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Original Article

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The impact of violence and COVID-19 on Mexico's life-expectancy losses and recent bounce-back, 2015–22

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Abstract

Background: Before the COVID-19 pandemic, life expectancy in Mexico stagnated from the early 2000s, mainly due to increased homicides. During the pandemic, Mexico experienced sizable excess mortality. We aimed to assess the contribution of violence, COVID-19, and causes of death that were amenable to healthcare to life-expectancy changes between 2015 and 2022 in Mexico.

Methods: We used administrative mortality and adjusted population estimates to construct life tables. We applied demographic methods to untangle contributions of causes of death to life-expectancy changes by year and sex at the subnational level.

Results: Between 2015 and 2019, life expectancy declined from 71.8 to 71.1 years for males and stagnated at 77.6 years for females. Violence among young males explains most of the decline (54.3%). Between 2019 and 2020, life expectancy decreased by 7.1 and 4.4 years for males and females, respectively. COVID-19 accounted for 55.4% of that change for males and 57.7% for females. In 2021, male life expectancy stagnated but continued to decline for females by 0.44 years due to COVID-19 deaths. In 2022, we observed unequal recovery patterns in life expectancy across regions, as northern states experienced larger improvements than central and southern states.

Conclusion: We documented large variations in life-expectancy losses across Mexican states before, during, and after the COVID-19 pandemic. Before the pandemic, violence accounted for most of the male life-expectancy losses. During the pandemic, following COVID-19 deaths, mortality due to diabetes and causes that were amenable to healthcare contributed considerably to observed losses, with an uneven impact on the sexes.

Keywords: mortality; subnational; homicides; COVID-19; Mexico.

Key Messages

- This is the first study to uncover the contribution of violent deaths and various causes of death to life-expectancy changes in Mexico before, during, and after the COVID-19 pandemic.
- Since 2015, the upsurge in violence has slowed life-expectancy gains for both females and males in Mexico, offsetting potential improvements from other causes of death.
- Life-expectancy losses during the COVID-19 pandemic were significant, primarily driven by COVID-19 deaths, increased diabetes-related deaths, and other causes that were amenable to healthcare.

Introduction

Latin America is one of the most violent regions in the world. In 2017, Latin America accounted for 7.8% of the global population but 37% of global victims of intentional homicides, with a homicide rate of 17.2 per 100 000 people [1]. During the twenty-first century, several countries, including Mexico, have experienced waves of violence [2], with sizable impacts on population health, life expectancy, and lifetime uncertainty [3].

Alongside the high levels of homicides in the region [4], Latin America was heavily affected by the COVID-19 pandemic [5]. The lack of timely policy responses, unequal healthcare access, and high prevalence of cardiovascular disease and comorbidities led to a high burden of excess mortality in the region [6]. For some Latin American countries, life-expectancy losses at the beginning of the pandemic ranged from 3 (Chilean females) to 10 years (Peruvian males) [5, 7, 8]. In Mexico, life-expectancy losses in 2020 were

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estimated at 2.7 and 3.5 years for females and males, respectively, with large regional variation [8]. It is unknown, however, how increased violence, diabetes, causes of death that were amenable to healthcare (e.g. respiratory diseases and some neoplasms), and the COVID-19 pandemic have affected life expectancy in Mexico recently.

In Mexico, violence has contributed to life-expectancy declines among males and stagnation among females [9, 10]. In the period 2006–19, there were 325 884 recorded homicides, of which 88.8% were men (see Supplementary Figure S7; see online supplementary material for a color version of this figure) [11], largely attributed to public policies that allowed military interventions to mitigate drug cartels' operations that started in December 2006—the beginning of the so-called 'war on drugs' [9, 10]. The homicide rate among males increased rapidly from 22 to 43 deaths per 100 000 people between 2006 and 2012. Between 2012 and 2014, it decreased slightly but, in 2015, it started to increase again, reaching its maximum in 2019 with a homicide rate of 75 deaths per 100 000 people.

Another important public health challenge for Mexico is the increase in diabetes-attributable mortality, which has also contributed to life-expectancy stagnation [10]. Between 2000 and 2018, the prevalence of diabetes increased from 7.5% to 10.3% [12] and the number of deaths attributed to diabetes increased by 77% between 1990 and 2017. In total, diabetes accounted for almost 1 million deaths (948 532) between 2010 and 2019 [11]. After diabetes-attributable mortality and violence, some causes of death that were amenable to healthcare—that should not have resulted in death if effective and pertinent medical care had been provided—have also increased. Among those are infectious and respiratory diseases, and some types of cancer (e.g. breast and prostate cancer) [13]. Other causes that were amenable to healthcare, such as infectious and respiratory diseases, contributed to increases in life expectancy between 2000 and 2015 [9, 10].

This article makes three main contributions. First, we document the contribution of violence, diabetes, causes of death that were amenable to healthcare, and the COVID-19 pandemic to changes in life expectancy before, during, and after the COVID-19 pandemic (2015–22). Second, we contribute to the existing literature on violent mortality by looking at the most recent years, which have been characterized by increasing homicides between 2015 and 2019. Third, this analysis contributes to our knowledge of mortality change at subnational levels across Mexican states.

Methods

Data

We obtained the death certificate data (2000–22) from vital statistics files from the National Institute of Statistics [11]. These files contain information on causes of death, sex, and the age at the time of death. We used these data to obtain the proportion of causes of death in each age group, by sex, year, and state. From the National Population Council, we retrieved the population at risk and the number of deaths to construct death rates from 2000 to 2022 by age group, sex, and state [14]. These estimates are corrected for completeness, age misstatement, and international migration.

We focus our analysis on COVID-19 and the causes of death that contributed the most to life-expectancy stagnation before the pandemic. We grouped the deaths into six categories: (i) homicides and violent deaths, (ii) COVID-19, (iii) diabetes, (iv) causes that were amenable to healthcare, (v) external causes of death, and (vi) all other causes. Analysis of COVID-19 and causes that were amenable to healthcare separately allows us to distinguish those causes that were primarily driven by SARS-CoV-2 from those that would have occurred in a non-pandemic year. We classified deaths by using the International Classification of Diseases 10th revision (ICD-10). The ICD-10 code groupings are presented in Supplementary Table S1 (see online supplementary material for a color version of this table).

We present results at the subnational level. We group Mexican states into three large regions to ease the interpretation of the results in the figures and to more effectively refer to states and regions by following the same grouping as Aburto *et al.* [10]. Supplementary Figure S1 (see online supplementary material for a color version of this figure) shows the states that belong to each region.

Statistical methods

We first computed age- and cause-of-death-specific death rates by 5-year age groups for each state and the national level, stratified by sex and year, by multiplying the age- and sex-specific proportion of causes of death by the age-specific mortality rates. We then constructed period life tables at the national level and for all 32 Mexican states by sex for the period 2000–22 by using standard demographic techniques [15]. We used the continuous-change decomposition method to quantify the contribution of age and causes of death to changes in life expectancy for the periods: 2015–19, 2019–20, 2020–1, and 2021–2 by using the R package 'DemoDecomp' [16, 17]. In addition, we compared life-expectancy and age-standardized death rates for all-cause and cause-specific mortality at national and subnational levels from 2000 to 2022, using the 2010 Mexican population as standard (see Supplementary Figures S7–S12; see online supplementary material for color versions of these figures).

Results

Figure 1 shows age- and cause-of-death-specific contributions to changes in life expectancy by sex before the pandemic (2015–19), during two pandemic years (2019–20 and 2020–1), and after (2021–2). Between 2015 and 2019, life expectancy decreased by 0.7 years, from 71.8 to 71.1 years, for males and stagnated with a slight increase of 0.1 years, from 77.5 to 77.6 years, for females. The decline in life expectancy among males occurred mostly in ages 20–39 years due to homicides and violence (54.3%). During the first year of the pandemic (2019–20), life expectancy decreased by 7.1 years, from 71.2 to 64.1 years, among males and by 4.5 years, from 77.6 to 73.1 years, among females. Most of the decrease in life expectancy was attributed to COVID-19 deaths in adults aged ≥60 years, accounting for 34.4% and 41.3% of life-expectancy losses for males and females, respectively. In the second year of the pandemic (2020–1), male life expectancy stagnated with a slight increase of 0.1 years from 64.1 to 64.2 years, mostly due to improvements in diabetes and causes that were amenable to healthcare in individuals aged ≥60 years. Conversely, for females, life expectancy continued to decrease by 0.4 years (5.3 months), from 73.1 to 72.7 years. For females, COVID-19 contributed to decreased life expectancy, offsetting positive contributions from

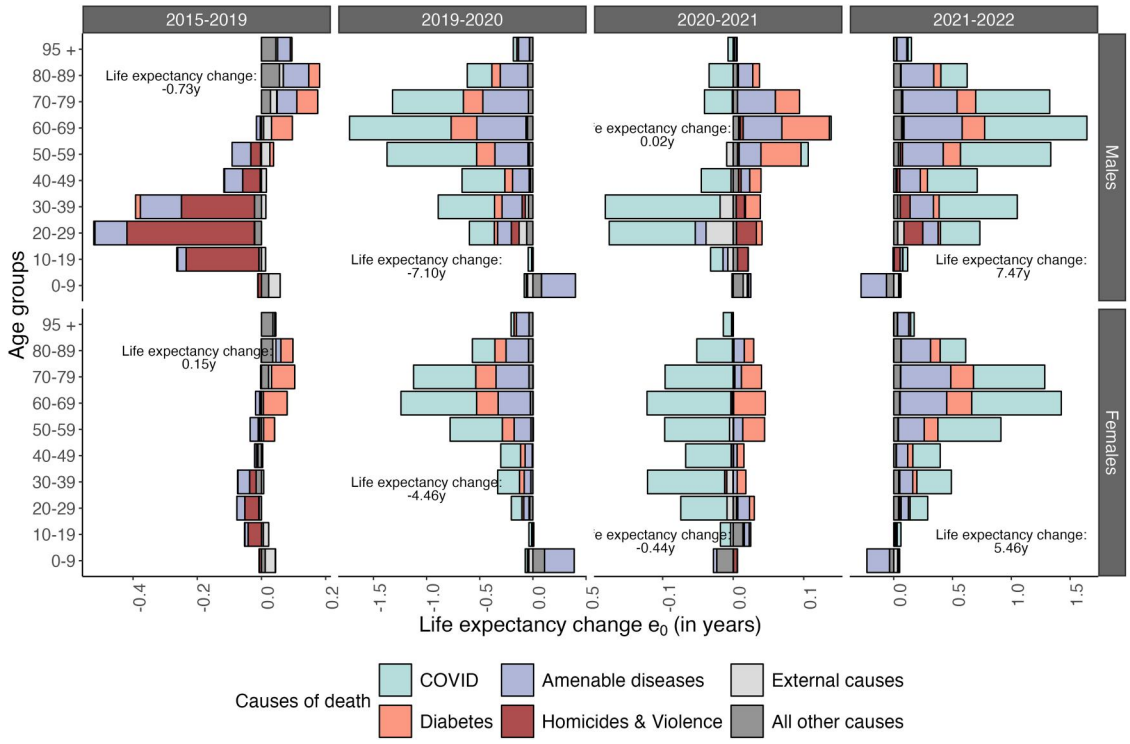

Figure 1. Cause-specific contributions to life-expectancy changes by age, sex, and period, 2015–22. We used a different scale on the *x*-axis to capture the contribution of each cause of death during each period. Source data: National Institute of Statistics and Geography (INEGI) and National Population Council (CONAPO).

diabetes after age 50 years. In 2022, life expectancy recovered to 78.3 and 71.4 years for females and males, respectively, mostly due to improvements in COVID-19 and causes that were amenable to healthcare in all age groups.

Our analysis shows a large variation in changes in life expectancy across Mexican states. Supplementary Figure S2 (see online supplementary material for a color version of this figure) shows levels and changes in life expectancy at birth in 2015–22 by sex across Mexican states. Life-expectancy losses between 2019 and 2021 and life-expectancy changes between 2019 and 2022 are shown in Supplementary Figures S3 and S4 (see online supplementary material for color versions of these figures). Figures 2–5 show the total contribution of homicides, COVID-19, diabetes, and causes that were amenable to healthcare to changes in life expectancy at the state level by sex over the period 2015–21, respectively.

Homicides contributed to changes in life expectancy between 2015 and 2019, particularly among males in 26 out of 32 states (Figure 2). During the first year of the pandemic, homicides contributed to reduced life expectancy in some of the northern states. Between 2021 and 2022, contributions from homicides were positive in some northern and central states for males. For females, homicides and violence contributed to a modest reduction in life expectancy at birth in 12 states before the pandemic.

Across all Mexican states, COVID-19 contributed to sizable life-expectancy losses during the pandemic. In 2022, COVID-19 mortality decreased, leading to life-expectancy recoveries, albeit with regional variations (Figure 3). For both males and females, the largest life-expectancy losses occurred in central and southern Mexico. For states in the northern region, we observed early recoveries from COVID-19 in 2020–1 compared with central and southern regions, where those recoveries occurred in 2021–2.

Mortality due to diabetes had a strong regional variation (Figure 4). Diabetes mortality contributed to increasing life expectancy between 2015 and 2019 in the northern and central regions but not in the south of Mexico. However, during the pandemic in 2019–20, diabetes contributed to reductions in life expectancy at birth across all states and, between 2020 and 2021, reductions in diabetes-related deaths contributed to increasing life expectancy at birth in all states, and those recoveries continued between 2021 and 2022.

Causes of death that were amenable to healthcare contributed to life-expectancy losses between 2015 and 2019 in most of the southern states (Figure 5). During the first year of the pandemic (2019–20), those causes contributed negatively to life-expectancy changes for all regions. During the second year, we observed early recoveries in northern regions and a heterogeneous pattern across states in central and southern Mexico. Causes that were amenable to healthcare contributed to life-expectancy recoveries after the COVID-19 pandemic.

Discussion

Summary of results

Before the COVID-19 pandemic (2015–19), male life expectancy at birth decreased by 0.7 years, from 71.8 to 71.1 years, and female life expectancy at birth stagnated, at ~77.5 years. Violence among males aged 20–39 years accounted for 54.3% of life-expectancy losses in the period. Between 2019 and 2020, life expectancy decreased by 7.1 and 4.4 years at the national level for males and females, respectively. In 2021, male life expectancy at birth stagnated at 64.1 years with improvements in diabetes at older ages. However, life expectancy continued to decrease for females, resulting in losses of 0.44 (5.3 months) years due to COVID-19.

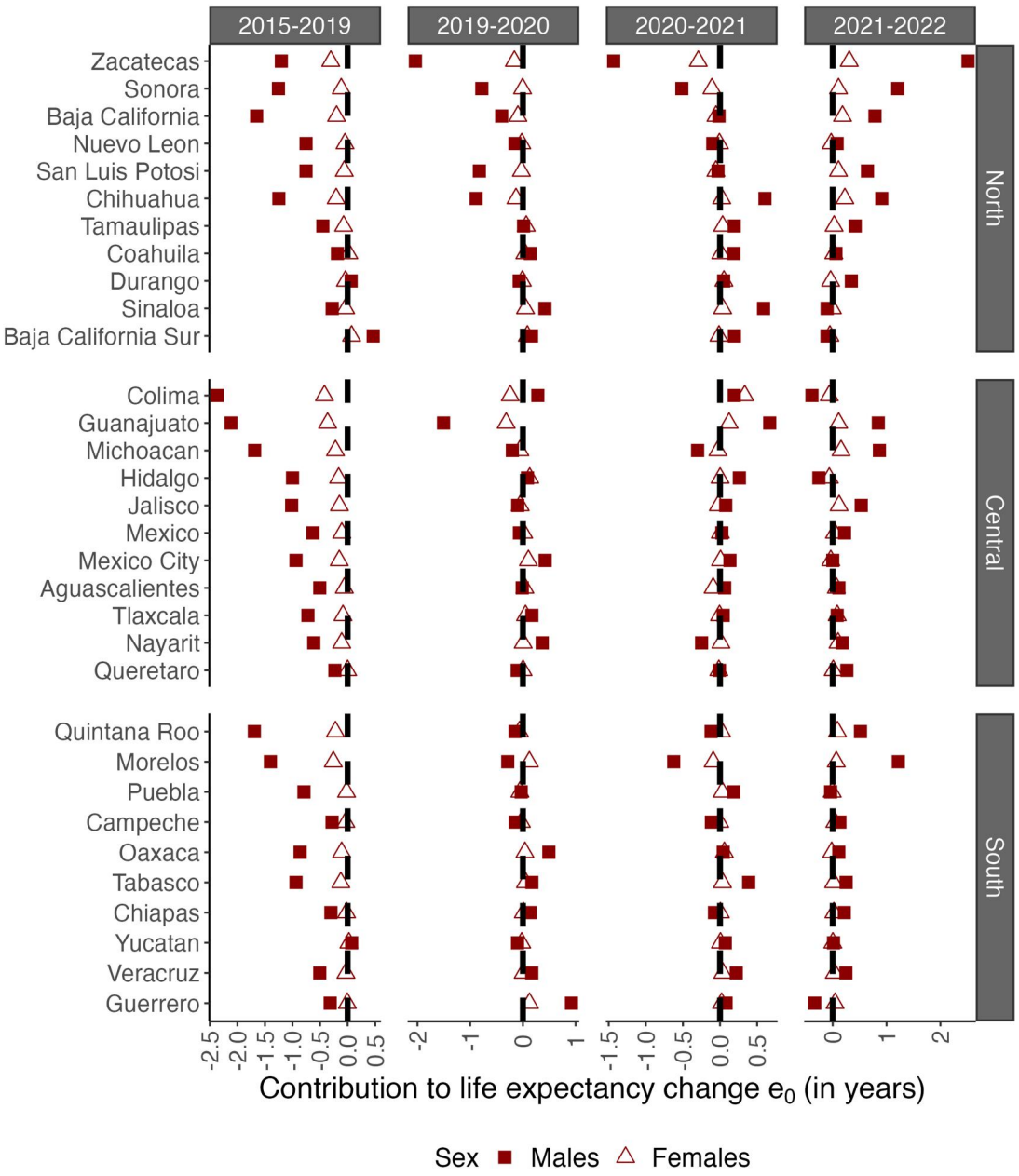

Figure 2. Contribution of homicides and violence to life-expectancy changes between 2015 and 2022 by state and sex. Source data: National Institute of Statistics and Geography (INEGI) and National Population Council (CONAPO).

We capture large variability in life-expectancy losses across Mexican states that range from 2.6 years for males in Tamaulipas (northern region) to 10.1 years for males in Tlaxcala (central region). In 2022, life expectancy recovered to the pre-pandemic levels across all Mexican states (see Supplementary Figure S4; see online supplementary material for a color version of this figure).

Interpretation of results

Levels of homicides in Mexico have increased since 2006 [10]. The homicides that were once concentrated in the north of Mexico and primarily affected young males [9, 10, 18] have intensified and spread across the country. We observe that, nationally, and in almost all Mexican states, the number of deaths due to homicides and violence among females has increased over time (see Supplementary Figure S7; see online supplementary material for a color version of this figure). Our analysis reveals that, after 2015, the contribution of homicides to life-expectancy losses spread across all Mexican states. As has been observed in previous years, homicides had a higher negative impact on male life expectancy than female life expectancy [9, 10]. However, between 2015 and 2019, homicides contributed modestly to decreases in female life expectancy. A contribution of this nature had only previously been observed in states with high levels of violence, such as Chihuahua in 2005–9 [10], but, today, this is also present in some states in the central region. While previous studies on the relationship between violence and life expectancy have focused on males because they are killed violently more often than females, our results serve as a reminder that violence has negative mortality implications for both sexes. The changing nature of the contribution of violence to changes in female life expectancy is consistent with other research which has found that the nature of lethal violence against women has

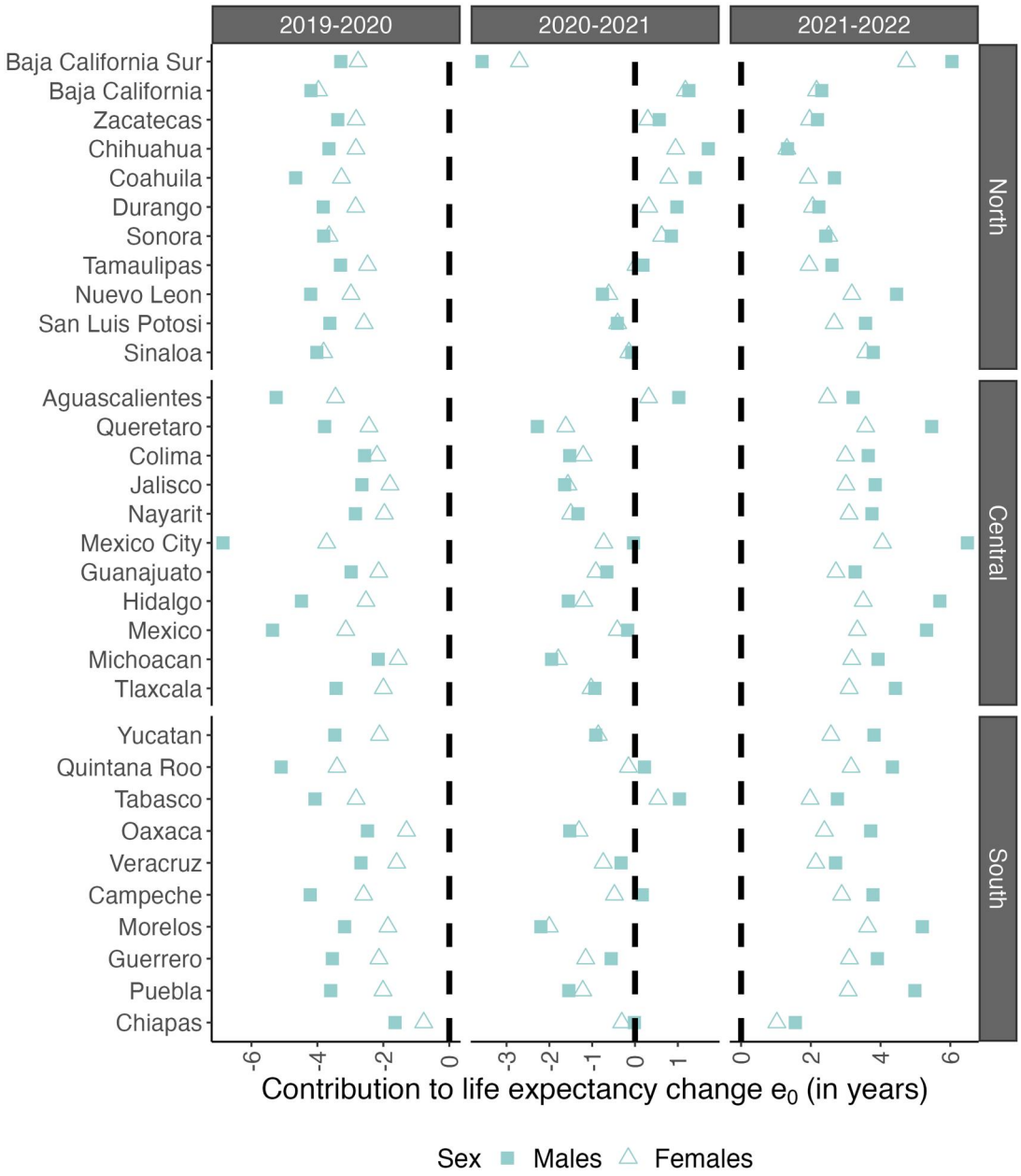

Figure 3. Contribution of COVID-19 to life-expectancy changes between 2019 and 2022 by state and sex. Source data: National Institute of Statistics and Geography (INEGI) and National Population Council (CONAPO).

changed since 2006 [19]. For example, whereas lethal violence against women was once characterized as deaths that occurred inside the home by someone the victim knew, violence against women in Mexico now has an increasingly public nature, with more women being killed in public places and by strangers [20]. Many of these deaths form part of Mexico's ongoing feminicide crisis, in which women and girls are killed intentionally because of their gender. Public health measures that were aimed to curb the spread of COVID-19, such as lockdowns, may have also resulted in increased violence against women and girls, although this can also be difficult to quantify due to reporting challenges [21].

During 2020 and 2021, Mexico was severely impacted by the COVID-19 pandemic, with variation across Mexican states. Life-expectancy losses exceeded 2 years for both sexes across states. To put this number into perspective, in Italy and Spain—two countries that were epicenters of the COVID-19 pandemic—life-expectancy losses in 2020 ranged from 1.0 year among Italian females to 1.5 years among Spanish females [22]. In the USA—the country with the second-highest number of COVID-19-related deaths—life-expectancy losses were 1.7 and 2.2 years for females and males, respectively [22]. In most European countries, life expectancy at birth in 2021 started to recuperate but the levels are still lower than those reported in 2019 [23]. Among Latin American countries, few studies have examined life-expectancy losses at the subnational level. For Chile, life expectancy decreased by 1.8 years for males and 1.3 years among females in 2020, but poorer urban municipalities were the most affected [24]. In Brazil, life expectancy decreased in 2020 and the Amazonian and northern regions experienced the largest losses. Overburdened healthcare facilities, including insufficient hospital beds and disruption in primary care services, are potential explanations for regional

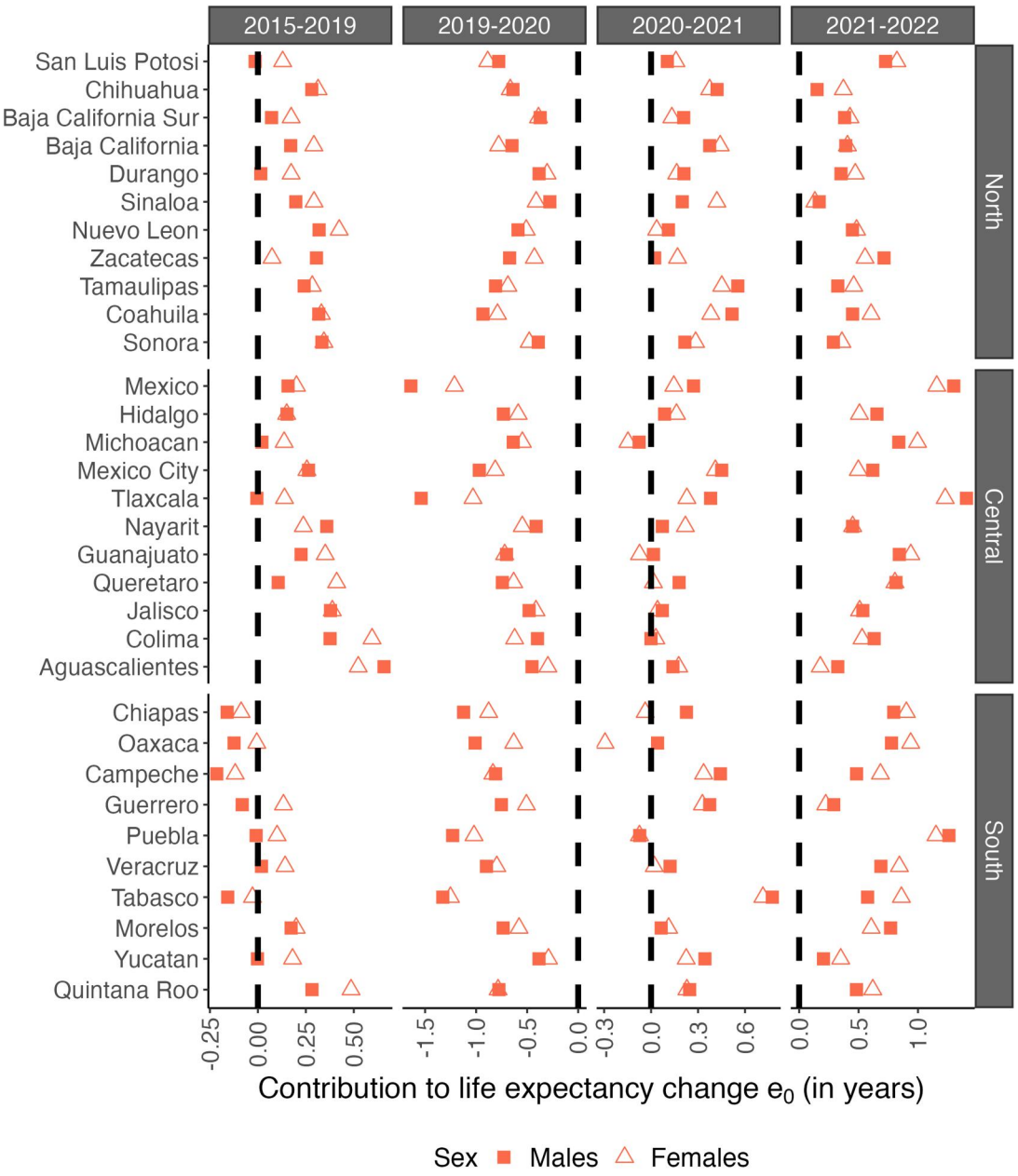

Figure 4. Contribution of diabetes to life-expectancy changes between 2015 and 2022 by state and sex. Source data: National Institute of Statistics and Geography (INEGI) and National Population Council (CONAPO).

differences and continued life-expectancy losses in Brazil in 2021 [7].

Regarding sex differences across some high-income countries, women continued to experience life-expectancy losses in 2021 and the age groups that contributed to those in 2020 also contributed to the life-expectancy losses in 2021 [23]. In our analysis, we observed sex differences in life-expectancy losses between 2020 and 2021 in which life expectancy stagnated for males but decreased by 5.4 months for females. One potential hypothesis is that mortality among males was displaced, leading to frail males dying in 2020, selecting the male population for 2021. Additionally, sex differences in labor-market dynamics offer another potential explanation for these outcomes. Men—particularly those in the informal sector—continued to work during the pandemic in 2020 whereas women's occupations were allocated to work remotely [25], suggesting different degrees of exposure to COVID-19 [26]. Additionally, women were more likely to be unemployed and therefore to be at home during the COVID-19 pandemic [27]. This unequal exposure may have led to frail males being more vulnerable to COVID-19 before the vaccination campaigns. However, in contexts with highly feminized healthcare sectors, such as in the USA [29], women continued to experience higher levels of workplace exposure to COVID-19. In Mexico, 65% of all workers in the healthcare sector are female [30], which may help to explain the continued contribution of COVID-19 to female life-expectancy losses in 2021.

For Mexico, the largest losses in life expectancy at birth between 2019 and 2021 may be explained by preexistent comorbidities across socioeconomic groups. Socio-demographic and health profiles of individuals who died due to COVID-19 provide corroborating evidence for this hypothesis. Preexistent health risk factors among the population, such as diabetes

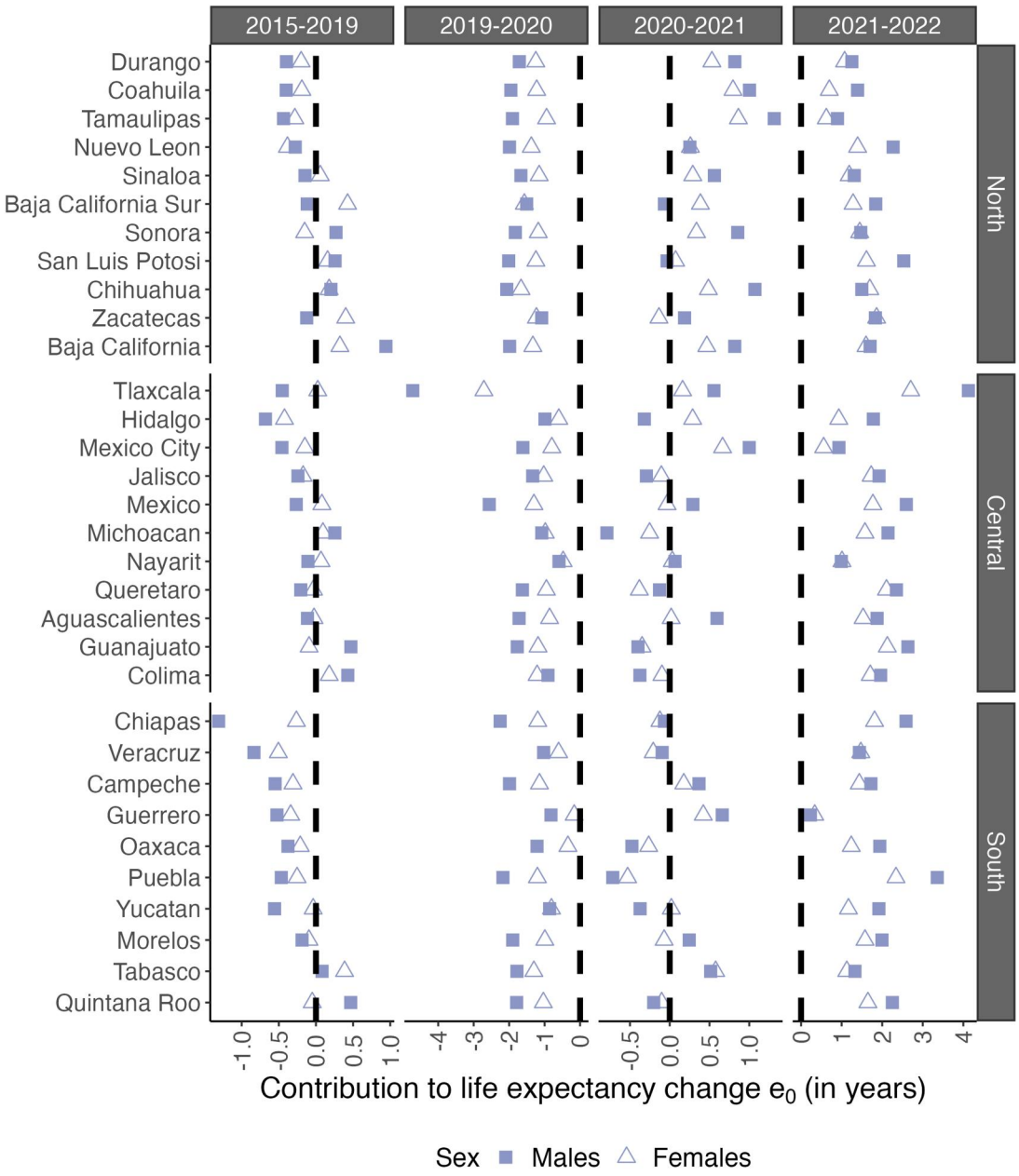

Figure 5. Contribution of causes that were amenable to healthcare to life-expectancy changes between 2015 and 2022 by state and sex. Source data: National Institute of Statistics and Geography (INEGI) and National Population Council (CONAPO).

and obesity, seem to be one of the reasons why Mexico was so heavily affected by COVID-19 [28, 29]. However, studies that used individual-level data on patients who tested positive for COVID-19 highlight that, after controlling for health risk factors, individuals' socioeconomic characteristics were important in determining mortality outcomes [30–32]. For example, the probability of dying due to COVID-19 among individuals in the lowest income quantile was five times the probability of dying among those in the highest decile, even after accounting for health risk factors [31]. Individuals' socioeconomic conditions were important for coping with lockdowns and mitigating virus spread. For example, having limited financial resources and depending on emergency government assistance made it harder for individuals to adhere to isolation measures [32].

We observed that life expectancy recovered to the 2019 levels (see Supplementary Figure S4; see online supplementary material for a color version of this figure) due to a reduction in causes that were amenable to healthcare, COVID-19, and diabetes. Despite these recoveries, we capture unequal patterns across regions. For example, in northern states, COVID-19, diabetes, and causes that were amenable to healthcare have started to contribute to early life-expectancy recoveries since 2020–1 whereas, across central and southern states, those recoveries took place after 2021. These regional differences seem to be driven by socio-demographic characteristics and health inequalities across states [30, 32]. Northern Mexico is characterized by lower levels of poverty and lower levels of social vulnerability index. Indeed, municipalities with a higher degree of social disadvantage had a higher number of excess deaths due to COVID-19 and non-COVID-19 deaths [30] and individuals who lived in municipalities with higher poverty levels had a higher risk of dying from COVID-19 [32]. Based on previous findings in Latin America and Mexico

[24, 30], it is likely that most disadvantaged groups experienced larger life-expectancy losses and this is an important next step for future research.

Similarly, causes of death that were amenable to healthcare contributed to life-expectancy losses between 2019 and 2021. Hospitals that were overwhelmed by COVID-19 were an important determinant of higher mortality in 2020 [32], which very likely continued during 2021. This might be linked to the healthcare reform that started in 2018, with the replacement of Seguro Popular and the start of the Instituto de Salud para el Bienestar [33]. By 2016, 93% of the Mexican population had medical coverage [12] whereas, in 2022, the number of people with no access to medical insurance was estimated to be 40% [33]. Analysis of out-of-hospital deaths in Mexico during the pandemic revealed that most of the excess deaths that occurred during 2020 took place outside of hospital [34]. In 2020, the regions with higher non-COVID-19 excess mortality were associated with low access to social security and healthcare [32]. Our results present a similar trend: we observed that southern Mexico reported a higher contribution of causes of death that were amenable to healthcare to changes in life expectancy between 2019 and 2021 whereas, in northern Mexico, mortality improvements due to causes that were amenable to healthcare helped to mitigate life-expectancy losses.

Limitations

Our study is subject to limitations. The classification of causes of death plays an important role in our results. Some COVID-19 deaths may have been misclassified as other causes [35], particularly deaths due to acute respiratory diseases, which may have led to under-registration of deaths when COVID-19 was the true underlying cause [30]. In Mexico, the available information did not allow us to disentangle this, but we mitigated this limitation by restricting our analysis to six groups of causes of death rather than individual causes. Similarly, homicides are likely to be underreported, especially in Mexico's current militarized context. Enforced disappearances [36], the prevalence of common and clandestine graves [37], and the ongoing forensic crisis reflect pathways through which homicide may not be have been registered in vital statistics. Additionally, homicides may be improperly assigned ICD-10 codes, making them impossible to classify as such [10].

When performing analysis at the state level in Latin American countries, we are aware of the sensitivity to the quality of the data. We used data that were published by the National Population Council, which is reliable in the international context [38]. However, the exposures and death counts for 2022 were forecasted by considering the 1950–2019 mortality trends; we performed a sensitivity analysis by using the unadjusted death count in directly administrative records from 2022 and observed that the life-expectancy levels are different but trends are similar (see Supplementary Figure 11; see online supplementary material for a color version of this figure).

Conclusion

Demographic analyses can aid in identifying and understanding structural challenges regarding population health in Mexico. Between 2015 and 2022, violence and COVID-19 were the major public health challenges that the Mexican population faced, but the impacts of these crises have not been evenly distributed. Homicides continue to negatively impact male life expectancy and, from 2015 to 2019, they also resulted in modest declines in female life expectancy. States with lower healthcare coverage in the southern region of the country experienced larger life-expectancy declines due to COVID-19 and causes that were amenable to medical care. Further research is necessary to better understand the sex differences in life expectancy during the first 2 years of the COVID-19 pandemic and to examine why life expectancy stagnated for males and continued to decline for females between 2020 and 2021. We captured a double penalty for southern regions in Mexico—they experienced large life-expectancy losses and a slower recovery.

Ethics approval

This research project does not require ethics approval as it uses only macro data that are freely available online.

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Author contributions

J.D.Z.B., P.V.C., and J.M. conceptualized the study; J.D.Z.B. performed formal analysis; M.G. supervised and replicated formal analysis; J.D.Z.B. and J.M. wrote the first draft; J.D.Z.B., J.M., P.V.C., and M.G. helped to write the final draft. All authors agree to submit.

Supplementary data

Supplementary data are available at *IJE* online.

Conflict of interest: None declared.

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Data availability

The data and code for this project are publicly available. The mortality data were obtained from INEGI (https://www.inegi.org.mx/programas/mortalidad/) and the population exposures from CONAPO (https://datos.gob.mx/busca/dataset/proyecciones-de-la-poblacion-de-mexico-y-de-las-entidades-

federativas-2020-2070); both sources are publicly available. A complete replication package is available at OSF: https://osf.io/cxnuh/.

Use of artificial intelligence (AI) tools

This work did not use any AI tools.

References

1. UN. *Global Study on Homicide 2019*. United Nations Office on Drugs and Crime, 2019. https://www.unodc.org/documents/data-and-analysis/gsh/Booklet2.pdf (March 2025, date last accessed).
2. Canudas-Romo V, Aburto JM. Youth lost to homicides: disparities in survival in Latin America and the Caribbean. *BMJ Global Health* 2019;**4**:e001275.
3. Aburto JM, di Lego V, Riffe T, Kashyap R, van Raalte A, Torrisi O. A global assessment of the impact of violence on lifetime uncertainty. *Sci Adv* 2023;**9**:eadd9038.
4. Briceño-León R, Villaveces A, Concha-Eastman A. Understanding the uneven distribution of the incidence of homicide in Latin America. *Int J Epidemiol* 2008;**37**:751–7.
5. Lima EEC, Vilela EA, Peralta A *et al.* Investigating regional excess mortality during 2020 COVID-19 pandemic in selected Latin American countries. *Genus* 2021;**77**:30.
6. Halpern B, Ranzani OT. Lessons from the COVID-19 pandemic in Latin America: vulnerability leading to more vulnerability. *Am J Public Health* 2022;**112**:S579–S580.
7. Castro MC, Gurzenda S, Turra CM, Kim S, Andrasfay T, Goldman N. Reduction in life expectancy in Brazil after COVID-19. *Nat Med* 2021;**27**:1629–35.
8. García-Guerrero VM, Beltrán-Sánchez H. Heterogeneity in excess mortality and its impact on loss of life expectancy due to COVID-19: evidence from Mexico. *Can Stud Popul* 2021;**48**:165–200.
9. Aburto JM, Beltrán-Sánchez H. Upsurge of homicides and its impact on life expectancy and life span inequality in Mexico, 2005–2015. *Am J Public Health* 2019;**109**:483–9.
10. Aburto JM, Beltrán-Sánchez H, García-Guerrero VM, Canudas-Romo V. Homicides in Mexico reversed life expectancy gains for men and slowed them for women, 2000–10. *Health Affairs* 2016;**35**:88–95.
11. INEGI. Administrative registers of deaths. In: Geografía INEGI, editor. 2023.
12. Gutiérrez-León E, Escamilla-Santiago RA, Martínez-Amezcua P *et al.* Trends and effect of marginalization on diabetes mellitus-related mortality in Mexico from 1990 to 2019. *Scientific Reports* 2022;**12**:9190.
13. Beltrán-Sánchez H, Avoidable mortality. In: RG Rogers (ed.), *International Handbook of Adult Mortality*. Springer, 2011, 491–508.
14. CONAPO. Proyecciones de la población de México y sus entidades federativas, 2020–2070, Documento metodológico.: Secretaria de Gobernación, Consejo Nacional de Población, UNFPA, 2023.
15. Preston SH, Heuveline P, Guillot M. *Demography: Measuring and Modeling Population Processes*. Oxford: Blackwell Publishers Oxford, 2001.
16. Horiuchi S, Wilmoth JR, Pletcher SD. A decomposition method based on a model of continuous change. *Demography* 2008;**45**:785–801.
17. Riffe T. *Package 'DemoDecomp'. Decompose Demographic Functions*. R package version 1.0. 1st edn. 2014. https://CRAN.R-project.org/package=DemoDecomp (20 January 2025, date last accessed).
18. Canudas-Romo V, García-Guerrero VM, Echarri-Cánovas CJ. The stagnation of the Mexican male life expectancy in the first decade of the 21st century: the impact of homicides and diabetes mellitus. *J Epidemiol Commun Health* 2015;**69**:28–34.
19. ONU Mujeres, SEGOB, INMUJERES. *La Violencia Feminicida en México, Aproximaciones y Tendencias 1985–2016*. Mexico: ONU Mujeres, 2017.
20. Data-Civica. *Claves Para Entender y Prevenir Los Asesinatos de Mujeres en México*. Mexico City, Mexico: Data Civica, 2019.
21. Rivera Rivera L, Séris Martínez M, Reynales Shigematsu LM *et al.* Violence against women during the COVID-19 pandemic in Mexico. *Healthcare* 2023;**11**:419.
22. Aburto JM, Schöley J, Kashnitsky I *et al.* Quantifying impacts of the COVID-19 pandemic through life-expectancy losses: a population-level study of 29 countries. *Int J Epidemiol* 2022;**51**:63–74.
23. Schöley J, Aburto JM, Kashnitsky I *et al.* Life expectancy changes since COVID-19. *Nat Hum Behav* 2022;**6**:1649–59.
24. Mena G, Aburto JM. Unequal impact of the COVID-19 pandemic in 2020 on life expectancy across urban areas in Chile: a cross-sectional demographic study. *BMJ Open* 2022;**12**:e059201.
25. Ramírez T, Joann V. *The Impact of COVID-19 on Employment in Mexico, 2020–2023*. WIEGO, 2023. Contract No.: 37.
26. Urbina Cortés G, Mora Salas M. Prácticas y paradojas frente al COVID-19 en sectores populares de la Ciudad de México. *Notas de Población* 2021;**112**:63–91.
27. Hoehn-Velasco L, Silverio-Murillo A, Balmori de la Miyar JR, Penglase J. The impact of the COVID-19 recession on Mexican households: evidence from employment and time use for men, women, and children. *Rev Econ Household* 2022;**20**:763–97.
28. Argoty-Pantoja AD, Robles-Rivera K, Rivera-Paredez B, Salmerón J. COVID-19 fatality in Mexico's indigenous populations. *Public Health* 2021;**193**:69–75.
29. Hernández Bringas H. COVID 19 en México: un perfil sociodemográfico. *Notas de Población* 2020;**111**:105–32.
30. Antonio-Villa NE, Bello-Chavolla OY, Fermín-Martínez CA *et al.* Socio-demographic inequalities and excess non-COVID-19 mortality during the COVID-19 pandemic: a data-driven analysis of 1 069 174 death certificates in Mexico. *Int J Epidemiol* 2022;**51**:1711–21.
31. Arceo-Gomez EO, Campos-Vazquez RM, Esquivel G, Alcaraz E, Martinez LA, Lopez NG. The income gradient in COVID-19 mortality and hospitalisation: An observational study with social security administrative records in Mexico. *Lancet Reg Health Am* 2022;**6**:100115.
32. Ríos V, Denova-Gutiérrez E, Barquera S. Association between living in municipalities with high crowding conditions and poverty and mortality from COVID-19 in Mexico. *Plos ONE* 2022;**17**:e0264137.
33. Knaul FM, Arreola-Ornelas H, Touchton M *et al.* Setbacks in the quest for universal health coverage in Mexico: polarised politics, policy upheaval, and pandemic disruption. *Lancet* 2023;**402**:731–46.
34. Bello-Chavolla OY, Antonio-Villa NE, Fermín-Martínez CA *et al.* Diabetes-related excess mortality in Mexico: a comparative analysis of National Death Registries between 2017–2019 and 2020. *Diabetes Care* 2022;**45**:2957–66.
35. Luck AN, Preston SH, Elo IT, Stokes AC. The unequal burden of the Covid-19 pandemic: Capturing racial/ethnic disparities in US cause-specific mortality. *SSM Popul Health* 2022;**17**:101012.
36. Mandolessi S, Introduction-Disapparence in Mexico. From the dirty war to the war on drugs. In: Mandolessi S, Rico KO (eds.), *Disapparence in Mexico From the Dirty War to the War on Drugs*. London: Routledge, 2022, 1–27.
37. Fortuna M, Corrales L, Robinson A, Farias RE, Marquez-Grant N. Unidentified bodies in the Mexican context. *Forensic Anthropol* 2022;**5**:195–205.
38. Glei D, Barbieri M, Aburto JM, Barajas Paz A. Mexican mortality 1990–2016: comparison of unadjusted and adjusted estimates. *Demogr Res* 2021;**44**:719–58.

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