

# KIN LOSS DUE TO VIOLENT DEATH IN MEXICO: A SUBNATIONAL MICROSIMULATION APPROACH

**ANTONINO POLIZZI**

University of Oxford  
Department of Sociology & Nuffield College

**DIEGO ALBUREZ-GUTIERREZ**

Max Planck Institute for Demographic Research  
Kinship Inequalities Research Group

## SHORT ABSTRACT

Mexico ranks among the countries with the highest rates of violent death. In this project, we provide estimates of the loss of a parent, child, or sibling to a violent death for each Mexican state and at the Mexican national level. Our microsimulation approach documents the large indirect toll of the surge in violence in Mexico. Between 2010–2019, on average 1 in 1,400 children below age 18—roughly 30,000 children—lost a father to violence each year, underlining the gendered dimension of violence in Mexico. In some Mexican states, rates of violent paternal loss have reached levels of non-violent paternal loss, pointing towards the unfortunate normalization of the loss of fathers to violence. Timely estimates of the loss of kin to violence are needed to mitigate the detrimental emotional and socioeconomic consequences for those who lost a parent, child, or sibling.

## INTRODUCTION

The number of violent deaths worldwide is tragic. In 2019, it was estimated that around 400,000 individuals around the world died as a result of interpersonal violence (1). Mexico is among the countries with the highest rates of violent death today and has recently experienced a rapid increase in the number of victims of violence. Following the start of the so-called “War on Drugs” in 2006 aimed at curbing drug trafficking and its associated violence, violent deaths actually increased from around 13,000 in 2006 to around 41,000 in 2019.<sup>1</sup> Most violent deaths in Mexico occur at young working ages and among men. Of the roughly 36,000 violent deaths that were recorded among Mexican men in 2019, around 30,000 occurred at ages 49 and younger. While levels of violent death are lower among women, they also have experienced increases in violent deaths over the period since 2006.

Violent deaths in Mexico also show strong regional clustering at the subnational level. While contemporary rates of violent death must be considered high in most states of Mexico, states such as Chihuahua and Guerrero have—in the recent past or at present—seen age-standardized violent death rates among men reach levels above 100 deaths per 100,000 population. In addition, trends among states over time have been very heterogeneous. For example, while Guanajuato and Zacatecas have seen rates of violent deaths among men increase above the national average, rates of violent deaths have remained far below average in Aguascalientes and Yucatán.

The demographic consequences of violence for Mexican individuals are remarkable. Violence has slowed improvements in life expectancy at birth and has contributed to an increase in life disparity, or lifetime uncertainty (2). In 2014, 71% (women) and 64% (men) of remaining life expectancy at age 20 was spent with self-reported vulnerability in one’s state of residence (3).

The consequences of violence in Mexico also extend beyond the direct victims. Given the relatively young and large kinship networks in Mexico, many of the young victims of violence already have children and still have living parents and siblings (4). A recent systematic review on parental loss in Latin American countries concluded that violent parental death is associated with worse mental health, complicated grief, and stigma, among other things (5), underlining the need for timely estimates of kin loss due to violence. In 2010, it was

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<sup>1</sup> If not otherwise indicated, information on deaths in Mexico reported in this extended abstract is taken from individual-level death certificate data provided by the Mexican National Institute of Statistics and Geography (or INEGI, by its Spanish acronym).

estimated that 50,000 children in Mexico had previously lost their father to the “War on Drugs” (6). However, more recent estimates of the number of children affected by the violent loss of their parents are lacking. Similarly, estimates are lacking for people who lost a child or sibling to violence.

In this project, we use demographic kinship microsimulation to generate estimates of individuals who lost a parent, child, or sibling to a violent death in Mexico. Our analyses consider the state and national levels across the period 1998–2019. In this extended abstract, we report estimates of parental loss at the national level and for six Mexican states (Aguascalientes, Chihuahua, Guanajuato, Guerrero, Yucatán, and Zacatecas). We selected states based on recent trends in violent death rates (stable low: Aguascalientes, Yucatán; stable high: Chihuahua, Guerrero; increasing: Guanajuato, Zacatecas).

## **DATA**

We generate age- and year-specific fertility and mortality rates for each Mexican state and the Mexican national level using information on deaths, births, and mid-year population for the period 1970–2019 published by the National Population Council of Mexico (CONAPO). Age-specific mortality rates are transformed into probabilities of death using a piecewise exponential function (7). For the period 1998–2019, we derive information on the age- and year-specific share of deaths that are violent deaths from individual-level death certificate data provided by the Mexican National Institute of Statistics and Geography (INEGI). We identify violent deaths using the ICD-10 codes X85–Y09 (Assault), Y10–Y34 (Event of undetermined intent), and Y35–Y36 (Legal intervention and operations of war). We generate probabilities of violent death by multiplying the all-cause probabilities of death by the corresponding share of deaths that are violent deaths (7).

## **METHOD**

We use the Socsim microsimulation engine, as implemented in the R package ‘rsocsim’ (8), to generate annual estimates of bereavement for each Mexican state and the Mexican national level for the period 1998–2019. Socsim uses age- and year-specific fertility rates and probabilities of death as input to project a kinless starting population forward in monthly increments following a competing-risk framework (9). For each individual, random waiting times are generated for different demographic events (such as childbirth and death), and the event with the shortest waiting time is scheduled for execution. After the scheduled event is executed, new waiting times are generated for all demographic events and the above process is repeated. The Socsim output is a rectangular dataset, with each row representing an individual ever alive in the simulated population. The columns of the rectangular dataset represent several variables, such as mother and father identifiers that allow us to link related individuals (for example, all individuals with the same mother or father identifier are siblings). Using information on the date of birth and death of the simulated individuals and their linked relatives, we can identify the individuals at risk of losing a given type of kin (denominator) and the individuals that experienced the loss of a given type of kin (numerator) in each year.

We conduct our microsimulations separately for each Mexican state and the Mexican national level. As is common in demographic kinship research (10), we start our microsimulation by subjecting the kinless starting population to the fertility rates and (all-cause) probabilities of death estimated for the first observed year (1970) for 100 years. To identify the cause of death of a given relative, we use Socsim’s ‘group’ feature. At the time of their birth, individuals are assigned to ‘group 1.’ They can stay and die in ‘group 1’ or move to ‘group 2’, which coincides with the death from a violent cause. We control the movement from ‘group 1’ to ‘group 2’ using the age- and year-specific probabilities of violent death described above.

In this extended abstract, we focus on parental loss. We report two indicators: (a) the annual rate of paternal and maternal loss from a violent or non-violent cause of death among children aged 0–17; (b) the annual probability that an 18-year-old previously lost their father or mother to a violent or non-violent cause of death. In the literature on kin loss, the latter measure is also referred to as orphanhood, or ‘prevalence’ of parental loss (11). Since the output generated by Socsim is subject to stochasticity, we rerun each microsimulation five times. For each of the two indicators, we report the median estimate. To further reduce the influence of the

stochastic component, we use a cohort component projection model to determine what size the kinless starting population would have to be in order to reach a size of 50,000 after the 1970 rates are applied for 100 years.

## RESULTS

Figure 1 shows annual rates of parental loss due to a violent or non-violent death among underage (0–17) children (per 100 population) over the period 1998–2019. The time trends for paternal and maternal loss broadly follow the trends for sex- and cause-specific mortality, suggesting that, despite the young age profile of victims of violence in Mexico, a meaningful number of children is left bereaved. At the national level and in most states, a gradual increase in violent parental loss has been visible after the onset of the “War on Drugs” in 2006, marked by the black vertical line. Paternal loss from violence occurred more frequently in states where violence has been high (Chihuahua, Guerrero) or increasing (Guanajuato, Zacatecas). In Guerrero, on average 1 in 560 children lost their father to a violent death each year in the decade 2010–2019. At the national level, this rate was closer to 1 in 1400 children.

Figure 2 shows the total number of underage (0–17) children affected by paternal and maternal loss in each year of the period 1998–2019. This estimate is derived by applying the rates estimated in Figure 1 to the corresponding mid-year population aged 0–17. While the time trends in the number of affected children traced trends in the rate of parental loss, similar rates of parental loss across different states did not necessarily translate into the same number of affected children, depending on the size and age structure of the state population. For example, despite a smaller rate of violent paternal loss in Chihuahua (1 in 840) vs. Guanajuato (1 in 670) in 2019, a larger number of children was affected in Guanajuato (~3,000) vs. Chihuahua (~1,400). At the national level, on average 29,500 underage children lost their fathers to violence each year in the decade 2010–2019, translating into an estimated total of 295,000 children who became paternal orphans due to violence within one decade.

Finally, Figure 3 shows the prevalence of paternal and maternal loss (in percent) among individuals aged 18, i.e., children who ever lost their father or mother to a violent or non-violent death. Given that our cause-of-death data are only available from 1998, this prevalence is only reliably estimated for 2015 and later. For the years before 2015, the estimates presented in Figure 3 represent a lower bound. In 2019, the prevalence of paternal orphanhood from violence was around 1.8% and 2.6% in Chihuahua and Guerrero, respectively. At the national level and in Guanajuato and Zacatecas, the prevalence of paternal orphanhood from violence was closer to 1%. Perhaps most noticeable is the fact that the prevalence of paternal orphanhood from violence in Chihuahua and Guerrero reached levels of paternal orphanhood from all other causes. At the national level and in all states, the prevalence of maternal orphanhood remained below 0.5% reflecting lower levels of violent deaths among females.

## DISCUSSION

In 2019, around 41,000 people died from a violent cause in Mexico. This marks one of the biggest violent death tolls since the beginning of the so-called “War on Drugs” in 2006. The negative effects of this rise in deadly violence have been quantified using several indicators of population health. The surge in violence has slowed down or reversed improvements in life expectancy at birth and contributed to an increase in lifetime uncertainty at the national and state level (2). In addition, more and more citizens report feeling ‘vulnerable’ living in their state (3).

Our project documents the large indirect toll of the epidemic of violence in Mexico. In the decade 2010–2019, on average 1 in 1,400 underage children—roughly 30,000 children—lost a father to violence each year, underlining the gendered dimension of violence in Mexico. Nonetheless, a rising number of children lose their mother to violence, reflecting increases in the female rate of violent death.

Despite overall high levels of violence, our state-level microsimulation approach highlights the large heterogeneity in experiences of violent parental loss between Mexican states. In the decade 2010–2019, on average 1 in 560 children in the state of Guerrero lost their father to a violent death. Thus, rates of violent

paternal loss have reached levels of non-violent paternal loss in some Mexican states, pointing towards the unfortunate normalization of the loss of fathers to violence.

Our estimates of kin loss are subject to three sources of bias. First, the cause-of-death information used for our analysis may be subject to under-registration and age misclassification. Importantly, it can be expected that these patterns of incompleteness are non-randomly distributed by age, sex, and state. Second, our microsimulation approach assumes the experience of an average individual. This means that the risk to die from a violent death is not correlated with levels of fertility in our models. In reality, however, there might be different mechanisms to argue for higher or lower levels of fertility among those who did vs. did not die from a violent death. Similarly, experiences of violent loss may cluster more in some than in other families, making an estimate of multiple bereavement due to violence difficult. Finally, our analytic approach simulates kinship dynamics in each state separately, assuming no international or interstate migration. This may be particularly problematic if the violent death rates in a given state are associated with the level of in- or out-migration.

Despite these limitations, the strength of our study lies in the estimation of rates of kin loss due to violent deaths and their trends over time using state-of-the-art methods from kinship demography. A recent literature review has linked experiences of violent parental loss in Latin America to worse mental health, complicated grief, and stigma, among other things (5). As the rate of violent parental loss in many Mexican states increases, these experiences are becoming more common. Most violent deaths will leave multiple family members behind, and some individuals will lose multiple family members to violence. While knowledge of the number of individuals affected by the violent loss of a family member will not help curb the high rates of violence in Mexico, it highlights the emotional and socioeconomic needs of the growing population of people affected by the loss of a parent, child, or sibling. Thus, our findings illustrate that the consequences of increasing violence in Mexico reach far beyond the victims of violent acts, and that the full scope of the effects of violence in Mexico become more clearly visible when approached with a kinship lens.

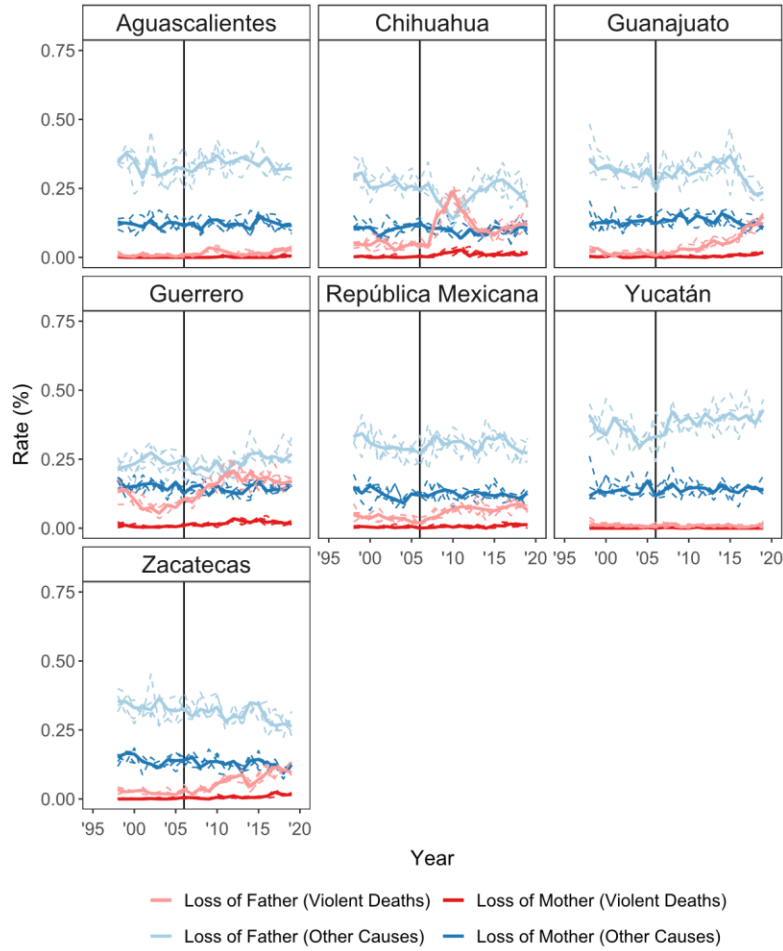
#### **NEXT STEPS**

For the European Population Conference 2024, we are planning to complete our analysis for all 31 Mexican states and to include estimates of child and sibling loss. In addition, we are planning to benchmark our model-based estimates against survey-based estimates on loss of a household member due to violence from the Mexican *National Survey of Victimization and Perception of Public Safety*.

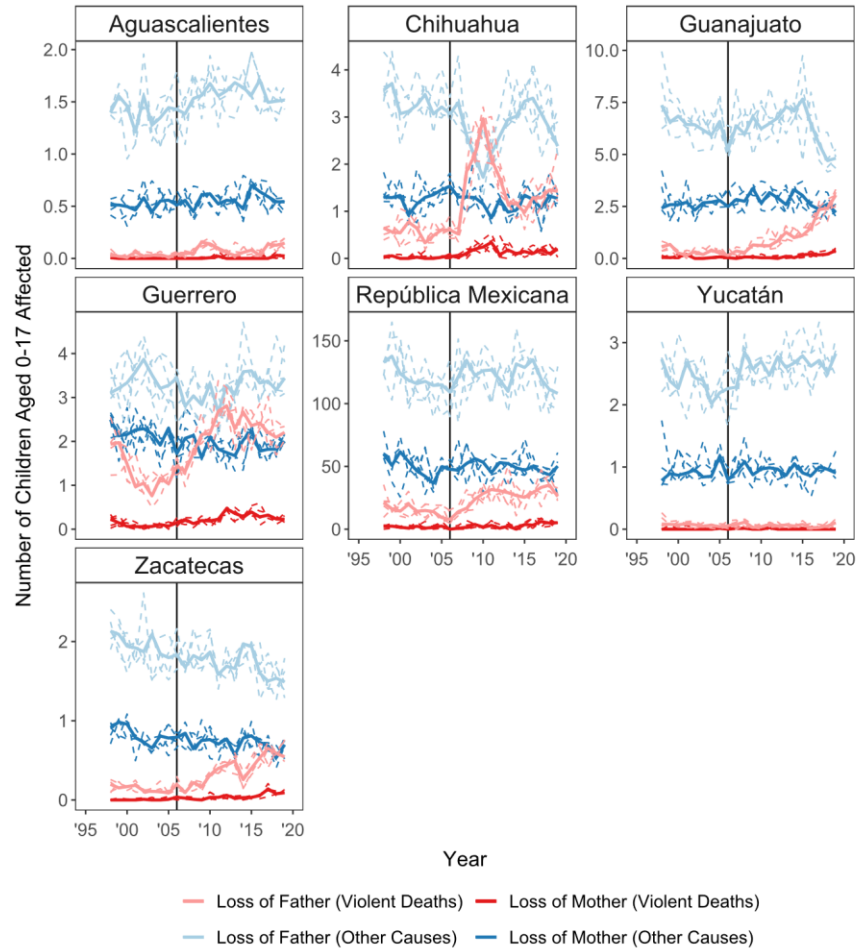
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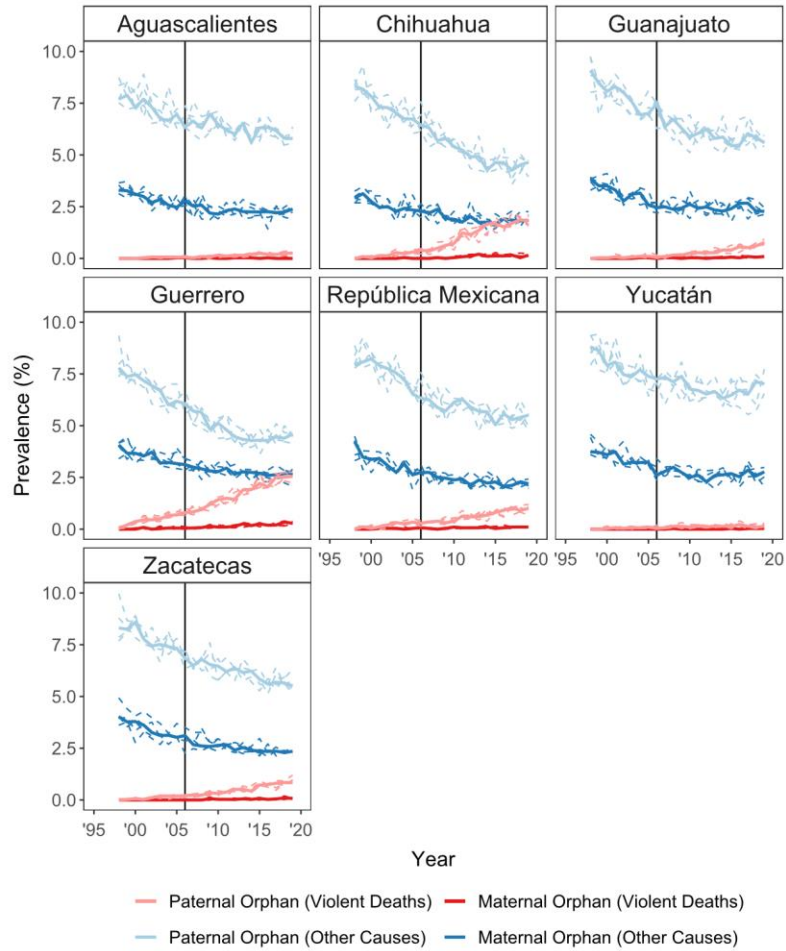
FIGURES



**Figure 1.** Annual rate of violent and non-violent parental death among children aged 0–17, 1998–2019. National average shown in middle panel (“República Mexicana”). Vertical line indicates start of “War on Drugs”. Dashed lines indicate results from five individual microsimulations. Solid lines represent median estimate across all microsimulations.



**Figure 2.** Annual number children aged 0–17 affected by violent and non-violent parental death (in thousands), 1998–2019. National average shown in middle panel (‘República Mexicana’). Vertical line indicates start of ‘War on Drugs’. Dashed lines indicate results from five individual microsimulations. Solid lines represent median estimate across all microsimulations.



**Figure 3.** Annual percentage of individuals aged 18 who are orphaned due to violent and non-violent parental death, 1998–2019. National average shown in middle panel (‘República Mexicana’). Vertical line indicates start of “War on Drugs”. Dashed lines indicate results from five individual microsimulations. Solid lines represent median estimate across all microsimulations.