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Changes in fertility rates and desires in the wake of the homicide surge in Mexico

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Abstract
Since 2006, Mexico has experienced a surge in homicide violence due to national policies and international influences on drug trafficking activities. While the effects of the so-called "Drug War" have been extensively studied in demography and social science research, whether and how the increase in homicides has affected fertility is unknown. This study provides a comprehensive account of the relationship between homicides and changes in fertility rates and desires in Mexico. Using fixed-effects models and a staggered difference-in-differences estimator, we study the effect of homicidal violence on the total fertility rate (TFR) across all Mexican municipalities between 2000–2020. Then, using random-intercept and fixed-effects models, we analyse the association between changes in homicide rates and fertility desires for 6,341 women from the Mexican Family Life Survey (2002–2012). Our findings show no average effect of homicides on TFR for the whole period considered, although TFR declined slightly faster (by 0.1 children per woman) in municipalities experiencing very large homicide spikes between 2010 and 2015. We find no association between municipality-level homicide rates and fertility desires, consistent across educational levels and by parity. Our results show remarkable continuity in the Mexican fertility decline despite the rapid escalation of violence.

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Introduction

Exposure to violence can have significant implications for individual livelihoods and populations. Violence has been found to affect the determinants of demographic change, namely mortality (Aburto et al., 2016), fertility (Cetorelli, 2014), and migration (Abel et al., 2019). This paper examines the impact of increases in the homicide rate on the total fertility rate (TFR) and women's fertility desires. We focus our analysis on Mexico, where the homicide rate rapidly increased to very high levels in the past two decades. Studying changes in individual fertility desires alongside area-level summary indicators of fertility allows us to delve deeper into the mechanisms by which homicidal violence may affect demographic trends. From a policy perspective, it can reveal potential mismatches between desired family size and actualised behaviour that call for interventions to expand the coverage of family planning services in the areas most affected by violence (Svallfors, 2022).

Since 2006, Mexico has undergone an unprecedented wave of homicidal violence due to national policies and international influences on drug trafficking activities, the so-called "Drug War" (Dell, 2015). This has impacted life expectancy (Aburto et al., 2016), union formation and dissolution (Caudillo & Lee, 2023), infant health (Brown, 2018), mental health (Villarreal and Yu, 2017), and socio-economic outcomes (Brown and Velásquez, 2017; Velásquez, 2019). The effects of violence exposure tend to differ by gender (Cockburn, 2004). In the case of the "Drug War", the impact on mortality and educational attainment has been particularly pronounced among young males (Aburto et al., 2016; Brown & Velásquez, 2017), but the psychological toll of rising homicides may fall disproportionately on women through the disruption of everyday life (Cockburn, 2004). The psychological and structural changes brought about by homicidal violence may have influenced fertility behaviours and preferences. However, we do not know how the increase in homicides affected fertility rates nor desires among women of reproductive age. Beyond the Mexican context, a body of literature examines the impact of violence exposure on realised fertility, with mixed results (Cetorelli, 2014; Hill, 2004; Kraehnert et al., 2019). The impact of violence on fertility *desires* is relatively understudied, with a few exceptions (e.g., Svallfors, 2022).

We investigate the effect of rising homicide rates on TFR across municipalities in Mexico, as well as on changes in fertility desires among women of reproductive age. In the first part of the analysis, we document changes in fertility since 2000, and study the relationship between homicide rates and TFR across 2,454 municipalities. Using linear models with fixed effects as well as a staggered difference-in-differences (DID) estimator, we find no significant overall effect of homicides on TFR, although the results suggest that fertility decline was slightly faster in heavily affected municipalities between 2010 and 2015. In the second part of the analysis, we study the relationship between municipality-level homicides and changes in fertility desires between 2002–2012. Using models with woman-specific random intercepts and fixed effects, we find no association between homicides and fertility desires. Our study contributes to a comprehensive understanding of the impact of homicide violence on fertility in the Mexican context.

Background

Fertility trajectories in Mexico: 1960s–2020s

The fertility transition in Mexico since the 1960s mirrors the pattern of rapid fertility decline observed in other Latin American countries including Colombia, Paraguay, and Brazil (Castro Torres, 2021). According to United Nations estimates, Mexico experienced its highest recorded TFR in the early 1960s, at a level of 6.8 children per woman (UN, 2022). Fertility decline in Mexico unfolded over three phases (Tuiran et al., 2002): during an "initial descent" (1964–1973), the TFR decreased from 6.8 to 6.3 children per woman. The years between 1974–1984 were characterised by an "accelerated descent" subsequent to the creation of the *Consejo Nacional de Población* (National Population Council, CONAPO), aimed at expanding access to family planning services (Rodriguez-Barocio et al., 1980). Over this phase, the TFR declined to around 4.2 children per woman. This was followed by a prolonged "moderate decline", with the TFR stabilising around 2.5 children per woman in the early 2000's and reaching replacement levels (2.1) in 2015 (UN, 2022). Relatively less is known about sub-national trends in fertility levels. This is important because, over the last half century, Mexico has undergone important economic, social, cultural and environmental changes—including the increase in homicides—that may affect fertility, but these have occurred at different pace across areas (Páez & Zavala de Cosío, 2017).

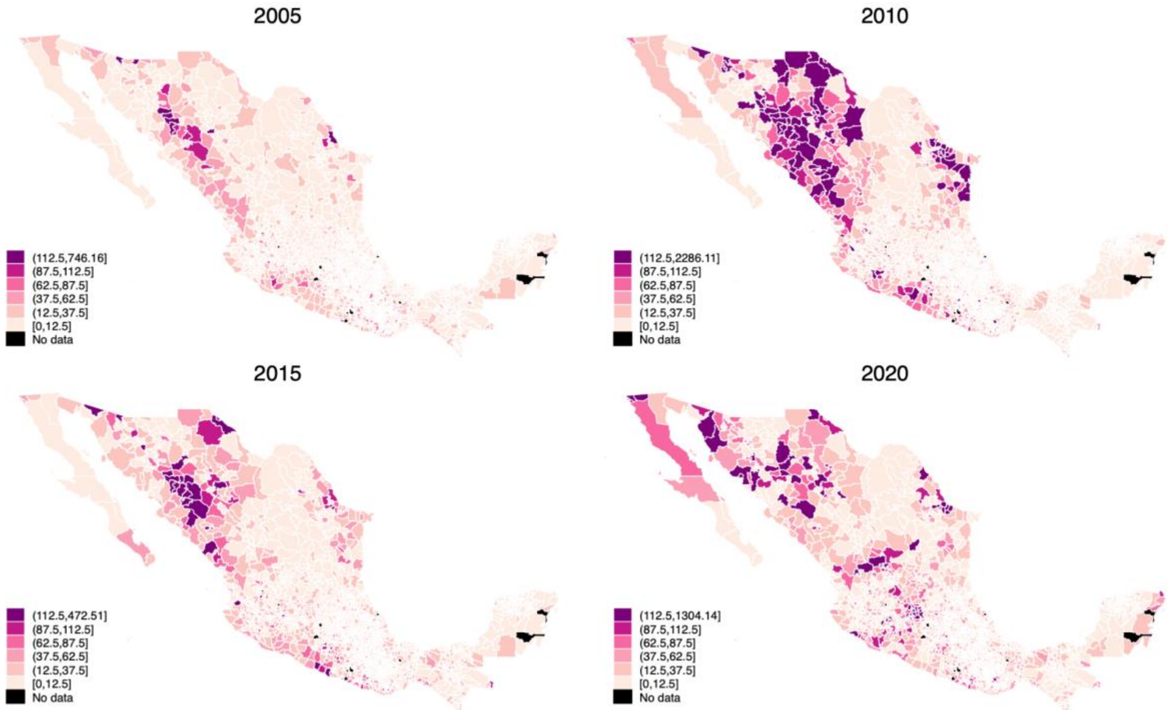
Fertility decline in Mexico has been socio-economically stratified across individuals (Castro Torres, 2021; Páez & Zavala de Cosío, 2017) and states (Tuiran et al., 2002). Women of higher socio-economic status delayed the timing of their first birth and mainly achieved smaller family sizes through non-permanent contraceptive methods, while women of lower socio-economic status anticipated the timing of first birth and stopped having children early, often via sterilisation (Castro Torres, 2021). At the state level, fertility decline began in the most economically developed states, but quickly extended to the rest (Tuiran et al., 2002). The fastest states to undergo the transition to low birth rates include Mexico City and the Northern states of Baja California, Baja California Sur, Coahuila, Nuevo León, Sonora, and Tamaulipas. The last states to attain a low fertility regime are mostly in the South: Chiapas, Guerrero, Michoacán, San Luis Potosí, and Oaxaca, as well as Zacatenas in the North (Tuiran et al., 2002). At the municipality level, a recent study shows that around 47% of municipalities had below-replacement fertility in 2020 (Núñez

Medina, 2022). However, municipalities in rural areas without access to health services have experienced slower declines in TFR (Núñez Medina, 2022). These trends have not been previously linked to the increase in homicides. In this paper, we document area-level changes in the TFR between 2000 and 2020 in Mexico, and link them to homicide rates as well as indicators of socio-economic deprivation.

The surge in homicides in Mexico

Homicide rates have dramatically increased in Mexico since December 2006, leading to stagnation in overall life expectancy by reversing previous gains among men and slowing them for women (Aburto et al., 2016; Dell, 2015). The stark rise in homicides and other violent crimes since 2006 has been widely documented and analysed (Brown, 2018; Dell, 2015; Guerrero-Gutierrez, 2011; Rios, 2013). The general consensus about its causes is centred around the so-called "Drug War" first implemented by former president Felipe Calderón, which involves the direct intervention of the military to crack down on drug trafficking organisations (DTOs). Military capture or killing of DTO leaders has resulted in the fracturing of the original organisations and intense within-group fighting over power vacuums (Guerrero-Gutierrez, 2011). Struggles for the control of territory have resulted in the conspicuous use of violence, with the homicide rate more than doubling from 8.4 homicides per 100,000 population in 2007 to 23.7 in 2011 (Canudas-Romo et al., 2017). Estimates suggest that over 85% of homicides have involved drug traffickers killing each other (Dell, 2015). Violent crimes toward civilians also increased as traffickers turned to extortions, kidnappings, human smuggling, arson, and car theft due to lower revenues from trafficking activities (Dell, 2015; Guerrero-Gutierrez, 2011). Canudas-Romo et al. (2017) estimate that the proportion of years lived feeling vulnerable to becoming victim of violence at the state level rose to up to 70% for both males and females between 2005 and 2014. In the early stages of the "Drug War", homicides remained concentrated in the most valuable regions for DTOs to control, with the four states of Michoacán, Guerrero, Sinaloa, and Chihuahua accounting for the majority of killings in 2007 (Espinal-Enríquez & Larralde, 2015; Rios, 2013). Since then, homicides spread first along the Pacific coast, and then to the North-western part of the country, to the states of Nuevo León and Tamaulipas (Espinal-Enríquez & Larralde, 2015). Figure 1 compares the homicide rate per 100,000 people across Mexican municipalities in 2005, 2010, 2015, and 2020, showing the wide spatial and time variation in homicide violence since the beginning of the "Drug War".

Figure 1. Distribution of homicides per 100,000 inhabitants across Mexican municipalities, 2000–2020



It is unclear whether and how the "Drug War" has affected fertility. So far, two studies on infant health outcomes yield mixed evidence on fertility responses. Brown (2018) finds that birth rates responded negatively to violence exposure during the middle of gestation for higher-educated women, and significantly declined for women in poorer health who were exposed to violence in early gestation. Torche & Villarreal (2014) find instead no overall fertility response and minimal selectivity of women giving birth in the wake of rising local homicides. A study of the effect of the "Drug War" on teenage pregnancies finds that the average increase in municipal-level homicides corresponds to a decline in teenage pregnancies by 1.5%, which is mostly attributable to changes in the sexual behaviour of young women—with exposure to violent crime at municipality level reducing the probability of ever having had sex (Tsaneva & Gunes, 2020). None of these studies address the question of changes in the TFR or fertility desires in the wake of the rapid increase in homicides.

The relationship between violence and fertility

At the population level, exposure to violence through war or other forms of armed conflict can affect fertility rates via a variety of pathways, by influencing the proximate and distal determinants of fertility. Among the proximate determinants of fertility, generalised violence can reduce birth rates by reducing opportunities for marriage and cohabitation as well as the stability of unions (Caudillo & Lee, 2023a, 2023b), or by impairing women's fecundity through stress and health deterioration (Agadjanian & Prata, 2002; Thiede et al., 2020). The 1998–2000 conflict between Eritrea and Ethiopia led to a steep reduction in fertility, largely by reducing the proportion of married women living with their husbands and therefore exposed to the risk of pregnancy (Blanc, 2004; Woldemicael, 2008). Thiede et al. (2020) study the relationship between exposure to armed conflict and fertility in 25 sub-Saharan African countries and find modest reductions in the probability of recent childbearing among women affected by conflict, suggesting they are mainly driven by reductions and delays in marriage and cohabitation. With regard to women's health, O'Brien (2020) finds that exposure to conflict during the Tajiki civil war increases the likelihood of experiencing a miscarriage. However, the effect of conflict on fertility through its proximate determinants is not necessarily negative. In the context of the Iraqi war of 2003–2011, Cetorelli (2014) finds an increase in fertility due to earlier ages at marriage and first birth during conflict years.

Exposure to violence can alter the structural determinants of fertility, by damaging infrastructure and affecting business cycles. Access to contraception and family planning services may be negatively affected by conflict and unrest, resulting in increases in unplanned fertility. Svallfors and Billingsley (2019) study the Colombian armed conflict and find a decline in contraceptive use in areas more affected by violence, which is not fully explained by an increase in fertility desires. Within the same context, Svallfors (2021) finds an increased uptake in sterilisation in areas most affected by violence, suggesting that women may opt for sterilisation due to the decreased accessibility of reversible methods of contraception. Conflict is also related to negative economic conditions (Velásquez, 2019). To the extent that fertility is counter-cyclical to economic growth (Goldstein et al., 2013), exposure to violence at area level may lower fertility rates. In the Latin American context, Adserà and Menendez (2011) document a strong negative relationship between business cycles and fertility between the 1980s and the 2010s.

Exposure to violence has psychological consequences that may affect fertility rates at the population level (Caldwell, 2006; Villarreal & Yu, 2017). Generalised violence may lead families to have more children in the face of heightened mortality conditions (Rahman, 1998). Research on the Rwandan genocide finds strong evidence for a "child replacement" effect, as having experienced the death of a child during conflict is related to higher hazards of having a child and more births in the 15 years after the conflict (Kraehnert et al., 2019; Schindler & Brück, 2011). Torrisi (2020) studies fertility changes in Azerbaijan to find substantially higher probabilities of transitioning to second birth for women exposed to conflict relative to non-exposed women. Further positive effects of conflict exposure on fertility among women who lost a child during peak conflict years are suggestive of insurance and replacement mechanisms (Torrisi, 2020). However, fertility responses to violence through psychological pathways can also be negative. Caldwell (2006) argues that major social upheavals lead to increased uncertainty about the future and a desire to postpone childbirth until the situation is clearer. Recent studies of economic insecurity (Vignoli et al., 2020) and the COVID-19 pandemic (Guetto et al., 2022) find these to be related to fertility decline in the face of increased collective uncertainty. Finally, conflict can induce changes in fertility rates through forced or voluntary migration (Fargues, 2000). In Burundi, Verwimp et al. (2020) find the risk of a first pregnancy to be higher in the year in which a woman is forcibly displaced due to civil war, and lower in the year when a woman migrates voluntarily. In both cases, residency in a new place increases the risk of pregnancy.

As is clear from the above review of potential pathways, one cannot make unambiguous predictions about the effect of exposure to violence on fertility. In fact, the general message from the empirical literature is one of heterogeneity. First, fertility responses to violence exposure are heterogeneous by the nature of the conflict being studied. Genocides (e.g., in Rwanda) and prolonged political conflicts (e.g., in Palestine) are generally associated with higher fertility (Fargues, 2000; Kraehnert et al., 2019). Studies of other types of social upheaval as well as outright war show evidence of fertility decline (Blanc, 2004; Caldwell, 2006), although the results are mixed (Cetorelli, 2014; Torrisi, 2020). A second source of heterogeneity is the time frame considered. In a review of evidence on crises, conflict, and displacement across different historical and geographical contexts, Hill (2004) finds that violence tends to lower fertility in the short-run, but the effects vanish in the long-run. In a study of conflict in Angola, Agadjanian and Prata (2002) also support the idea of a short-term fertility decline followed by a rebound. Castro Torres and Urdinola (2019) highlight the importance of distinguishing between short-term violence exposure and protracted, long-term exposure. Heterogeneity in effects can also derive from the stage of the fertility transition of the affected population (Caldwell, 2006). For example, at the time when war with Ethiopia broke out, Eritrea was already undergoing a fertility decline, which may have been accelerated by conflict (Woldemicael, 2008). Finally, substantial heterogeneity in fertility responses to violence can be found within affected populations. Castro Torres and Urdinola (2019) examine the effect of the Colombian internal conflict on fertility and find a positive effect for rural areas only—which were the most affected by violence. In general, the literature suggests that women of higher socio-economic status may be better able to control their fertility during conflict, and as such more likely to experience fertility decline (Agadjanian & Prata, 2002; Thiede et al., 2020).

Given the lack of research on the relationship between violence exposure and fertility in the context of the Mexican "Drug War", we deem it important to document fertility responses to this protracted and ongoing internal conflict that continues to affect demographic, psychological and socio-economic outcomes of the population (Aburto et al., 2016; Velásquez, 2019; Villarreal & Yu, 2017). We focus on the homicide rate, which is widely used to measure and compare levels of violence in Latin America (Rivera, 2016). While other types of violence have also increased in Mexico since 2006 (Dell, 2015), homicides are the most commonly used measure in the literature on the effects of the so-called "Drug War" because they are less prone to measurement error and underreporting than other statistics about crime and violence, and are available from population death registers at highly granular (municipality) level for a long time series (Brown, 2018; Caudillo & Lee, 2023a). ***The first objective of our study is to assess how rising homicide rates affected the TFR across Mexican municipalities between 2000 and 2021***.

Violence exposure and fertility desires

To better understand changes in fertility rates upon increased homicide violence in Mexico, we examine changes in fertility desires among women of reproductive age. Desires are the first conscious expression of fertility preferences, and lead to intentions on whether or not to have children, parity, and the timing of childbearing. Within fertility preferences, desires are more distal determinants of fertility as they are based on someone's feelings, whereas intentions are more proximate as they imply a commitment to act and are often based on a person's current situation (Miller, 2011). While the literature commonly refers to fertility intentions, most surveys measure fertility desires by asking individuals how many (more) children they would like to have (Kost & Zolna, 2019). In this study we focus on fertility desires in line with the available survey questions.

While levels of over- and under-achieved fertility are high in low- and middle-income countries, fertility desires are predictive of realised fertility (Yeatman et al, 2020; Kodzi et al., 2010). At the same time, fertility desires are flexible (Yeatman et al., 2013). There is widespread agreement that fertility preferences respond to contingencies, inputs, and shifts that occur at the micro and macro levels, rather than emerging from clarity about a predictable future (Johnson-Hanks et al., 2011; Ní Bhrolcháin & Beaujouan, 2019; Vignoli et al., 2020). Flexibility in childbearing is a strategic response to life's uncertainties and it is especially important in contexts of political and social unrest (Johnson-Hanks, 2005). Trinitapoli & Yeatman (2018) find that women's flexibility in fertility preferences in Malawi is patterned by age, socio-economic status, and so-called existential uncertainty, which is proxied by having ever experienced a miscarriage or the death of a child, a death in the close network, and a heightened sense of one's own mortality. As such, the unexpected onset of violence can shape women's fertility preferences by increasing the perceived (as well as actual) unpredictability of lives (Caldwell, 2006).

The "Drug War" in Mexico has resulted in increased fear, uncertainty, and risk aversion in the affected communities (Brown et al., 2019; Villarreal & Yu, 2019). In line with insurance and replacement mechanisms (Rahman, 1998), women may desire more children subsequent to increased homicides exposure in the hope that at least some of those children will survive. For example, Rutayisire et al. (2013) find increased fertility preferences in the wake of the Rwandan genocide. In a study of women aged 18–22 in Michigan, Weitzman et al. (2021) find that nearby homicides have a positive, long-term effect on young women's desire for pregnancy, which emerges three-to-five months post exposure to violence. Heightened fear and uncertainty may also decrease the desired number of children. Witnessing violence may discourage women from having children by lowering their expectation that any unborn child will have a good life (Agadjanian, 2005). Recent studies in high-income countries suggest that uncertainty related to economic downturn, environmental issues, and the COVID-19 pandemic has resulted in lower desired family size (Lazzari et al., 2023; Rackin et al., 2022; Vignoli et al., 2020). Some research also indicates stability in fertility preferences in the wake of uncertainty. Buber-Ennser et al. (2023) find no changes in fertility intentions in Austria in response to the COVID-19 pandemic. Similarly, Zimmerman et al. (2022) find the pandemic to be unrelated to major shifts in fertility desires in Kenya. Highly relevant for the context of this study, Svallfors (2022) examines the relationship between area-level armed conflict and fertility preferences in Colombia and finds no differences in fertility desires between women living in areas affected by violent unrest and women living in unaffected areas. However, given the cross-national design of the study, results are subject to confounding and cannot reveal potential underlying mechanisms.

As in the case of realised fertility, predictions about how exposure to a violent environment affects fertility desires are ambiguous, with potentially heterogeneous effects across groups. In microeconomic theory, higher educational attainment increases the "opportunity costs" of childbearing, such that violence may predominantly affect higher-educated women (Schmidt, 2008; Adserà & Menendez, 2011). Higher-educated women may be better informed about the contextual level of violence and therefore respond more strongly by adjusting their fertility desires. Homicide exposure may also affect fertility desires differently across parity levels. On the one hand, women who are childless or at lower parities may exhibit stronger behavioural fertility response to mortality shocks (Nobles et al., 2015). For instance, Kraehnert et al. (2019) find that the death of a child subsequent to the genocide in Rwanda had a stronger positive effect on fertility at lower parities. On the other hand, higher-parity women may be more determined to prevent additional births when the time is not right (Agadjanian & Prata, 2002). Changes in fertility desires among reproductive-age women upon the Mexican "Drug War" have not been previously studied. ***The second***

objective of this study is to analyse the relationship between changes in area-level exposure to homicides and changes in fertility desires among Mexican women aged 15–45 between 2002 and 2012.

Data and Methods

Municipal-level homicide rates

As of 2023, Mexico has 2,454 municipalities across 32 states. Municipal-level homicide rates were calculated using vital statistics published by the National Institute of Statistics and Geography (*Instituto Nacional de Estadística, Geografía e Informática*, INEGI) and data from the Census of Population and Housing conducted by INEGI in 2000, 2010, and 2020. The municipality-month numerators for the rates were calculated using death certificate microdata.[1] Deaths were classified as homicides if they were assigned causes of death X95–Y09 according to the 10th International Classification of Diseases. Of death certificates with these causes of death listed, records missing information about the year and month when the death occurred, as well as the state and municipality where the death occurred were excluded. This information was missing in less than 0.1% of records of deaths due to homicides. Records of homicides that occurred outside of Mexico were also excluded. The numerator of the rates was then calculated as the total number of homicide deaths containing the minimum required information (year and month of death and municipality and state of death) for each municipality-month from January 2000 through December 2021. Mid-year municipality-level population counts were calculated by linearly interpolating municipality-level population counts between census years. Municipal-level monthly crude homicide rates were then calculated by dividing the monthly homicide counts by the monthly population exposure and multiplying by 100,000 to get the homicide rate per 100,000 population. As part of this work, we have prepared a public repository with the homicide rate data, available at https://osf.io/u8dc3/.

Fertility rates and socio-economic indicators

Municipal-level total fertility rates (TFR) were calculated using data from vital statistics published by INEGI and population counts provided by CONAPO. Yearly age-specific municipal-level birth counts for 2000–2021 were calculated using birth certificate microdata.[2] Births were assigned to the municipality where the mother was residing at the time of birth and grouped into 5-year age groups based on the mother's

[1] The death certificate microdata can be downloaded from: https://www.inegi.org.mx/programas/mortalidad/?ps=Microdatos.

[2] The birth certificate microdata can be downloaded from: https://www.inegi.org.mx/programas/natalidad/#Microdatos.

age when the birth occurred. Births where the mother's municipality of residence or age at birth were missing were excluded from these counts, representing approximately 1% of all available birth certificate data during the study period. We also excluded births where the mother was not residing in Mexico at the time of the birth. To calculate TFR, age-specific fertility rates were calculated using age-specific municipality-level female population counts. The data prior to 2016, a product of the 2015 *Conciliación Demográfica* (Partida Bush, 2017), were shared with us directly by CONAPO; from 2016–2021, the population counts come from projections published by CONAPO (Consejo Nacional de Población, 2018).[3] We also derived socio-economic indicators for each municipality using data from CONAPO (Villasana Ocampo et al., 2020). These include: the percentage of the population aged 15+ who are illiterate; the percentage living without electricity; the percentage living in overcrowded households; and the percentage of people living with less than two minimum salaries. Since these indicators are only available for years when a census or population count was conducted, we linearly interpolate missing values between years. We analyse data for 2,443 municipalities for which we have information on homicide rates, TFR, and socio-economic deprivation. All the municipality variables are summarised in Supplementary Table 1 for years with an available census or population count.

Mexican Family Life Survey

The MxFLS is a longitudinal survey representative of the Mexican population in 2002, covering the period before and after the onset of the so-called "Drug War". The MxFLS has three waves of data, collected in 2002 (MxFLS1), 2005–2006 (MxFLS2), and 2009–2012 (MxFLS3). The baseline survey has information on approximately 35,600 individuals in 8,440 households, and covers 150 municipalities across 16 states throughout Mexico. We restrict our target population to women of reproductive age (15–45), for whom fertility desires are relevant. Previous research has shown that survey drop-out in the MxFLS is very low among this group of women (around 6%) and unrelated to homicide rates (Brown, 2018). Since we are mainly interested in change over time, our analytic sample consists of 6,341 women observed at least twice in the survey. The total number of observations is 13,646. For each observation, we link the municipal homicide rate based on month of interview and municipality of residence. The MxFLS contains data on various aspects of family life, including fertility desires for women of reproductive age. The MxFLS is ideal for the purposes of our study because data collection was conducted some time before (2002), immediately before (2005–2006), and after (2009–2012) the rise in the homicide rate. The data collection

[3] These population projection data can be downloaded from CONAPO: https://datos.gob.mx/busca/dataset/proyecciones-de-la-poblacion-de-mexico-y-de-las-entidades-federativas-2016-2050/resource/0e21e97e-1faf-4045-8dc2-06691e0379a8 (database 1) and https://datos.gob.mx/busca/dataset/proyecciones-de-la-poblacion-de-mexico-y-de-las-entidades-federativas-2016-2050/resource/b3b4ab0d-83ea-49e0-913e-54ee032c1dbd (database 2).

period for wave 3 (2009–2012) includes some of the most violent years on record in Mexico (Espinal-Enríquez & Larralde, 2015).

Our outcome of interest is the total desired fertility, measured by the sum of current parity and additional fertility desires. We generate this variable from two survey questions. The first asks women of reproductive age: "How many (more) children would you like to have?" at each wave. The values of this variable range from 0 (no more children) to 12. The second asks women to report any children ever born (at wave 1) or that were born since the previous wave (at waves 2 and 3), which ranges from 0 to 13. For each wave, we set our outcome as the sum of these two numbers. This is likely to provide an overestimation of fertility desires, as it assumes that all parities were desired. However, for the scope of this analysis, we are interested in changes in fertility desires over time, rather than desired family size. Accounting for the number of children born between waves is essential to isolate changes in desires from changes in parity that get women closer to their desired fertility. For example, consider a woman who reports desiring two additional children at wave 1, has one child between waves 1 and 2, and reports desiring one additional child at wave 2. The total desired fertility for this woman remains stable at two children, and the change in her fertility desires is zero since the previous wave.

We code an indicator for educational attainment, categorised as "less than secondary schooling", "secondary schooling", "high school", and "college or higher". We also define current parity based on the number of children the woman currently has, which we recode as a binary indicator of whether each woman has any children or not. As control variables, we code indicators for women's age in years, partnership status (whether married/cohabiting or not), employment status (not working; working less than 30 hours per week; working 30+ hours per week); equivalised household consumption (in 1000s pesos) (for the equivalence scale, see Hagenaars et al., 1994); household size; and self-rated health ("poor"; "fine"; "good"; or "very good").

Analytic approach

Our first objective is to study the relationship between the homicide rate and TFR at the municipality level between 2000–2021 across 2,443 Mexican municipalities. We start with a linear model for the TFR based on the first or second lag of homicides with municipality fixed-effects (γ_m):

$$TFR_{mt} = \beta_1 homicide.rate_{m,t-n} + \gamma_m + \varepsilon_{mt}$$

The coefficient β_1 gives the association between a one unit increase in the homicide rate in the previous period and the current TFR. We alternatively plug the one-year ($n = 1$) and two-year lag ($n = 2$) of the homicide rate into the model, as associations may be delayed due to conception and gestation periods. The unadjusted association is likely to be confounded by municipality characteristics linked with homicides and fertility. Socio-economically disadvantaged municipalities may have higher TFR and be more likely to experience rising homicides. We therefore control for the municipality socio-economic indicators summarised in Supplementary Table 1. The new equation is as follows, where X_{mt} indicates a vector of time-varying municipality-level covariates:

$$TFR_{mt} = \beta_1 homicide.rate_{m,t-n} + \beta_i X_{mt} + \gamma_m + \varepsilon_{mt}$$

The fixed-effects model does not account for the potential presence of time-varying unobserved confounders, nor for heterogeneous effects over time. As a complementary analysis, we perform a staggered DID analysis following the approach recently proposed by Callaway and Sant'Anna (2021). This estimates the average treatment effect on the treated (ATT) by comparing trends in the outcome between units that received treatment at different points in time, and never-treated units. In our case, we define two treatments: an increase in homicides by 20/100,000 population, or higher; and an increase in homicides by 50/100,000 population, or higher, between two and one years prior. We compare municipalities that experience such spikes at any point between 2007–2020 with municipalities that never experience them. The assumption is that, once the municipality experiences a spike, it remains affected until the end of the observation period. An increase in the homicide rate by 20/100,000 or higher between one year and the next is detected in around 10% of observations (municipality-years). Among the 2,443 municipalities for which we have data, 1669 (67.65%) experience an increase in the homicide rate of this magnitude at least once between 2007 and 2020. Increases by 50/100,000 or more are observed in around 4% of all observations: 847 municipalities (34.33%) experience such an increase at least once between 2006 and 2020. These represent considerable spikes, given that the overall homicide rate for the Americas in 2017 was 17/100,000 (UNODC, 2019). These figures give an idea of the intensity and territorial spread of homicidal violence in Mexico during this period.

In the staggered DID approach, treated units are grouped into g groups based on the time t at which they are first exposed to treatment. One ATT per treatment group is estimated from:

$$ATT(g,t) = [E(Y)(g)_t - E(Y)(NT)_t] - [E(Y)(g)_{t-1} - E(Y)(NT)_{t-1}]$$

Where $E(Y)$ indicates the expected value of the outcome, TFR, and NT indicates the "never treated" group. The estimator takes the difference between the difference in average outcomes between treated and never-treated units at time t and $t-1$. Just like standard DID designs, it assumes parallel trends. In our case, this means that in the absence of a spike in homicides between $t-2$ and $t-1$, municipalities affected by a homicide spike would have experienced the same change in TFR as municipalities that never experienced such a spike. For this to hold, never-treated municipalities should be as comparable as possible to those affected. Therefore, we cluster municipalities by state, and report results with and without controls for the socio-economic characteristics described above (see Supplementary Table 1). The ATTs for each group g are then combined into a single ATT following Callaway & Sant'Anna (2021).

Our second objective is to assess how changes in the municipality homicide rate over time correspond to changes in the desired number of children for women of reproductive age (15–45)[4]. Our statistical analysis relies on linear models of the change in total desired fertility since the previous wave, net of any children born between waves. We fit the following linear regression:

$$fert.desires_{imt} = \beta_1 homicide.rate_{m,t-n} + \beta_i X_{imt} + \theta_i + t \cdot \gamma_m + \varepsilon_{imt}$$

Each woman i lives in municipality m at month t. We regress changes in fertility desires on the homicide rate in the woman's municipality of residence, with alternative lags by three ($n = 3$) and six months ($n = 6$). These have been identified as the lower- and upper-bound of the relevant period during which a spike in homicide violence may affect fertility desires (Weitzman et al., 2021). We control for women's characteristics associated with fertility desires expressed by the vector X, which include age, partnership status, educational attainment, work status, number of people in the household, and the woman's self-rated health. θ_i indicates woman-specific intercepts, while the term $t \cdot \gamma_m$ represents a municipality time trend, accounting for changes in fertility desires within municipalities over time that are unrelated to homicides. Finally, ε_{imt} indicates the woman-specific error term. We adopt two alternative specifications of the model. The first treats θ_i as woman-specific random intercepts, resulting in a random-effects model with observations nested within women. The model accounts for the clustering of observations within individuals, and β_1 summarises co-variation in the homicides and fertility desires both across-women as well as within-women over time. As a second specification, we treat θ_i as women-specific fixed-effects. This model only relies on variation within women over time to estimate β_1 and other coefficients, thus accounting for unobserved time-invariant differences in fertility desires between women.

A potential concern with estimating the effect of an increase in the municipal homicide rate on fertility desires is selective out-migration of women from the most affected municipalities, which may be related to characteristics that independently influence fertility desires (such as the family's socio-economic status). To minimise the risk of bias from selective migration, we follow Brown (2018) in fixing the municipality

[4] Results are not sensitive to using 15–49 as the age range.

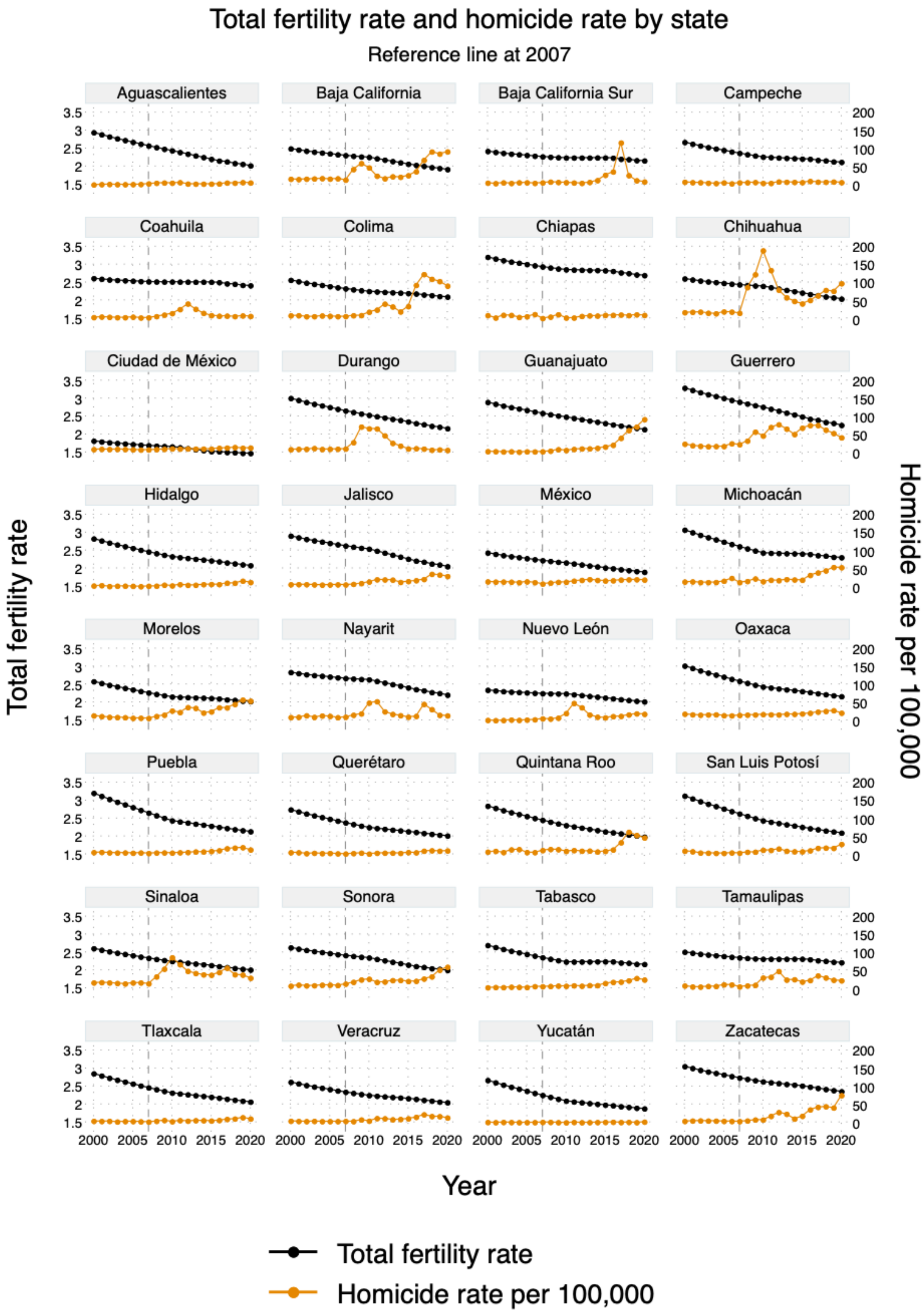
of residence at wave 2 (2005–06) for women who migrate. Given that the "Drug War" began in December 2006, it is unlikely that women were able to anticipate the increase in homicides at wave 2 of the MxFLS.

Results

Changes in TFR and homicide rate across Mexican states, 2000–2020

We begin by providing an overview of changes in TFR and the homicide rate for each of the 32 Mexican states. Figure 2 summarises trends for 2000–2020, with TFR on the left-hand side scale and the homicide rate per 100,000 people on the right-hand side. The decline in the TFR appears linear over time, with states with higher TFR in 2000 (e.g., Guerrero, Michoacán, Puebla, and San Luis Potosí) experiencing steeper declines between 2000–2010. Overall, the TFR declined from around three children per woman in 2000 to around two in 2020, with the exception of Mexico City, where it was consistently below two children per woman and declining throughout the period. In some states (e.g., Campeche, Chiapas, Puebla, Tlaxcala), an initially more rapid fertility decline (2000–2010) was followed by slower reductions (2010–2020). However, from visual inspection, the change in slopes does not seem to be systematically related to trends in the homicide rate. The figure shows the heterogeneous effect of the "Drug War" across the country. Some states (e.g., Chihuahua, Durango, Sinaloa) experienced large spikes in homicide rate in the initial years of the "Drug War" (up to 180/100,000 in 2010 in Chihuahua). Other states were mainly affected after 2015 (e.g., Baja California Sur, Colima, Guanajuato). Others remained relatively unaffected (e.g., Aguascalientes, Yucatán). At the state level, the Spearman correlation coefficient between the TFR and the homicide rate is -0.29, indicating a weak negative correlation. This correlation may be attributable to consistent fertility decline during a period when homicides substantially increased, and more granular data are needed to test for this relationship.

Figure 2. Trends in Total Fertility Rate and homicide rate per 100,000 inhabitants across Mexican states



The relationship between homicides and fertility, 2000–2020

To study the relationship between homicides and fertility across municipalities, we begin by fitting a fixed-effects model of TFR on the homicide rate for 2,443 municipalities over time. Table 1 shows the coefficients for the fixed-effects model, with and without controls for municipality deprivation. The first and second lags of the homicide rate are studied in alternative models, with the other coefficients remaining virtually unchanged. Regardless of which lag of the homicide rate is considered, we find a negative association between an increase in homicides and the TFR within municipalities over time in the unadjusted model. Specifically, an increase in homicides by 10/100,000 is associated with a reduction in TFR between 0.02 and 0.03 children per woman. However, when time-varying controls for municipality deprivation indicators are included, the association between TFR and the homicide rate goes to zero in both cases. An alternative model specification with first differences also shows no effect, whether or not socio-economic controls are included, with coefficients presented in Supplementary Table 2.

Table 1. Coefficients and 95% confidence intervals from fixed-effects models for total fertility rate

	No controls	**With deprivation controls**
Lag of homicide rate	-0.002 (-0.003 ; -0.002) ***	0.000 (-0.000 ; 0.000)
2nd lag of homicide rate*	-0.003 (-0.003 ; -0.002) ***	-0.000 (-0.000 ; 0.000)
% illiterate		0.036 (0.032 ; 0.040) ***
% with no electricity		0.021 (0.019 ; 0.023) ***
% in overcrowded hh's		0.030 (0.029 ; 0.032) ***
% communities < 5,000 pop.		-0.001 (-0.002 ; 0.000)
% < 2 minimum salaries		-0.001 (-0.002 ; -0.000) **
N (municipalities)	2,443	2,443
N (observations)	34,144	34,144

* coefficient from an alternative model.

As a complementary approach, we check our null result using a staggered DID design (Callaway and Sant'Anna, 2021). Figure 3 displays the estimated ATTs for each group defined by exposure to a spike in homicides by either 20/100,000 or more (top panel) or 50/100,000 or more (bottom panel) between two and one years prior, with and without controls for municipality-level deprivation. In all cases, we find no overall effect of a homicide spike on TFR for the entire period considered. The aggregated ATTs for a homicide spike by 20/100,000 (with 95% confidence intervals) are -0.042 [-0.150 ; +0.067] without municipality deprivation controls, and -0.028 [-0.113 ; +0.057] with controls. The aggregated ATTs for a spike by 50/100,000 are -0.089 [-0.188 ; +0.010] without controls, and -0.017 [-0.078 ; 0.044] with controls. Among municipalities that first experienced an increase in homicides by 50/100,000 between 2010 and 2015, we detect small negative effects on TFR, by around -0.1 children per woman. This suggests that fertility fell more rapidly in areas with extremely high levels of homicidal violence during the initial years of the "Drug War", when areas in Guerrero, Durango, and Chihuahua were the most heavily affected (Figures 1 and 2). No similar effect is detected in later years.

Homicide rates and changes in fertility desires, 2002–2012

Moving on to the analysis of fertility desires, Table 2 displays the sample characteristics of women at baseline observation in the MxFLS. Our outcome of interest, total desired fertility, decreases over time and especially between waves 2 and 3, which is partly the result of falling desired fertility, and partly deriving from the fact that higher-parity women leave our analytic sample as they reach the age of 45. To complement these numbers, Figure 4 displays changes in fertility desires net of woman-specific births for the overall sample and across cohorts born in the 1960's, 1970's, and 1980's. Once the birth of additional children between survey waves is accounted for, fertility desires are relatively stable over the 10-year period, with some decline between 2005 and 2009 (by around 0.2 children per woman). There are large differences across cohorts, as women born in the 1980's desire one fewer child on average than women born in the 1960s, in line with the trends in TFR decline discussed above (see Figure 2). A substantial proportion of women complete university education during the survey period (from 9.13 to 15.62%), and there is an increase in the proportion of women working full-time (from 22.62 to 29.93%).

Figure 3. Average treatment effect on the treated (ATT) of increases in homicide rates by 20/100,000 and 50/100,000, by period of first exposure.

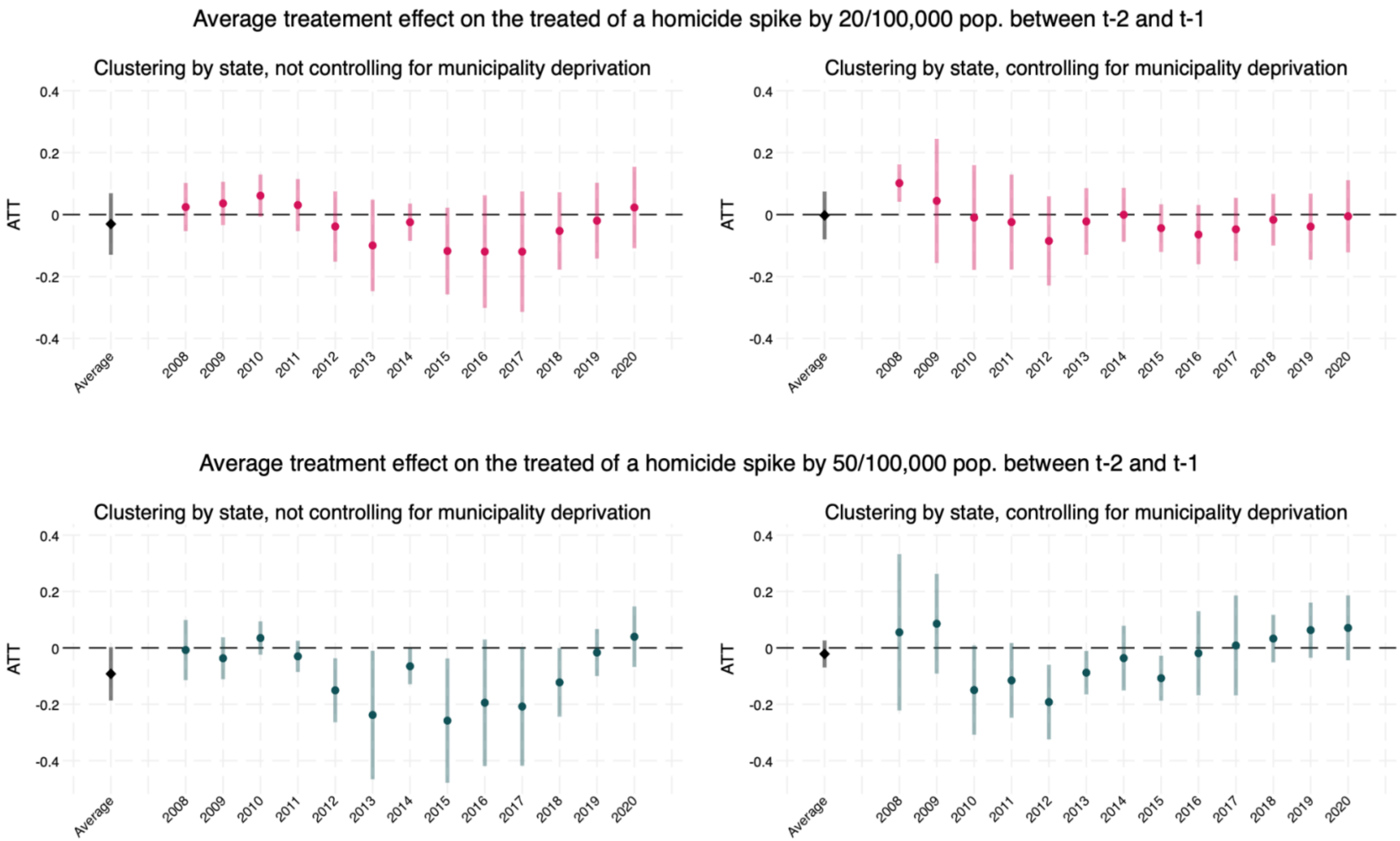
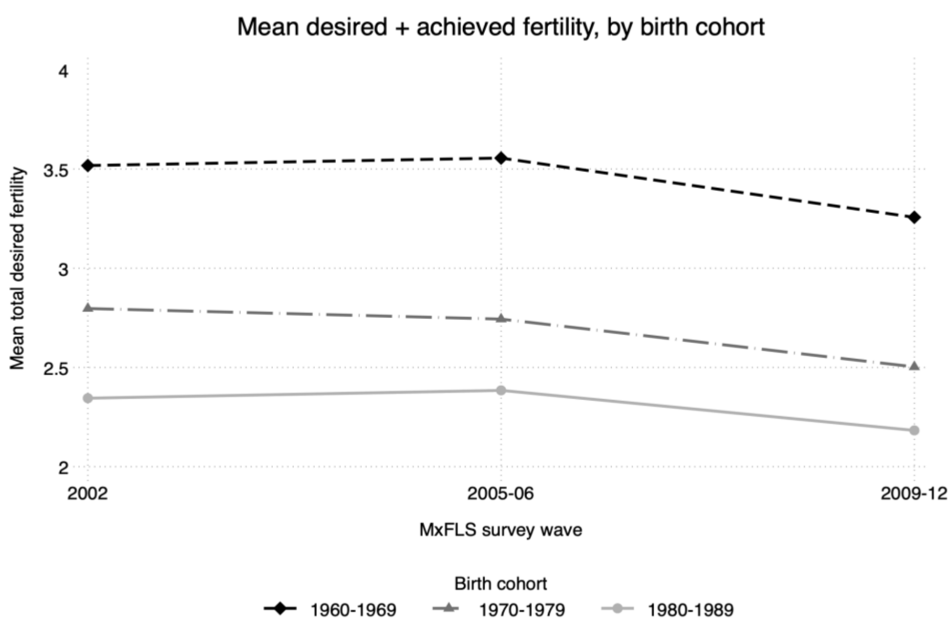


Table 2. MxFLS analytic sample characteristics by survey wave (N = 6,341)

	Wave 1 (2002)	**Wave 2 (2005–06)**	**Wave 3 (2009–12)**
Total desired fertility (mean)	2.96	2.87	2.53
Additional children desired (mean)	1.11	1.14	0.93
Number of children (mean)	1.85	1.73	1.60
Age in years (mean)	27.99	29.61	31.69
Educational attainment: none (%)	38.34	35.24	31.88
Secondary (%)	35.42	34.47	34.00
High School (%)	17.11	18.27	18.50
University (%)	9.13	12.02	15.62
Married or cohabiting (%)	60.60	56.84	60.58
Working status: not working (%)	66.77	67.23	59.29
Working <30 hours/week (%)	10.60	9.96	10.78
Working 30+ hours/week (%)	22.62	22.82	29.93
hh expenditure in 1000s pesos (mean)	1.60	1.61	1.96
hh size (mean)	5.17	5.40	5.76
Self-rated health: poor (%)	3.13	2.36	2.83
Fine (%)	42.29	38.11	40.83
Good (%)	49.70	51.76	48.82
Very good (%)	4.87	7.77	7.52

Figure 4. Change in mean total desired + achieved fertility, by cohort



Did changes in the municipal-level homicide rate correspond to changes in women's desires for (additional) children? Table 3 displays and compares the coefficients from random-effects and fixed-effects models for fertility desires. The main coefficients of interest are the three-month and six-month lag of the homicide rate, which are plugged into separate models but reported here together, since the other coefficients remain unchanged when switching between the two. The results from both random-intercept and fixed-effect models show no change in fertility desires subsequent to increases in exposure to homicides. Coefficients on the municipality homicide rate are close to zero and not statistically significant. From the random-intercept model, we observe that older women, married women, and women living in larger households have higher average desired fertility, while higher-educated women and women working full-time have lower average desired fertility. These differences disappear once we isolate changes within women over time. In the fixed-effects model, completing university is associated with an increase in fertility desires, and having an additional household member is correlated with lower desired fertility.

The null result may mask heterogeneities in the relationship between homicide rates and fertility desires. The first panel of Table 4 reports coefficients for the municipal homicide rate from the same models, fitted separately by the highest level of educational attainment attained during the survey period (2002–2012). The second panel reports separate results for women with and without children based on parity at wave 2, right before the increase in homicides. These results confirm that there is no association between homicide rates and fertility desires. All the coefficients are close to zero, and none are statistically significant. We conclude that there is no association between homicide rates and average desired fertility in Mexico.

Table 3. Coefficients and 95% confidence intervals from random intercept and fixed-effects models for fertility desires. All models include municipal-level time trends

	Random intercept model	**Fixed-effects model**
Homicide rate: 3-month lag	-0.000 (-0.001 ; 0.001)	-0.000 (-0.001 ; 0.001)
Homicide rate: 6-month lag(*)	-0.001 (-0.001 ; 0.001)	-0.000 (-0.001 ; 0.000)
Age	0.055 (0.051 ; 0.059) ***	-0.007 (-0.031 ; 0.016)
Education: none		
Secondary	-0.263 (-0.328 ; -0.198) ***	-0.033 (-0.079 ; 0.145)
High school	-0.239 (-0.321 ; -0.158) ***	0.137 (-0.005 ; 0.279)
University	-0.250 (-0.343 ; -0.157) ***	0.219 (0.050 ; 0.388) **
Married: no		
Yes	0.251 (0.197 ; 0.307) ***	0.056 (-0.021 ; 0.133)
Working: no		
< 30 hours/week	-0.033 (-0.097 ; 0.030)	0.033 (-0.028 ; 0.094)
30+ hours/week	-0.089 (-0.140 ; -0.038) ***	0.018 (-0.054 ; 0.090)
hh consumption	-0.000 (-0.003 ; 0.003)	0.000 (-0.003 ; 0.003)
hh size	0.093 (0.081 ; 0.105) ***	-0.045 (-0.066 ; -0.024) ***
Health: poor		
Fine	-0.035 (-0.147 ; 0.077)	-0.033 (-0.158 ; 0.092)
Good	-0.038 (-0.152 ; 0.076)	-0.018 (-0.146 ; 0.111)
Very good	0.073 (-0.061 ; 0.206)	0.093 (-0.059 ; 0.245)
Municipality*time	yes	yes
N (women)	6,341	6,341
N (observations)	13,646	13,646

(*) coefficient from an alternative model.

*, **, and *** indicate p<0.05, p<0.01, and p<0.001, respectively

Table 4. Coefficients and 95% confidence intervals on the 3- and 6-month lag of the homicide rate from random-effects and fixed-effects models for fertility desires. Separate models fitted by educational attainment and by parity. All models include control variables and municipal-level time trends.

Panel 1. By education

	Random intercept model		**Fixed effect model**	
	3-month lag	**6-month lag**	**3-month lag**	**6-month lag**
No formal education	-0.001	0.000	-0.001	-0.000
(N = 2,008, n = 4,452)	(-0.002 ; 0.001)	(-0.001 ; 0.002)	(-0.003 ; 0.001)	(-0.002 ; 0.001)
Secondary	-0.000	-0.001	0.000	-0.001
(N = 2,036, n = 4,481)	(-0.001 ; 0.001)	(-0.002 ; 0.000)	(-0.001 ; 0.002)	(-0.003 ; 0.001)
High school	0.001	0.000	0.000	-0.001
(N = 1,196, n = 2,437)	(-0.001 ; 0.004)	(-0.001 ; 0.002)	(-0.002 ; 0.003)	(-0.003 ; 0.001)
University	-0.000	0.000	0.000	0.000
(N = 1,097, n = 2,273)	(-0.002 ; 0.002)	(-0.001 ; 0.002)	(-0.002 ; 0.003)	(-0.001 ; 0.002)

Panel 2. By parity

	Random intercept model		**Fixed effect model**	
	3-month lag	**6-month lag**	**3-month lag**	**6-month lag**
Childless	-0.000	0.000	0.000	-0.000
(N = 2,184, n = 4,109)	(-0.002 ; 0.001)	(-0.001 ; 0.001)	(-0.002 ; 0.002)	(-0.001 ; 0.001)
With children	-0.000	-0.000	-0.000	-0.001
(N = 4,153, n = 9,534)	(-0.001 ; 0.001)	(-0.001 ; 0.000)	(-0.001 ; 0.001)	(-0.002 ; 0.000)

Discussion

Our study has investigated the fertility response to the increase in homicides in Mexico over the past 20 years (Dell, 2015). The country has experienced an unprecedented wave of homicides since December 2006, coinciding with a period during which fertility continued to decline steadily, with TFR going from around three children per woman in 2000 to below-replacement level in 2020 (UN, 2022). This is the first study to formally test the relationship between these two synchronous trends. We find that, at municipality level, average TFR is unrelated to homicide rates once indicators of socio-economic deprivation are taken into account. However, homicidal violence during the "Drug War" has been unequally distributed, with different areas affected to widely different extents at various points in time (Espinal-Enríquez & Larralde, 2015; Rios, 2013). We explicitly model such heterogeneity through a staggered DID approach (Callaway & Sant'Anna, 2021). While we find no overall effect of large homicide spikes on TFR for the period considered, areas where homicide rates increased by 50/100,000 or more in a year between 2010 and 2015 experienced slightly faster reductions in TFR, by around 0.1 children per woman. These years of the conflict are among the most violent on record (Espinal-Enríquez & Larralde, 2015). Our findings are in contrast with previous evidence of insurance and replacement fertility in the wake of armed conflict (Cetorelli, 2014; Kraehnert et al., 2019). This likely reflects the different nature of the Mexican "Drug War", which is more similar to the internal armed conflict experienced in Colombia (Castro Torres & Urdinola, 2019; Svallfors, 2022) as opposed to outright war. The small negative effects we detect are in line with the literature on discouragement of fertility (Caldwell, 2006). They may be explained by delayed ages at first marriage (Caudillo & Lee, 2023b), lower mental health (Villarreal and Yu, 2017), and worsened socio-economic conditions (Velásquez, 2019) in heavily affected municipalities. Beyond these direct pathways, however, the negative effects may also be the result of internal migration out of the most violent municipalities (Verwimp et al., 2020).

We delve deeper into whether and how homicidal violence has affected fertility by looking at changes in fertility desires among reproductive-age women living in 150 municipalities between 2002 and 2012, accounting for selective migration out of the most affected areas (Brown, 2018). Results consistently indicate no association between the municipality-level homicide rate and total desired and achieved fertility. Consistent with previous research (Berrington & Pattaro, 2013), we show that while differences in fertility desires exist across women of different socio-economic status, the main predictors of within-woman changes in desired fertility are completing education and changes in household size. We do not find any evidence of heterogeneity by education or parity, which are commonly conceptualised moderators (Agadjanian & Prata, 2002; Schmidt, 2008), reinforcing our confidence in a true null result. The MxFLS sample indicates a decline in desired family size across cohorts of women, with those born in the 1980's having a total desired and achieved family size of 2.2 children, compared to 3.3 children for women born in the 1960's. Overall, our results reach the same conclusions as Svallfors' (2022) indication of "remarkable stability" subsequent to the armed conflict in Colombia. They are similarly in line with recent literature on the stability of fertility desires in the face of COVID-19-related uncertainty (Buber-Ennser et al., 2023; Zimmerman et al., 2022).

Our study has limitations to acknowledge. While homicide rates are commonly used in the literature and considered to be the most complete of the data documenting crime and violence in Mexico (Brown, 2018; Caudillo & Lee, 2023), homicide data is still under-reported. In the context of the so-called "Drug War", the simultaneous rise in disappearances poses an additional barrier to complete homicide documentation using vital statistics data. As of July 12, 2023, Mexico's National Search Commission (*Comisión Nacional de Búsqueda*, CNB) reports that there are over 95,000 open and unresolved missing person and disappearance cases.[5] Many of these unresolved cases are likely to be homicides for which a death certificate has not been issued. Moreover, the true number of victims of disappearances may be higher as not all disappearances are reported to the CNB. Alongside the rise in homicides and disappearances, Mexico has also been experiencing a forensic crisis. As of August 2021, state officials reported a backlog of over 52,000 unidentified cadavers in public cemeteries and other institutions (Brewer, 2022; Movimiento por nuestros desaparecidos en México, 2021). Backlogs may delay or prevent the issuance of homicide death certificates. These challenges indicate that homicide rates are likely underestimated in at least some municipalities, although publicly available information does not allow us to identify which municipalities, nor to estimate the potential degree of under-reporting.[6] With respect to the fertility data, we only analyse short-term changes in fertility, which is appropriate given that the TFR is a period measure rather than representative of any cohort of women. As such, future research may fruitfully investigate the long-term consequences of the "Drug War" once more data is available. In our analysis of TFR, we cannot account for internal migration out of the most heavily affected areas due to lack of available data. We do account for the potential out-migration of women when studying fertility desires, and this does not affect the results. In our analysis of fertility desires, we refrain from making causal claims as the longitudinal associations between homicide rates and desired fertility may be affected by unobserved differences between and within women over time. The limited number of municipalities covered in the MxFLS (150 in total) does not allow

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[5] These statistics can be accessed through the Commission's public facing database at: https://versionpublicarnpdno.segob.gob.mx/Dashboard/Index.

[6] Omission, impunity, and outright collusion on the part of the State also impact the documentation of homicides, disappearances, and other forms of violence, resulting in under-reporting. The State's involvement in the disappearance of 43 students from the rural teachers' college *Raul Isidro Burgos* in Ayotzinapa, Guerrero is one tragic, but emblematic, example of the role that the State has played in the commission and reproduction of violence in the context of the so-called "Drug War" (e.g., GEIE, 2023).

for a staggered DID approach. The complete lack of association in our data—with all coefficients on the homicide rate close to zero —is indicative of no average change in desires corresponding to increases in homicides, but there may still be uncaptured effects in the most heavily affected areas. As mentioned above, we do not have reliable information on fertility intentions, which would help provide a more complete picture of fertility change (Miller, 2011).

The relative stability in fertility decline evidenced in our study in no way indicates that the "Drug War" has had no significant effects on the Mexican population. On the contrary, it is a testament of remarkable continuity and resilience in the face of extremely adverse conditions. It is important for future research to continue monitoring trends in sub-national fertility, and to understand the extent to which any potential mismatch between desires and realisations is due to postponement, cohort replacement, or systemic failures in enabling women to achieve their desired family size. If the latter were to be the case, national and local policies should be implemented to improve access to childbearing and child-rearing, from healthcare coverage and insurance to childcare service provision.

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Supplementary tables

Supplementary table 1. Summary statistics for municipality-level indicators for Census or population count years

	2000	2005	2010	2015	2020
Homicides per 100,000 pop.	11.69	10.48	23.21	16.94	22.63
Total Fertility Rate	3.54	2.94	2.76	2.23	1.84
Socio-economic deprivation					
% illiterate	16.20	14.76	14.06	11.75	10.16
% with no electricity	9.62	5.33	4.04	2.21	1.50
% in overcrowded hh's	52.87	48.01	44.72	36.31	26.54
% communities < 5000 pop	65.70	64.61	71.99	71.67	69.96
% < 2 minimum salaries	65.00	58.92	61.76	55.30	82.09
N (municipalities)	2,443	2,443	2,443	2,443	2,443

Sources: authors' calculations from INEGI (2022); CONAPO (2022)

Supplementary table 2. Coefficients and 95% confidence intervals from first-difference models for the total fertility rate

	No controls	With deprivation controls
Lag of homicide rate	0.000 (-0.000 ; -0.000)	-0.000 (-0.000 ; 0.000)
% illiterate		0.002 (-0.012 ; 0.015)
% with no electricity		0.018 (0.011 ; 0.025) ***
% in overcrowded hh's		0.003 (-0.004 ; 0.010)
% communities < 5000 pop		0.001 (-0.002 ; 0.004)
% < 2 minimum salaries		0.003 (0.002 ; 0.005) ***
N (municipalities)	2,443	2,443
N (observations)	34,144	34,144