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Relationship between economic recessions and health inequity: analysis of the gap in life expectancy at birth between Mexican States

Juan Pablo Gutiérrez[1*], Karina Mendoza[1], Armando Sánchez-Vargas[2] and Stefano M. Bertozzi[3,4,5]

Abstract

Objective To estimate the effect of economic recessions on health inequality, with a focus on identifying recessions that have a health component.

Methods This retrospective observational study uses the interannual rate of change in gross domestic product (GDP) as an indicator of economic conditions, and life expectancy at birth among Mexican states as a measure of health inequality. We calculated the Gini coefficient of life expectancy for the period 1980 to 2021 and examined its relationship with identified recessions through graphical analysis and an interrupted time series model.

Results The disparity in life expectancy at birth between states decreased over the study period. However, the Gini coefficient of life expectancy showed an inverse relationship with the interannual rate of GDP change, indicating increased inequality during economic recessions, with the most pronounced effect observed during the COVID-19-associated recession in 2020.

Conclusion Economic recessions have detrimental effects on health, exacerbating pre-existing inequalities. It is crucial to implement protection mechanisms targeted at socially vulnerable populations to mitigate these effects and prevent the widening of health inequalities.

Key Findings

- **Recessions increase mortality and exacerbate health inequalities**: Economic recessions not only lead to higher mortality rates but also amplify health disparities across different regions, with vulnerable populations disproportionately affected.
- **The COVID-19 recession unequally impacted life expectancy**: The recession caused by the COVID-19 pandemic exacerbated existing inequalities in life expectancy across Mexican states, further widening the health gap between more and less advantaged populations.

*Correspondence:
Juan Pablo Gutiérrez
jpgutierrez@unam.mx
[1]Center for Policy, Population & Health Research, School of Medicine, National Autonomous University of Mexico, Mexico City, Mexico
[2]Institute for Economics Research, National Autonomous University of Mexico, Mexico City, Mexico
[3]School of Public Health, University of California, Berkeley, USA
[4]Instituto Nacional de Salud Pública, Cuernavaca, Morelos, Mexico
[5]University of Washington, Seattle, United States of America

Introduction

The bidirectional relationship between economics and health has been documented extensively in the literature [1, 2] the strength of the economy in a territory is correlated with better living conditions, which are associated with better health status of the population; additional available resources can be invested in improved health services. On the other hand, health can boost economic growth: it has been estimated that improvements in health status measured by increases in life expectancy are associated with greater economic growth [3, 4]. Conversely, health crises may be associated with economic recessions, as was experienced with the HIV epidemic in sub-Saharan Africa [5, 6]. Recessions in turn generate job losses, generate a reduction in public spending in general - affecting public spending on health - and through the reduction in personal income, increase malnutrition and mental health and substance abuse problems, among others [7].

This relationship has been previously documented through changes in life expectancy as an indicator of health in the face of fluctuations in economic performance for a given geographic area measured as changes in Gross Domestic Product (GDP) [8–10].

Life expectancy at birth, the estimated number of years that a person born in a given year would live if the mortality of the year in which he or she was born were to remain the same, reflects the health risks in the year of birth and is therefore sensitive to changes in the short term, and thus useful for relating to economic fluctuations, given that economic circumstances may determine individual access to financial resources that could affect health and life expectancy.

In times of economic crisis, unemployment increases, and consumption is reduced, thus affecting household income. Crises have a negative impact on people's health through deterioration in living conditions (food, housing, environment) as well as through mental health effects, which also have repercussions on physical health. Poverty has previously been studied as a mechanism that generates differences in life expectancy at birth between territories in the countries of the region [11].

For example, during the global recession observed between 2007 and 2009, negative effects on mental and physical health were observed in high-income countries and the studies showed that safety nets tended to ameliorate these consequences [12]the negative health consequences of the recession were observed to a greater extent among populations from socially vulnerable groups [13]. Other studies documented a significant increase in suicide mortality associated with job loss in the recession [14]. Importantly, other studies have pointed to an inverse relationship between recessions and overall mortality, although recent evidence suggests that this is only due to certain causes, such as traffic accidents related to a decrease in vehicle use (due to job losses and lower economic activity) [15].

Life expectancy at birth

Considered a convenient indicator of aggregate health status [16]., can be significantly affected by relevant economic shocks that influence mortality rates [17]. Life expectancy at birth increased globally between 1980 and 2020 by an average of 10 years, from 62.2 years to 72.3 in 2020, although with significant differences between regions and countries. Thus, while it was 77.7 years in Europe, it barely reached 62.2 in Africa, i.e., the global average of 4 decades earlier [18]. In Mexico, life expectancy had increased by 8.4 years between 1980 and 2019 and had a significant reduction of 5.9 years in 2020 as a consequence of the increase in mortality generated by the COVID-19 pandemic. It rebounded to 75 years in 2022 [19].

The increase in life expectancy at birth has been mainly related to improvements in the living conditions of the population (associated with greater economic growth) that have led to a decrease in infant and maternal mortality due to infectious causes, as well as to technological development for the care of non-communicable conditions. While life expectancy at birth is generally lower for men than for women due to differential exposure to risks, this gap widened in Mexico as a result of the increase in mortality due to violence. Likewise, the reduction observed in the context of the pandemic was greater for men (6.9 years with respect to the previous year compared to a decrease of 4.4 years in the case of women) [19].

Regarding the behavior of the Mexican economy, the Mexican economy has recurrently experienced recessions (a decrease in economic activity, in which the rate of change of the Gross Domestic Product is negative in two or more consecutive quarters) in the period from 1980 to 2022. A total of seven recessions were observed: 1982–1983, 1985–1986, 1992–1993, 1995, 2000–2003, 2008–2009, and 2020–2021 [20]. The causes of these recessions have been variable. Most have been crises of internal or external financial origin, while two have been precipitated by health events (as occurred partially in 2009, and particularly in 2020) [20].

The effect of economic crises on health is not distributed homogeneously; it has been previously documented that people or regions in a precarious economic situation are more affected, so it is to be expected that crises exacerbate health inequities. Previous studies have suggested a relationship between the differentials in life expectancy between subnational units and economic inequality, suggesting that health inequities mirror economic inequalities [21].

Considering the possible negative synergy between recessions and health emergencies, it is possible that recessions that are caused by health emergencies have a greater effect on health equity, since the negative equity effects of recessions are combined with the negative equity effects of health emergencies and both are likely to be worse for people in vulnerable situations, as was documented during the recent pandemic [22].

The objective of this analysis is to describe the relationship between economic recessions and geographic inequality in health, measured as the gap in life expectancy at birth between states in Mexico during the period 1981 to 2021.

Methodology

Retrospective ecological study with secondary data on the behavior of the economy—the interannual rate of change of the Gross Domestic Product (GDP) — and life expectancy data by state in Mexico. Periods of recession (sometimes referred to as economic crises in the literature) were, measured by negative GDP rates.

Gross domestic product is the sum of the money value of all goods and services generated in a territory during a given period. The year-on-year growth rate of GDP corresponds to the percentage change in one year in this value measured in constant units.

The interannual GDP rates for the period 1981 to 2021 in 2018 pesos–constant pesos– were obtained from the national accounts system of the National Institute of Statistics and Geography (INEGI), the agency responsible for the official calculation of this metric in Mexico. From the documentary review, the recessions identified as relevant were those with nadirs in years 1983, 1987, 1993, 1995, 2003, 2009, and 2020 [20].

Life expectancy at birth (LE) for year X is the years of life an individual born in year X is expected to live assuming lifetime exposure to the sex and age-specific mortality rates in year X [23].

The Gini of Life Expectancy at Birth (LE) between entities was used as an indicator of inequality, and was calculated by year for the period 1980 to 2021. The modified Gini of life expectancy at birth was calculated as twice the area under the curve between the equal distribution line of life expectancy, and the observed distribution, and has been interpreted as the mean of the differences between the life expectancies for each entity, and the national life expectancy [24].

Life expectancy at birth by state and year for 1980 to 2021 corresponds to estimates from the National Population Council (Conapo) using Census data including the 2020 National Population and Housing Census and with death statistics through 2021. Both the Census and the death statistics are producen by the National Institute of Statistics (INEGI).

Analysis

Interannual GDP rates and the gaps in life expectancy between entities were plotted descriptively, pointing out the onset of recession and concomitant changes in the life expectancy gap to identify possible interruptions in the trend of the life expectancy gap for subsequent analysis.

Likewise, area graphs were made for male and female population with life expectancy by state, to represent the relative size of the population in the country for each level of life expectancy (considering the variability in population size by state) for 1980, 2000, and 2020. These graphs were intended to display the gap including the relative size of the population at each level of LE.

With the values of life expectancy per entity and per year, the modified Gini index of life expectancy was estimated, weighted by the size of the respective population, defining 55 years as the theoretical minimum value of life expectancy (since it is not possible for life expectancy to be zero). We estimated the modified Gini index for the entire population as well as for women and men separately.

We explored the serial correlation in the sample using the Cumby-Huizinga test for up to 5 lags and with robust option to recognize the potential conditional heteroskedasticity in the data using the actest command in Stata [25]. From the test, we identified only first order autoregressive process for the total population and for males, while for females it may also have second order (Table 1).

Subsequently, an interrupted time series (ITS) model with a first order autoregressive process was estimated, defining the nadir years of the identified recessions as moments of change, to estimate the changes in the level and slope of the Gini of life expectancy at birth between entities, that is, the indicator of health inequity, using the

Table 1 Cumby-Huizinga test for autocorrelation for the modified Gini index of LE

	Total		Males		Females	
Lag	c^2	p-val	c^2	p-val	c^2	p-val
1	8.061	0.0045	7.042	0.0080	10.319	0.0013
2	3.130	0.0769	2.349	0.1254	4.225	0.0398
3	2.739	0.0979	2.340	0.1261	3.300	0.0693
4	2.750	0.0972	2.648	0.1037	2.979	0.0843
5	2.605	0.1065	2.411	0.1205	2.739	0.0980

Prais model that assumes a first order serial correlation (AR [1]) [26]:

$Y = \beta_1 + \beta_2 (T) + \beta_3 (R) + \beta_4 (R^*T) + u_t$

where Y is the Gini of life expectancy among entities in year t, T is the year, and R identifies the years with recession; thus, β_1 corresponds to the initial level of the Gini, β_2 is the trend prior to the recessions, β_3 is the level change in the LE Gini after the recession, and β_4 is the change in the trend after the recessions. $u_t$is the error term that satisfies.

$ut = \rho\, u_{t-1} + e_t$

where e_t are normally distributed with mean zero. The model is then implemented with generalized least squares (GLS) following thePrais–Winsten estimator.

In this analysis, the model is extended to consider 5 recessions, so the coefficients for changes in level and trends are estimated for each year.

We implemented the model using the ITSA command in Stata with the option Prais for a Prais–Winsten regression [27]. We added as control variables that could be related to changes in the inequalities in LE, the public health expenditure in health as percentage of the GDP and the percentage of the population without health insurance. These two variables are also indicators of the different reforms in the Mexican health system thay may have affected health inequalities.

Results

Over a period of 40 years (1980 to 2020), in most Mexican states there was an increase in life expectancy at birth, as shown in Fig. 1. However, the gains observed in 2000 were reversed in 2020, when life expectancy was lower than 20 years earlier. The case of Mexico City stands out, for which life expectancy at birth in 2020 is even lower than that observed in 1980.

Figure 2 shows that there is an inverse relationship between recessions and the Gini of LE since 1990, but the effect is dramatic only for the 2020 recession. When analyzing changes in the Gini by sex, the years in which the rates changed are similar for men and women, while there are differences in magnitude, being greater for women than men, with the exception of the period associated with the COVID-19 pandemic, during which the increase in inequality among men was greater.

As can be seen in Fig. 3, the gap in life expectancy between entities for men decreasing behavior between 1980 and 2000, with the difference between the entity with the highest life expectancy at birth and the entity with the lowest life expectancy at birth going from 8.6 years in 1980 to 5.9 years in 2000; this gap increased again by 2020 and reached 9.3 years, that is, greater than four decades earlier. The nationwide decrease in life expectancy in 2020 is also clear in the figure, with the 2020 values falling from those in 2000 to values close to 1980 levels.

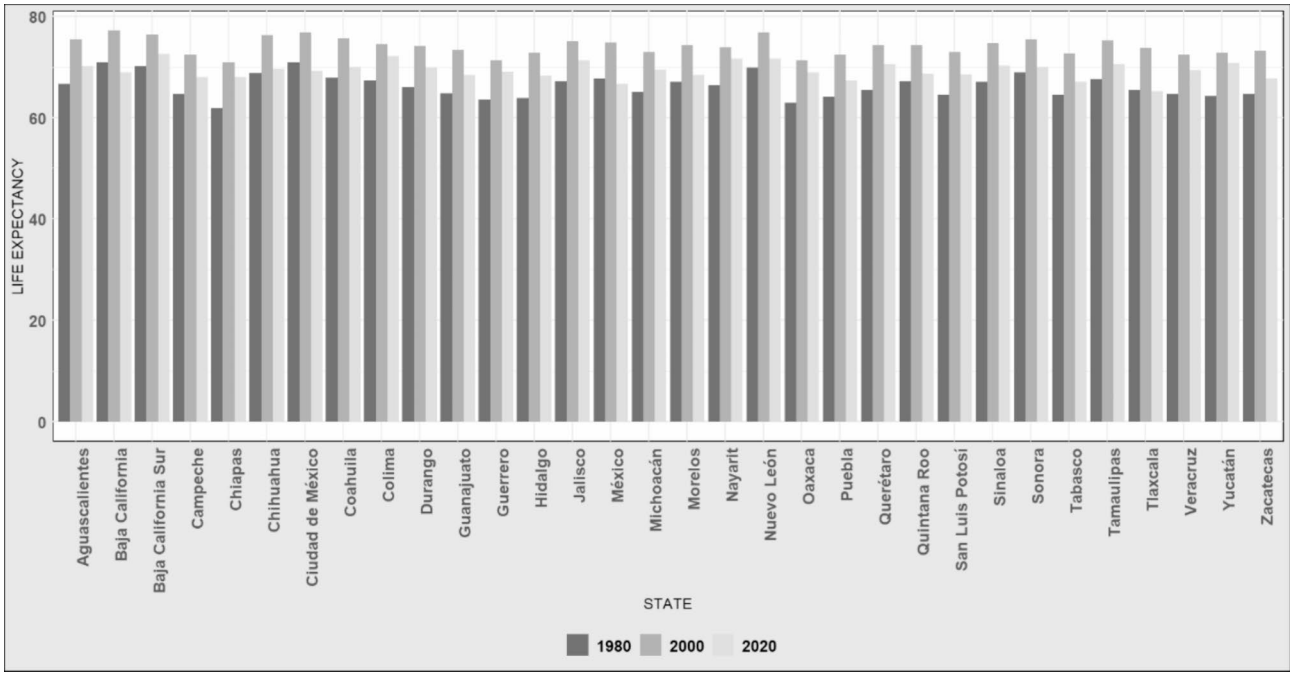

Fig. 1 Gap in life expectancy at birth between states, Mexico (1980,2000 and 2020)
Source: CONAPO. Databases of the Demographic Conciliation 1950 to 2019 and Projections of the population of Mexico 2020 to 2070. Mexico. 2024. [Available from: https://www.gob.mx/conapo/documentos/bases-de-datos-de-la-conciliacion-demografica-1950-a-2019-y-proyecciones-de-la-poblacion-de-mexico-2020-a-2070].

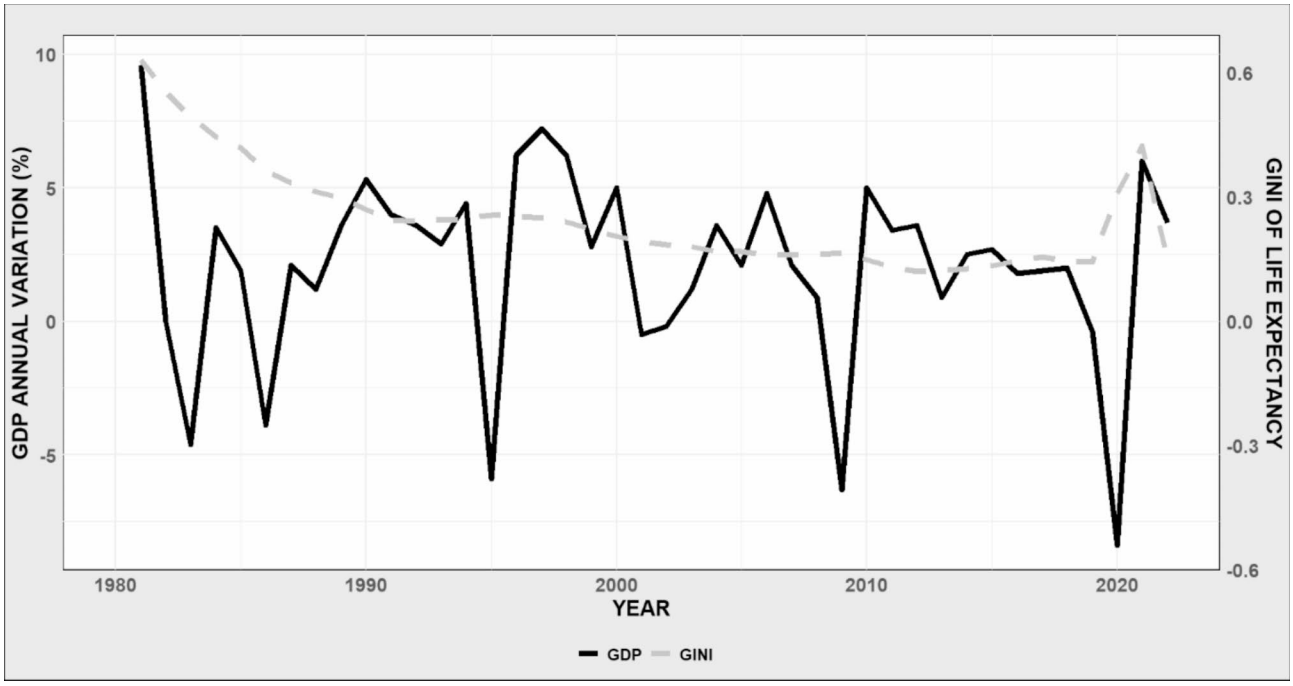

Fig. 2 Interannual rate of GDP and inter-entity Gini of life expectancy at birth, Mexico 1982–2022 Fig. 2
Source: CONAPO. Databases of the Demographic Conciliation 1950 to 2019 and Projections of the population of Mexico 2020 to 2070. Mexico. 2023. [Available from: https://www.gob.mx/conapo/documentos/bases-de-datos-de-la-conciliacion-demografica-1950-a-2019-y-proyecciones-de-la-poblacion-de-mexico-2020-a-2070] and INEGI. GDP annual percentage change at constant values. Mexico. 2023 [Available from: https://www.inegi.org.mx/datosabiertos/]

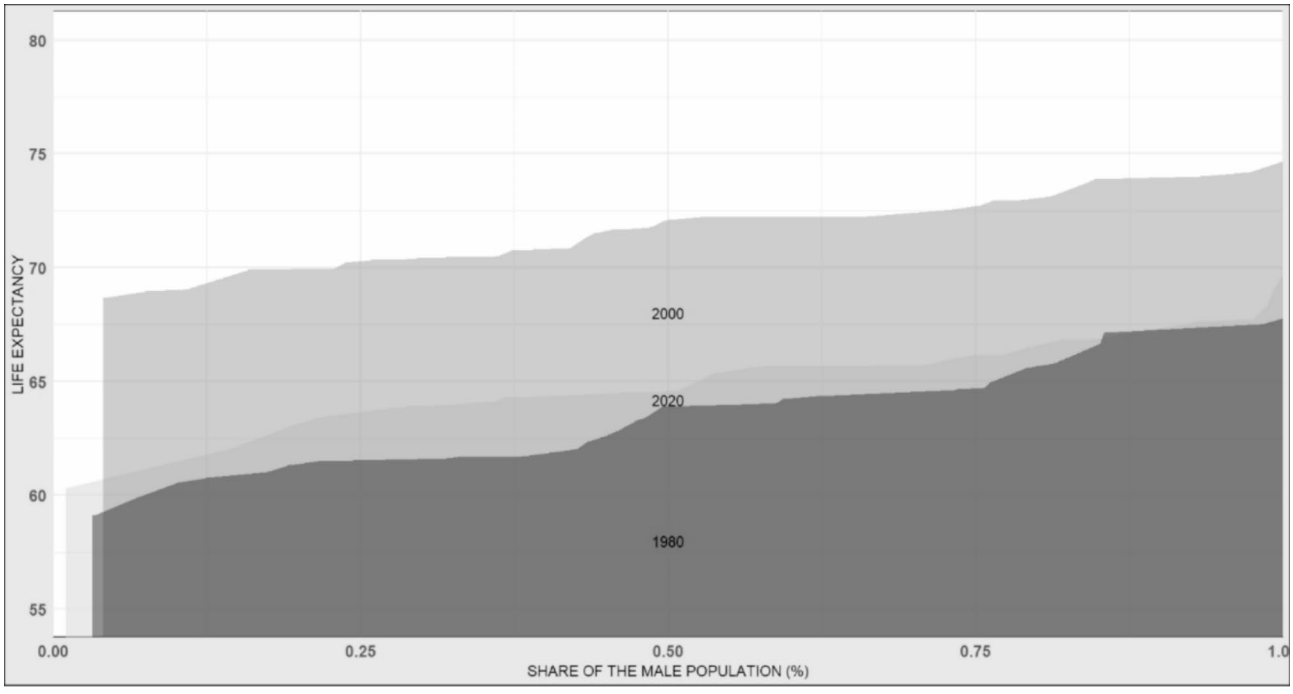

Fig. 3 Life expectancy at birth by entity considering population size among men, for 1980, 2000, and 2020
Source: CONAPO. Databases of the Demographic Reconciliation 1950 to 2019 and Projections of the population of Mexico 2020 to 2070. Mexico. 2024. [Available from: https://www.gob.mx/conapo/documentos/bases-de-datos-de-la-conciliacion-demografica-1950-a-2019-y-proyecciones-de-la-poblacion-de-mexico-2020-a-2070].

For women, as shown in Fig. 4, the improvement in the gap was maintained throughout the period, from 9.3 years in 1980 to 6.5 years in 2000, and finally 4.9 years in 2020. As among men, we observe a nationwide decrease in life expectancy at birth between 2000 and 2020, but the values maintain a much higher proportion of the gains since 1980 and more so among the states with lower life expectancy (unlike the men).

In Table 2, we present the results from the ITSA model by sex and for the total population. For the total population, positive coefficients for level changes, indicating increased Gini coefficients (greater inequality) at the nadir of the recessions, were significant for the years 1993 and 2020. In 1993, the Gini coefficient increased by 0.02, whereas in 2020, it increased significantly by 0.16—8.5 times higher.

Regarding the slope, positive coefficients were observed for all recession years except 1995, with statistically significant increases in 1983, 1987, 1993, and 2020. Specifically, the slope increased by 0.04 in 1983, 0.02 in 1987, 0.02 in 1993, and by 0.10 in 2020.

For males, the results followed a similar direction and significance, but with larger coefficients. Significant level changes were observed in 2020 (0.47). Positive slope coefficients were significant in 1983 (0.07), 1987 (0.04), 1993 (0.03), 2003 (0.02), and 2020 (0.15).

Of the additional variables included in the estimation (change in GDP, health expenditure as percentage of GDP, and population without health insurance), only the percentage of population without health insurance resulted associated with the Gini of LE, with increases in that percentage leading to increases in inequality in LE for the total population and for males–but not for females.

For females, significant level changes were noted in 1983 (0.03), 1993 (0.02), and 2020 (0.04). Positive slope coefficients were significant in 1983 (0.02), 1987 (0.01), 1993 (0.02), and 2020 (0.06).

Discussion

The extreme effect of the 2020 recession compared with the other recessions shown in the analysis suggests that economic shocks with a health component have a greater effect on health inequity than economic shocks without a health component, consistent with the notion that a recession may exacerbate inequities due to both direct and indirect effects.

The negative effect on health observed in relation to recessions (of clearly greater magnitude for the 2020 recession) is consistent with studies that have previously shown negative effects on mental and physical health mediated both by individual-level effects (loss of employment and income) and aggregate-level effects (lower public spending in general and in particular on health)- [15].

In the case of Mexico, with the exception of 2020, there is no correlation between recessions and the level of life

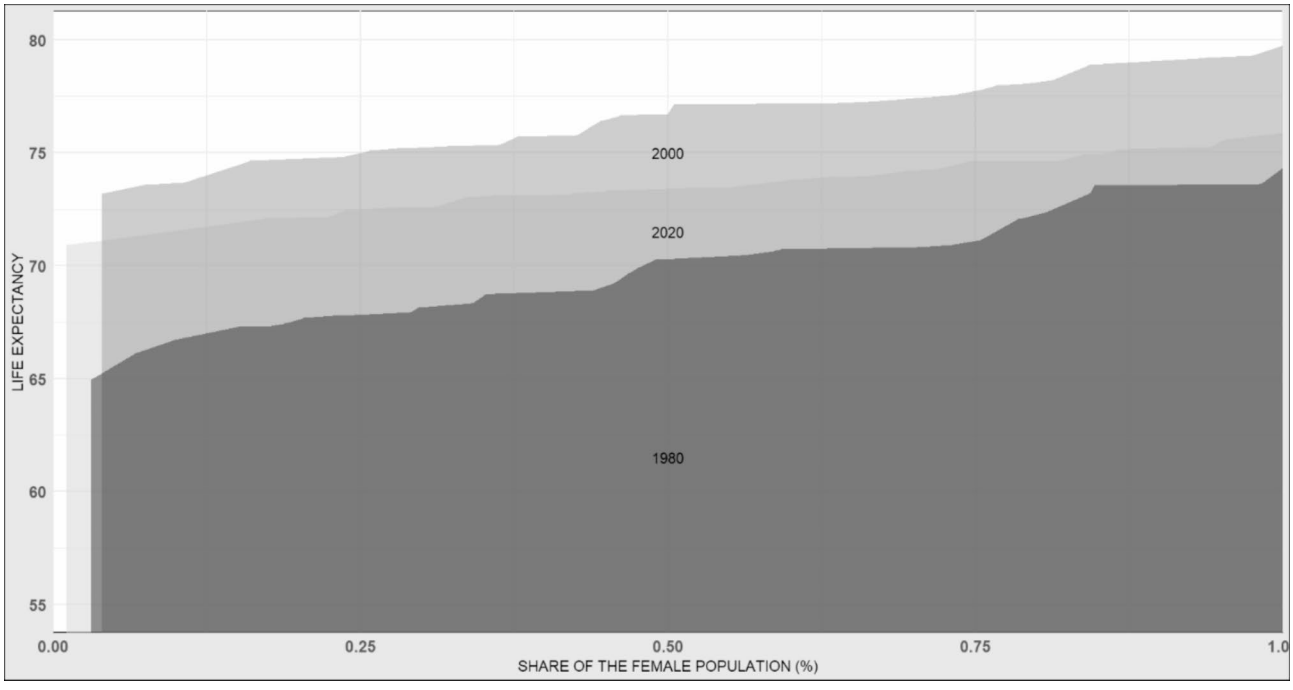

Fig. 4 Life expectancy at birth by entity considering population size among females, for 1980, 2000 and 2020
Source: CONAPO. Databases of the Demographic Conciliation 1950 to 2019 and Projections of the population of Mexico 2020 to 2070. Mexico. 2024. [Available from: https://www.gob.mx/conapo/documentos/bases-de-datos-de-la-conciliacion-demografica-1950-a-2019-y-proyecciones-de-la-poblacion-de-mexico-2020-a-2070].

Table 2 Changes in the Gini of LE associated with economic recessions, Mexico 1980–2021

	(1)	(2)	(3)
Variables	**Total**	**Males**	**Females**
Pre-1983 slope	-0.080***	-0.142***	-0.046***
	(-0.103 - -0.057)	(-0.179 - -0.105)	(-0.063 - -0.028)
Level change 1983	0.021	-0.010	0.028*
	(-0.017–0.060)	(-0.074–0.054)	(-0.001–0.057)
Slope change 1983	0.039***	0.070***	0.022**
	(0.013–0.065)	(0.029–0.111)	(0.002–0.042)
Level change 1987	0.013	0.027	0.007
	(-0.013–0.038)	(-0.013–0.067)	(-0.013–0.027)
Slope change 1987	0.023***	0.042***	0.013**
	(0.010–0.035)	(0.024–0.059)	(0.003–0.023)
Level change 1993	0.021*	0.026	0.016*
	(-0.002–0.045)	(-0.011–0.063)	(-0.002–0.035)
Slope change 1993	0.022*	0.033*	0.014
	(-0.001–0.045)	(-0.004–0.069)	(-0.004–0.031)
Level change 1995	0.004	0.005	0.004
	(-0.033–0.041)	(-0.054–0.064)	(-0.024–0.031)
Slope change 1995	-0.016	-0.022	-0.011
	(-0.039–0.007)	(-0.058–0.015)	(-0.029–0.006)
Level change 2003	0.006	0.009	0.005
	(-0.016–0.029)	(-0.025–0.044)	(-0.013–0.023)
Slope change 2003	0.012**	0.022***	0.007
	(0.002–0.022)	(0.008–0.035)	(-0.002–0.015)
Level change 2009	0.002	0.009	-0.001
	(-0.022–0.025)	(-0.028–0.045)	(-0.019–0.018)
Slope change 2009	0.002	0.002	0.001
	(-0.005–0.009)	(-0.008–0.012)	(-0.005–0.007)
Level change 2020	0.155***	0.466***	0.035***
	(0.122–0.189)	(0.412–0.520)	(0.010–0.061)
Slope change 2020	0.100***	0.149***	0.063***
	(0.068–0.131)	(0.100–0.198)	(0.038–0.087)
Change in GDP	-0.000	-0.000	-0.000
	(-0.001–0.001)	(-0.002–0.001)	(-0.001–0.000)
Health expenditure	-0.002	-0.000	-0.004
	(-0.031–0.027)	(-0.047–0.046)	(-0.026–0.019)
Health coverage	0.001*	0.002*	0.001
	(-0.000–0.003)	(-0.000–0.004)	(-0.000–0.002)
Constant	0.571***	0.929***	0.360***
	(0.450–0.691)	(0.745–1.113)	(0.265–0.454)
Observations	41	41	41
R-squared	0.995	0.997	0.989
ci in parentheses			

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Source: own estimation based on CONAPO data. Databases of the Demographic Conciliation 1950 to 2019 and Projections of the population of Mexico 2020 to 2070. Mexico. 2023

expectancy at birth, which is consistent with previous studies [28]. In our analysis, the gap in life expectancy at birth among states increased over time for men, but not for women, where it declined. Differences in life expectancy among subnational geographic entities have been documented in numerous other contexts [19] [29]. The greater effect of the 2020 crisis has also been previously documented, suggesting that the impact was greater for socially vulnerable populations in ways that are potentially long-lasting [30].

The years with absolute increases in the gap (increasing inequality) that coincide with recessions are 1993 and 2020. The first is a recession related to the devaluation of the peso, i.e., without a health component. For the 2009 recession, while the main factor is the global crisis—and in particular the economic contraction in the United States—it also had a health component with the influenza A(H1N1) pandemic, and in this year a positive value is observed in the Gini trend, i.e., towards increased inequality. The increase in health inequalities following economic recessions has been previously documented in particular in relation to the global crisis between 2007 and 2009 and for high-income countries [31].

As can be seen, in our analysis the change in the Gini during the pandemic is an order of magnitude larger than the increase observed in the 1993 recession. During the 1995 recession, the Gini of life expectancy at birth increased by 0.03, while the increase in the Gini in 2020 was 0.17.

It is important to note that this increase could have been even greater with a different health shock. In the case of COVID-19, there were differences in mortality among states due to different incidence rates of infection and differences in the case fatality rate (due presumably to differences in the prevalence of underlying conditions predisposing to severe disease and differences in the ability of the health services to provide quality medical care). If both incidence and lower access/quality of medical services are correlated with lower pre-shock life expectancy, they we would expect the largest impact on inequity. In the case of COVID-19, the incidence was highly variable across states and was especially high in Mexico City, among the states with the highest life expectancy prior to the pandemic. By 2020, its life expectancy had fallen to position 17 out of 32. This would have tended to close the life expectancy gap, suggesting that if the incidence rate had been more uniform (or perhaps higher among poorer states) the overall increase in the gap would have been even larger. This analysis has a number of significant limitations. This is an observational study, with a limited number of variables that are hypothesized to affect life expectancy. In addition, the analysis is conducted at the level of states, rather than the individual level. Thus, there may be other changes that may be affecting the results. For example, there have been changes over time in access to health insurance that we did not include in our analysis. That said, the correlation of changes in health inequity with a number of different recessions is strongly suggestive of a direct relationship. Other population-level changes, from health insurance access to levels

of education to climate change have not been varying with the cycles of recessions.

There are some limitations to our analysys that are important to mention. The very aggregate nature of the study likely obscures even larger inequalities between individuals related to differences in both probability of infection and access to health services, especially since those tend to be correlated with each other, with the poorer members of the population being both less able to isolate and protect themselves and less able to access high-quality health services. Also, it is impossible to directly observe someone's life expectancy at birth as this is a variable estimated from annual reported deaths and the estimated annual population structure for each year from census data. Although these estimates could be biased, the risk is reduced because we use data generated by the same institution, using the same methods, for the entire period.

Conclusion

Our analysis documents that recessions impact not only health levels but also health inequalities, as indicated by the Gini coefficient of life expectancy among the 32 states in Mexico. Recognizing that other factors, such as significant changes in the health system, could influence health inequalities during the period analyzed, we incorporated key indicators into our estimation: public health expenditure as a percentage of GDP and the percentage of the population without health insurance. These indicators capture the potential effects of health system reforms on health disparities. Our results indicate that, even after controlling for these variables, recessions are associated with increased health inequalities.

In addition to the well documented relationship between recessions and mortality (measured by life expectancy at birth), the consequences of economic crises are also reflected in changes in the distribution of mortality, causing an increase in health inequality among populations. Thus, it is necessary to implement actions to reduce the effect on inequality by prioritizing actions to protect the most vulnerable populations.

Author contributions

JPG, SB & ASV conceptualized the study. JPG and KM implemented the analysis. KM prepared figures. JPG, SB and KM wrote the main manuscript text. All authors reviewed the manuscript.

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Data availability

The datasets analyzed during the current study are available at public websites as described.

Declarations

Competing interests

The authors declare no competing interests.

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