life Expectancy Before and During the COVID-19 Pandemic, California, 2015-2021

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🞢 Supplemental content

IMPORTANCE The COVID-19 pandemic caused a large decrease in US life expectancy in 2020, but whether a similar decrease occurred in 2021 and whether the relationship between income and life expectancy intensified during the pandemic are unclear.

OBJECTIVE To measure changes in life expectancy in 2020 and 2021 and the relationship between income and life expectancy by race and ethnicity.

DESIGN, SETTING, AND PARTICIPANTS Retrospective ecological analysis of deaths in California in 2015 to 2021 to calculate state- and census tract–level life expectancy. Tracts were grouped by median household income (MHI), obtained from the American Community Survey, and the slope of the life expectancy-income gradient was compared by year and by racial and ethnic composition.

EXPOSURES California in 2015 to 2019 (before the COVID-19 pandemic) and 2020 to 2021 (during the COVID-19 pandemic).

MAIN OUTCOMES AND MEASURES Life expectancy at birth.

RESULTS California experienced 1 988 606 deaths during 2015 to 2021, including 654 887 in 2020 to 2021. State life expectancy declined from 81.40 years in 2019 to 79.20 years in 2020 and 78.37 years in 2021. MHI data were available for 7962 of 8057 census tracts (98.8%; n = 1 899 065 deaths). Mean MHI ranged from $21 279 to $232 261 between the lowest and highest percentiles. The slope of the relationship between life expectancy and MHI increased significantly, from 0.075 (95% CI, 0.07-0.08) years per percentile in 2019 to 0.103 (95% CI, 0.098-0.108; P < .001) years per percentile in 2020 and 0.107 (95% CI, 0.102-0.112; P < .001) years per percentile in 2021. The gap in life expectancy between the richest and poorest percentiles increased from 11.52 years in 2019 to 14.67 years in 2020 and 15.51 years in 2021. Among Hispanic and non-Hispanic Asian, Black, and White populations, life expectancy declined 5.74 years among the Hispanic population, 3.04 years among the non-Hispanic Asian population, 3.84 years among the non-Hispanic Black population, and 1.90 years among the non-Hispanic White population between 2019 and 2021. The income–life expectancy gradient in these groups increased significantly between 2019 and 2020 (0.038 [95% CI, 0.030-0.045; P < .001] years per percentile among Hispanic individuals; 0.024 [95% CI: 0.005-0.044; P = .02] years per percentile among Asian individuals; 0.015 [95% CI, 0.010-0.020; P < .001] years per percentile among Black individuals; and 0.011 [95% CI, 0.007-0.015; P < .001] years per percentile among White individuals) and between 2019 and 2021 (0.033 [95% CI, 0.026-0.040; P < .001] years per percentile among Hispanic individuals; 0.024 [95% CI, 0.010-0.038; P = .002] years among Asian individuals; 0.024 [95% CI, 0.011-0.037; P = .003] years per percentile among Black individuals; and 0.013 [95% CI, 0.008-0.018; P < .001] years per percentile among White individuals). The increase in the gradient was significantly greater among Hispanic vs White populations in 2020 and 2021 (P < .001 in both years) and among Black vs White populations in 2021 (P = .04).

CONCLUSIONS AND RELEVANCE This retrospective analysis of census tract–level income and mortality data in California from 2015 to 2021 demonstrated a decrease in life expectancy in both 2020 and 2021 and an increase in the life expectancy gap by income level relative to the prepandemic period that disproportionately affected some racial and ethnic minority populations. Inferences at the individual level are limited by the ecological nature of the study, and the generalizability of the findings outside of California are unknown.

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T he income-health gradient—the positive correlation be-
tween income and better health—is widely documented.[1-6]
Less clear is whether the slope of that gradient changed
in recent years, a period during which income inequality widened
in the US.

This question assumed greater importance during the
COVID-19 pandemic, during which mounting economic stresses
might have altered the slope of the gradient and increased pre-
mature mortality among people with low incomes. Linking
mortality to income at the individual level is difficult be-
cause income is not reported on US death certificates. An al-
ternative is to link mortality to place-based income for smaller
geographic areas, such as counties or census tracts.[6,7]

The relationship between income and mortality is fur-
ther complicated by the role of race and ethnicity. Genera-
tions of systemic racism have exposed racial and ethnic mi-
nority groups to both lower income and higher mortality
rates.[7-9] Notably during the pandemic, studies reported higher
COVID-19 mortality rates in the American Indian and Alaska
Native, Black, and Hispanic populations.[10-14] Whether de-
creases in life expectancy observed in 2020 extended into 2021
and whether its relationship with income, race, and Hispanic
ethnicity shifted during this time remains unclear.

This study's aim was to measure changes in life expec-
tancy in 2020 and 2021 and examine how the relationship be-
tween income and life expectancy varied by year and by race
and ethnicity. The study examined changes in the income–life
expectancy gradient between 2015 and 2021, capturing the pe-
riod before and during the first 2 years of the pandemic, and how
those changes differed across racial and ethnic populations.

Methods

The California State Institutional Review Board waived re-
quirements for informed consent because human subjects were
not involved.

Death, Population, and Income Data

Restricted death data were obtained from the California Com-
prehensive Death Files maintained by the California Depart-
ment of Health. These files provide detailed information about
every death in California, including dates of birth and death,
race and ethnicity, and census tract of residence. Although this
analysis focused on deaths that occurred in 2019, 2020, and
2021, deaths in 2015, 2016, 2017, and 2018 were also exam-
ined to assess prepandemic mortality trends.

State-level calculations were based on all reported deaths
in California (including decedents with out-of-state resi-
dence, consistent with the methodology of the US Mortality
Database).[15] Death data were obtained on March 22, 2022,
when death counts for 2021 were largely complete and chang-
ing by less than 0.03% per week. Census tract–level calcula-
tions were based on deaths that occurred in census tracts for
which data on median household income were available from
the US Census Bureau's American Community Survey (ACS).[16]
This excluded deaths that occurred in census tracts lacking
ACS income data or that could not be ascribed to a California

Key Points

Question How did the first 2 years of the COVID-19 pandemic affect
life expectancy in California and the relationship between census
tract income and life expectancy relative to prepandemic years?

Findings In this retrospective analysis of 1 988 606 deaths in
California during 2015 to 2021, life expectancy declined from 81.40
years in 2019 to 79.20 years in 2020 and 78.37 years in 2021. Life
expectancy differences between the census tracts in the highest
and lowest income percentiles increased from 11.52 years in 2019
to 14.67 years in 2020 and 15.51 years in 2021.

Meaning This ecological study of deaths in the state of California
demonstrated that life expectancy declines in 2020 increased in
2021 and that the life expectancy gap by income level increased
during the first 2 years of the COVID-19 pandemic relative to the
prepandemic period.

census tract (ie, not geocoded or geocoded to an out-of-state
residence). Population counts (overall and by race and ethnic-
ity) for 2015, 2016, 2017, 2018, and 2019 (the most recent year
with reliable estimates) were obtained from the ACS.

Grouping Census Tracts by Percentiles of Median Household Income

The income gradient was examined for the state population and
4 populations defined by race and ethnicity to identify racial
and ethnic differences in the income–life expectancy relation-
ship. Death data were analyzed by race and ethnicity based on
6 fixed-response options used by the California Comprehen-
sive Death Files: Hispanic and non-Hispanic American Indian
and Alaska Native, Asian, Black, Native Hawaiian and Pacific
Islanders, and White populations. This study constructed gra-
dients for 4 of these populations. For the non-Hispanic Native
Hawaiian and Pacific Islander population and the non-
Hispanic American Indian and Alaska Native population, a group
that is reported to have high mortality rates during the COVID-19
pandemic,[14] calculation of life expectancy was not possible be-
cause of historic[17] and COVID-19-related[18] deficiencies in the
quality of available death data. Many individuals in the US self-
identify as Latino/Latina. This paper uses the term *Hispanic* to
maintain consistency with data sources and with current guide-
lines on the reporting of race and ethnicity.[19]

For the statewide gradient analysis, census tracts were
ranked by median household income and then divided into 100
groups (percentiles), such that each group included approxi-
mately 1% of the California population. The population-
weighted mean of the median household income in each group
of census tracts was then computed for each calendar year. Al-
though the original ranking of census tracts by median house-
hold income was maintained throughout, for calculations of
racial and ethnic patterns, both the number of groupings and
the number of tracts within each grouping were modified to
ensure that each group of tracts included at least 250 000
people of a given race or ethnicity. For example, 93 census tract
groups, rather than 100, were formed to analyze the gradient
for the Hispanic populations. The new groups were assigned
the population-weighted mean rank of the census tracts con-
tained in a given group.

Table. Sociodemographic Characteristics and Life Expectancy by Median Household Income

Median income percentile[a]	Median household income, $[b]	Population in thousands (%)[c]				Life expectancy, y			Life expectancy change relative to 2019, y	
		Hispanic	Non-Hispanic Asian	Non-Hispanic Black	Non-Hispanic White	2019	2020	2021	2020	2021
1	21 279	179 (45.2)	60 (15.1)	50 (12.6)	85 (21.4)	75.90	72.11	71.05	−3.79	−4.85
2	27 599	241 (61.1)	31 (8.0)	32 (8.2)	72 (18.2)	77.35	72.95	72.20	−4.41	−5.15
3	30 527	244 (61.6)	33 (8.4)	39 (9.9)	61 (15.5)	78.22	74.69	73.93	−3.54	−4.30
4	32 325	262 (66.2)	19 (4.9)	31 (7.8)	65 (16.6)	77.84	74.10	73.29	−3.75	−4.55
5	34 197	228 (57.8)	20 (5.0)	38 (9.7)	88 (22.4)	77.95	74.78	73.32	−3.17	−4.63
10	40 562	234 (59.1)	28 (7.2)	33 (8.4)	80 (20.2)	78.25	74.91	74.54	−3.34	−3.72
20	49 555	214 (54.1)	35 (8.8)	28 (7.0)	100 (25.4)	80.83	77.38	76.98	−3.45	−3.85
30	57 422	200 (50.5)	38 (9.7)	27 (6.7)	110 (27.8)	79.80	78.42	77.37	−1.38	−2.43
40	65 670	167 (42.4)	44 (11.1)	18 (4.6)	141 (35.7)	81.52	79.59	78.44	−1.93	−3.07
50	74 633	159 (40.2)	48 (12.1)	18 (4.6)	146 (36.9)	81.68	78.71	78.25	−2.97	−3.43
60	84 238	152 (38.6)	58 (14.8)	17 (4.3)	145 (36.7)	82.45	80.36	79.71	−2.09	−2.74
70	95 135	129 (32.8)	59 (14.9)	17 (4.3)	160 (40.4)	82.61	81.20	80.48	−1.41	−2.12
80	109 190	84 (21.2)	73 (18.6)	18 (4.6)	192 (48.6)	83.16	82.81	81.83	−0.35	−1.33
90	132 154	69 (17.6)	77 (19.4)	11 (2.9)	208 (52.6)	84.45	83.22	82.67	−1.22	−1.78
95	153 053	47 (11.9)	87 (22.0)	10 (2.5)	221 (55.8)	86.51	85.16	84.71	−1.35	−1.80
96	158 945	39 (9.8)	115 (29.1)	7 (1.8)	206 (52.1)	85.67	84.89	84.30	−0.78	−1.37
97	166 104	39 (9.8)	103 (26.0)	7 (1.7)	215 (54.4)	85.65	85.08	84.24	−0.58	−1.41
98	180 526	33 (8.4)	98 (24.7)	7 (1.6)	228 (57.7)	87.35	85.70	85.29	−1.65	−2.06
99	197 471	27 (6.9)	121 (30.8)	6 (1.4)	211 (53.3)	85.88	85.85	85.65	−0.03	−0.23
100	232 261	23 (5.9)	106 (26.9)	4 (0.9)	231 (58.6)	87.42	86.78	86.56	−0.64	−0.86
Statewide	75 235	15 328 (39.0)	5617 (14.3)[c]	2169 (5.5)	14 605 (37.2)	81.40	79.20	78.37	−2.20	−3.04

[a] See Methods section for calculation of census tract median household income percentile. Life expectancy values and life expectancy changes across income percentiles among Hispanic and non-Hispanic Asian, Black, and White populations are reported in eTables 1-4 in the Supplement.

[b] Table presents the median household income averaged across census tracts included in a given percentile group.

[c] Population count in thousands of each percentile (parentheses) and the racial and ethnic composition (%) of that group of census tracts, calculated as population weighted mean.

Outcomes

The primary outcome was life expectancy at birth, an estimate of how long a cohort of newborns can expect to live were they to experience the prevailing age-specific mortality rates of the year in which life expectancy is measured at each age.[20] Estimates of life expectancy at birth in 2020, for example, describe the mortality experience of a population in that year of the pandemic; they are not a prediction of the lifespan of children born in 2020, which will depend on prevailing mortality rates across their life course.

Statistical Analysis

Calculation of Life Expectancy at Birth

For each year from 2015 to 2021, age-specific mortality rates were calculated for single years of age for ages 0 to 84 years. For adults aged 85 to 110 years, the US Census Bureau provides population data only in aggregate form; accordingly, an ordinary least squares regression was fitted to the log mortality rates for ages 55 to 84 years (ie, a Gompertz curve) to predict rates for single years of age older than 84 years.[5] Using standard life table methods,[20] age-specific mortality rates for ages 0 to 110 years were then used to calculate life expectancy. The same methodology was used to calculate age-specific mortality rates and life expectancy at the census tract level, using aggregate populations and death counts for each group of census tracts as described in the Supplement. Life

expectancy was calculated from largely complete death counts, obviating the need for error estimations as required in studies that model life expectancy based on sampling.

Calculation of Income Gradients in Life Expectancy

The calculated life expectancy and income rank of each census tract group were plotted for each year. They were overlaid with cubic polynomials fitted through the points via ordinary least squares. Linear income gradients were then estimated as the slope of a linear ordinary least squares regression of life expectancy on income percentile. The statistical significance of differences between slopes across years and racial and ethnic groups was based on 2-sided t tests with a significance threshold of .05. Additional details about the estimation of income gradients are provided in eAppendix part III in the Supplement.

All data were analyzed using Stata, version 16 (StataCorp).

Results

During 2015 to 2021, a total of 1 988 606 deaths occurred in California, including 320 882 deaths in 2020 and 334 005 deaths in 2021. ACS data on median household income were available for 7962 of 8057 census tracts (98.8%) in California,

representing 1 899 065 deaths (95.5%) occurring in the state. The excluded census tracts represented less than 0.1% of the state population. Approximately 4.5% of California deaths were omitted from the census tract analysis because they were not geocoded to a census tract (3.5%) or were geocoded to a census tract outside of California (0.9%). In 2019, median annual household income ranged from a mean of $21 279 in the lowest income percentile tracts to a mean of $232 261 in the highest percentile (**Table**). The median population per census tract in 2019 was 4918 people.

Statewide Life Expectancy

Life expectancy in California varied from year to year by less than 0.2 years in the period preceding the COVID-19 pandemic (2015-2019), but decreased from 81.40 years in 2019 to 79.20 years in 2020 and 78.37 years in 2021. The decline in life expectancy differed by race and ethnicity (**Figure 1**). Life expectancy in the Hispanic population, which has historically exceeded that of the non-Hispanic White population, experienced the largest decline during the pandemic, decreasing by 4.41 years, from 82.55 years in 2019 to 78.14 years in 2020—falling below life expectancy in the non-Hispanic White population—and decreasing an additional 1.33 years, to 76.81 years, in 2021. In contrast, the non-Hispanic White population experienced the smallest decrease in life expectancy, decreasing by 1.29 years, from 80.57 years in 2019 to 79.28 years in 2020, and decreasing an additional 0.61 years, to 78.67 years, in 2021. Life expectancy in the non-Hispanic Asian population, which has historically had the longest survival among US racial groups, decreased from 86.56 years in 2019 to 84.24 years in 2020 (a loss of 2.32 years) and 83.52 years in 2021 (a further loss of 0.72 years). Life expectancy among the non-Hispanic Black population, who entered the pandemic with longstanding disparities in life expectancy, decreased by 3.21 years between 2019 (74.87 years) and 2020 (71.65 years) and declined to 71.02 years in 2021 (an additional loss of 0.63 years).

Life Expectancy by Census Tract Income Percentile
Prepandemic Years
Higher census tract income was associated with longer life expectancy in every year (**Figure 2** and Table). In 2019, life expectancy ranged from 75.90 years in the lowest income group of census tracts (lowest 1%) to 87.42 years in the highest income tracts (highest 1%). The gradient—the estimated slope of the regression line through the percentile groups—in 2019 was 0.075 (95% CI, 0.070-0.080), indicating that moving from one group (percentile) of census tracts to the next highest percentile was associated with an increase of 0.075 years in life expectancy. The estimated gradients in 2019 did not differ significantly from the gradients in 2015 (0.072 years per percentile [95% CI, 0.067-0.076]; *P* = .14), 2016 (0.072 years per percentile [95% CI, 0.068-0.076]; *P* = .22), 2017 (0.074 years per percentile [95% CI, 0.070-0.079]; *P* = .65), or 2018 (0.078 years per percentile [95% CI, 0.073-0.082]; *P* = .36).

Pandemic Years (2020 and 2021)
In both 2020 and 2021, decreases in life expectancy in California were larger in the lowest income census tracts. This

Figure 1. Statewide Life Expectancy in California by Race and Ethnicity, 2015-2021
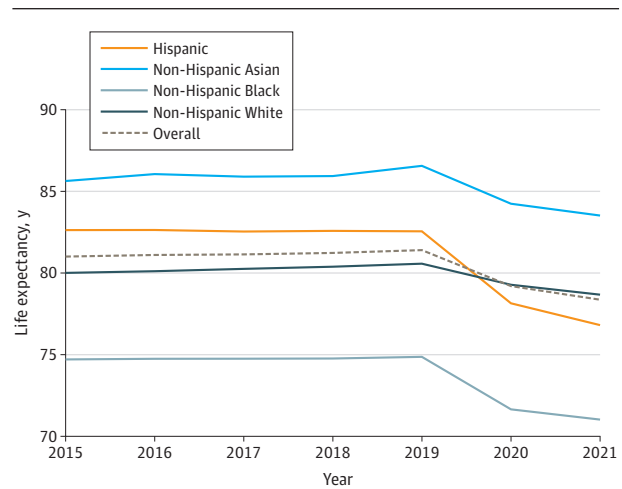
Life expectancy at birth for the total state population and for 4 racial and ethnic groups. Mortality rates were calculated by year based on all deaths in California, including nonresident decedents (numerator) and population counts from the American Community Survey (ACS; denominator). ACS population counts for 2015 to 2019 were used to calculate mortality rates for corresponding years and the 2019 population count, the most recent year with reliable estimates, was used to calculate rates for 2020 and 2021. See Methods and Results sections for methodology and life expectancy values for 2019, 2020, and 2021.
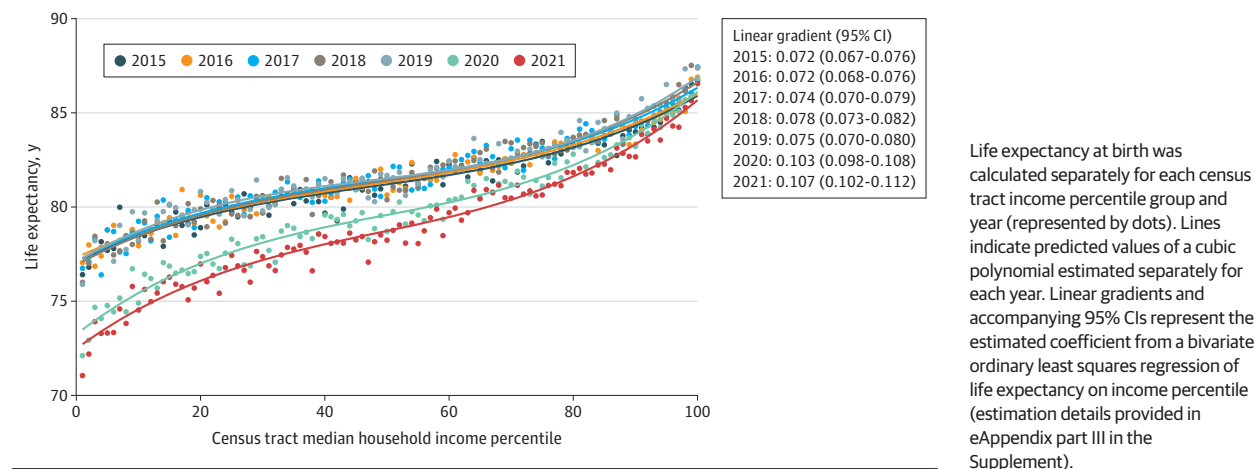
pattern was observed in the general population (Table) and in each of the 4 racial and ethnic populations (eTables 1-4 in the Supplement). Compared with 2019, life expectancy in 2020 decreased by 3.79 years (from 75.90 to 72.11 years) in the lowest income percentile, while it decreased by 0.64 years (from 87.42 to 86.78 years) in the highest income percentile. Compared with the 2019 gradient, the estimated gradient in 2020 increased significantly, to 0.103 years per percentile (95% CI, 0.098-0.108; *P* < .001), which increased the difference in life expectancy between the highest and lowest income percentiles from 11.52 years in 2019 to 14.67 years in 2020.

This phenomenon continued into 2021, when life expectancy decreased in the lowest income percentile tract by 4.85 years relative to 2019, compared with 0.86 years in the highest income percentile, increasing the difference between the highest and lowest percentile to 15.51 years. Compared with 2020, the gradient in 2021 increased significantly to 0.107 years per percentile (95% CI, 0.102-0.112; *P* < .001).

Life Expectancy Change by Census Tract Income and Racial and Ethnic Group
Compared with non-Hispanic White populations in California, Hispanic, non-Hispanic Asian, and non-Hispanic Black populations in California experienced larger decreases in life expectancy in 2020 and 2021 (Figure 1) and larger increases in the income–life expectancy gradient (**Figure 3**). Compared with 2019, the estimated gradient increased significantly in 2020 by 0.038 years per percentile (95% CI, 0.030-0.045; *P* < .001) in Hispanic individuals, by 0.024 years per percentile (95% CI, 0.005-0.044; *P* = .017) among non-Hispanic Asian individuals, by 0.015 years per percentile

Figure 2. Life Expectancy in California by Census Tract Median Household Income Percentile, 2015-2021

Life expectancy at birth was calculated separately for each census tract income percentile group and year (represented by dots). Lines indicate predicted values of a cubic polynomial estimated separately for each year. Linear gradients and accompanying 95% CIs represent the estimated coefficient from a bivariate ordinary least squares regression of life expectancy on income percentile (estimation details provided in eAppendix part III in the Supplement).

(95% CI, 0.010-0.020; $P < .001$) in Black individuals, and by 0.011 years per percentile (95% CI, 0.007-0.015; $P < .001$) in White individuals.

The increased slopes observed in 2020 were maintained in 2021 across these populations, but the estimated gradient did not change significantly between these 2 years ($P > .05$ in each of the 4 racial and ethnic groups). However, compared with 2019, gradients in 2021 increased significantly by 0.033 years per percentile (95% CI, 0.026-0.040; $P < .001$) among Hispanic individuals, 0.024 years per percentile (95% CI, 0.010-0.038; $P = .002$) among Asian individuals, 0.024 years per percentile (95% CI, 0.011-0.037; $P = .003$) among Black individuals, and 0.013 years per percentile (95% CI, 0.008-0.018; $P < .001$) among White individuals.

Compared with the non-Hispanic White population, the gradient increases experienced by the Hispanic population between 2019 and 2020 and 2021 were significantly larger ($P < .001$ in both years). Although the increase that occurred in the non-Hispanic Black population in 2020 did not differ significantly from that of the non-Hispanic White population ($P = .12$), the increase in 2021 was significantly larger ($P = .04$). Gradient increases in the non-Hispanic Asian and White populations did not differ significantly in either year.

Discussion

This retrospective analysis of mortality data in California from 2015 to 2021 demonstrated that declines in life expectancy in 2020 grew larger in 2021, the life expectancy gap by income level increased during the first 2 years of the COVID-19 pandemic relative to the prepandemic period, and life expectancy declines were larger in racial and ethnic minority populations, particularly in lower-income census tracts.

Other studies have reported that US life expectancy decreased significantly in 2020 and that these decreases were much larger among Hispanic and Black populations than White populations.[16-19,21,22] The current study shows that the decrease in life expectancy in California continued in 2021,

despite the availability of a highly effective vaccine. Further research is needed to clarify the potential contributors to that year's heightened mortality (eg, surges in contagious variants, resistance to public health measures).

The disproportionately large decreases in life expectancy among Hispanic and non-Hispanic Black populations reflect their exposure to higher COVID-19 infection, hospitalization, and death rates, especially early in the pandemic.[16-19,23] This disparity, much like other racial and ethnic inequities, has roots in the social determinants of health as well as structural barriers resulting from systemic racism that have helped perpetuate disparities for generations.[8,24] In the case of COVID-19, Hispanic and non-Hispanic Black populations were more likely to rely on jobs (often as frontline workers),[25] transportation, and housing conditions that heightened viral exposure[26] and to encounter barriers to health care,[27,28] a higher prevalence of comorbid conditions,[29] and socioeconomic challenges that jeopardized their health.

Families of lower socioeconomic status are more vulnerable to economic instability and were less likely to access income support programs during the pandemic,[30] raising concerns that the stresses brought on by the pandemic might have widened health gaps related to income and race and ethnicity. To our knowledge, this is the first study to confirm that, at least in 1 state, the income–life expectancy gradient increased significantly in both 2020 and 2021 and to report life expectancy trends during the pandemic in the non-Hispanic Asian population. This increase occurred across all 4 racial and ethnic groups, but the increase in the gradient in the Hispanic population was significantly larger than in the non-Hispanic White population.

Due, in part, to this changing gradient, people in low-income census tracts had larger decreases in life expectancy than people in higher income tracts. Within census tracts, these decreases were greater among Hispanic, non-Hispanic Black, and non-Hispanic Asian populations than among non-Hispanic White people, demonstrating the added health implications of race and ethnicity even within a given location.

Figure 3. Change in Life Expectancy in California in 2020 and 2021 Relative to 2019 by Race and Ethnicity
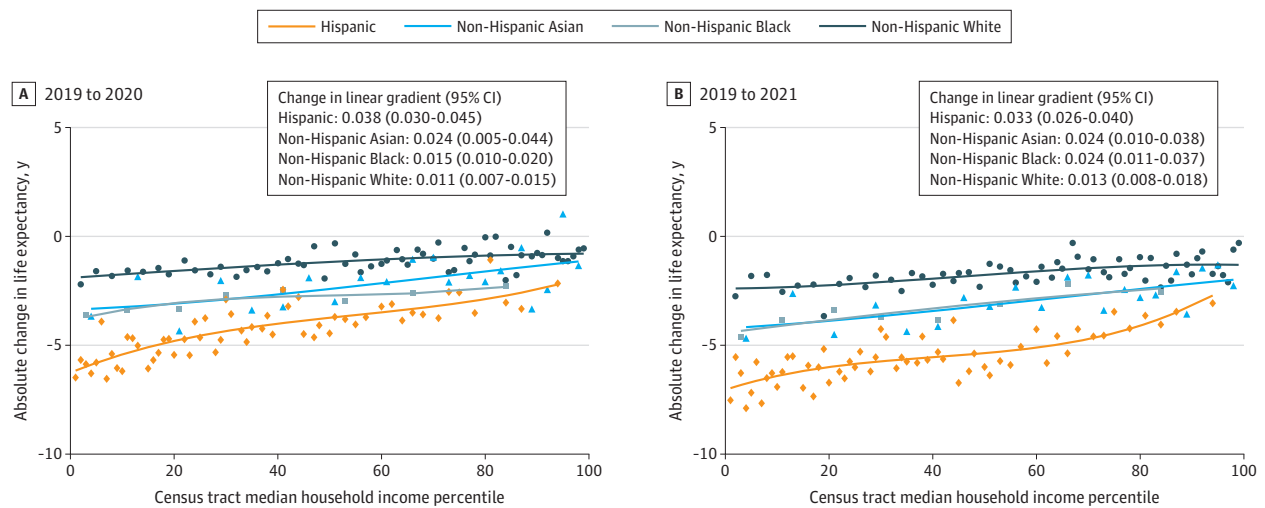
Changes in life expectancy at birth between 2019 and 2020 and between 2019 and 2021 were calculated separately for each group of census tracts (represented by dots) across 4 racial and ethnic groups. The number of groupings was modified to ensure that each group of tracts included at least 250 000 people of a given race and ethnicity. The percentile rank of modified groupings represents the mean income rank of the different tracts contained in the modified group. Lines indicate predicted values of a cubic polynomial estimated separately for each racial and ethnic category. The estimated change in the linear gradients for each racial and ethnic group are reported with 95% CIs (estimation details provided in eAppendix part III in the Supplement).

This study measured income at the census tract level, not for individuals or households. Research in social epidemiology and economics has demonstrated that population health and geographic health disparities are shaped by both individual-/ household-level and area-based socioeconomic status.[31-33] The social determinants of health include not only the educational, employment, and economic status of individuals and families, but also the resources and infrastructure in their communities. These factors include school systems, affordable housing and transportation systems, health care systems, jobs and economic development, air quality and other environmental conditions, and social services and infrastructure to support health. Census tracts with low levels of median household income are often marginalized communities with a smaller tax base, limited municipal budgets, and weaker economies to provide and sustain this infrastructure. Documenting area-based health disparities can help inform policy development and set priorities for targeting resources and investments to marginalized communities.

Limitations

This study has several limitations. First, the study lacked individual data on socioeconomic status and relied on place-based measures of income. Second, data on deaths and income may have been incomplete; data for all deaths in California were included, but a small proportion of unreported deaths cannot be ruled out. Data on income were lacking for 1.1% of census tracts, representing less than 0.1% of the state population, and were subject to some degree of uncertainty common to survey data. Third, mortality rate calculations for 2020 and 2021 relied on 2019 population counts, because reliable population data for later years were lacking. Fourth, in this ecological study, the observed correlation between census tract-level income and life expectancy cannot prove a causal relationship and is not generalizable to the individual level. Fifth, results for California are not generalizable to other states. The non-Hispanic Black population had higher death rates in other states than are reported here for California. Sixth, data limitations precluded the separate analysis of American Indian and Alaska Native populations, who are believed to have experienced disproportionately high mortality rates during the pandemic.[34]

Conclusions

This retrospective analysis of census tract-level income and mortality data in California from 2015 to 2021 demonstrated a decrease in life expectancy in both 2020 and 2021 and an increase in the life expectancy gap by income level relative to the prepandemic period that disproportionately affected some racial and ethnic minority populations. Inferences at the individual level are limited by the ecological nature of the study, and the generalizability of the findings outside of California are unknown.

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