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Mass shootings and Infant Health in the United States

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Abstract: We study the causal effect of mass shooting incidents during pregnancy on infant health outcomes. Our identification strategy exploits the spatial and temporal variation of mass shoot- ing incidents across counties of United States. We find increased severity of mass shooting incidents lead to lower average birth weight, shorter gestational age, increased incidence of low birth weight (less than 2500 gms), and higher infant mortality rate. Further, we use the exogenous variation in the media coverage of mass shooting incidents due to competing inter- national newsworthy events to show that the effects are exacerbated by the coverage of these events, suggesting that the adverse effects on health might be due to psychological stress from exposure to news coverage of shooting incidents.

Key words: mass shootings; infant mortality; birth weight; mental stress

JEL Classifications: I10, I18, J10

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1 Introduction

Mass shootings have become an unfortunate reality of life in the United States. Depending on the source and the definition used, there were somewhere between 12 to 323 incidents in 2018 alone, claiming 80 to 387 lives, injuring 70 to 1274, and leaving many more to mourn the loss. Discussions in academia, media and policy documents have, perhaps rightly, focused on the potential causes, regulation of gun ownership and on survivors of these incidents (Metzl and MacLeish (2015); Reeping et al. (2019); Luca et al. (2020); Knoll IV and Annas (2016)). However, there are other indirect and long-term effects of these incidents (Jetter and Walker (2018); Beland and Kim (2016); Yousaf (2018); Brodeur and Yousaf (2019)).[1]

One such indirect effect that has not received enough attention is the health effects of the mental stress it generates. Mass shooting incidents can cause elevated levels of stress and adversely affect the emotional and psychological well being of the larger community (Lowe and Galea (2017); Soni and Tekin (2020); Shultz et al. (2014)). Pregnant women and *in utero* children are especially vulnerable. There are multiple pathways through which stress might affect the health of the fetus and pregnant mother (see Coussons-Read (2013) and Buffa et al. (2018) for reviews). For example, stress during pregnancy triggers the production of hormones that reduce gestational age and birth weight (Hobel and Culhane (2003)). Stress also affects the body's immune response system and can make pregnant mothers vulnerable to infectious diseases (Morey et al. (2015); Priyadarshini and Aich (2012); Jemmott and Locke (1984); Herbert and Cohen (1993)). Next, stress can also trigger behavioral responses, like increased smoking or drinking by a pregnant mother or other family members in the household (Ayyagari and Sindelar (2010); Beijers et al. (2014)). A large body of evidence, spanning multiple disciplines, now documents the adverse effects of such stressful early-life conditions on later-life health, education, and well-being (Lähdepuro et al. (2019); Pagliaccio and Barch (2016); Taylor (2010); Alastalo et al. (2013)).

Using the natality records of births in the United States from 2003 to 2017, we examine the causal effects of mass shooting incidents on the birth weight, the gestational length and the infant mortality rate among children exposed to these incidents during their *in utero* period.[2] We use

[1] Jetter and Walker (2018) looks at the role of media coverage of mass shooting incidents in inadvertently motivating future mass shooting incidences, Beland and Kim (2016) finds a negative effect of mass shooting incidents on student performance, Yousaf (2018) investigates the impact on electoral outcomes, and Brodeur and Yousaf (2019) suggests a negative effect on employment, earning, and consumer confidence in affected regions.

[2] Other violent incidents, like terror attacks, riots or natural disasters, can have similar effects. For example, Camacho (2008) and Quintana-Domeque and Ródenas-Serrano (2014) show that terrorist attacks affect birth outcomes in Colom-

the number of fatalities due to mass shooting during the *in utero* period in the county of residence of the mother as a measure of the intensity of exposure to such incidents. We control for a large number of fixed effects, namely county of residence-month of birth fixed effects, month of birth - year of birth fixed effects, state of birth - year of birth fixed effects. These fixed effects control for multiple time variant and invariant factors, like county-specific seasonal factors, health and law and order infrastructure, disease environment, economic and political climate including elections, that may affect both the probability of mass shooting incidents and health of the children born in the county. We also control for county-level linear yearly time trends. These trends accounts for unobserved factors that may cause mass shooting incidents and child health outcomes to co-evolve. We argue, that conditional on these fixed effects, the timing and the severity of the mass shooting incidents are random, allowing us to discern the causal effects.

We find increased severity of mass shootings during pregnancy leads to lower average birth weight (1.10 gms), shorter gestational age (0.005 weeks), increase in incidence of low birth weight (0.03 percent) and an increased infant mortality rate (2.7 additional deaths per 100000 births) among all children born in the county. Following Rossin-Slater et al. (2020), we conjecture that the news of such incidents generates psychological stress that is harmful for fetal development.[3] Since people who are not directly involved in such incidents get to know about it through the media, especially electronic media reports, the psychological effect of such events may be affected by the coverage such incidents receive in the electronic media. We provide suggestive evidence of the pathway.

To do this, we examine the heterogeneity in the impact of the shootings by whether the incidents coincided with other unexpected international natural disaster-related deaths. Using information on mass shooting coverage in the ABC World News Tonight from Vanderbilt Television News Archive and a strategy similar to Eisensee and Strömberg (2007) and Jetter and Walker (2018), we show that such unexpected international incidents reduce the coverage mass shooting incidents receive in the electronic media. This is likely because the news of such events competes with the coverage of mass shootings for screen time. Incidents that get a higher level of media coverage might reach a greater number of people for longer periods of time. As a result, they may generate psycholog-

bia and Spain, respectively. However, terror attacks are rarer in the United States and are often limited to a specific area in the country, thus limiting spatial variation. Riots and natural disaster often have other effects, like destruction of property and economic damage, that can affect child health directly.

[3] Rossin-Slater et al. (2020) finds an increase in the use of antidepressant by youth exposed to fatal school shootings incidents.

ical distress in more people for longer periods. We find that the impact of county mass shooting incidents is smaller if they coincide with international natural disasters suggesting a mediating role of media coverage of mass shootings.

This paper relates to multiple strands of literature. Studies find that exposure to violent events in early life can affect health and education in both the short term (Bundervoet et al. (2009); Shemyakina (2011); Mansour and Rees (2012); Minoiu and Shemyakina (2014)) and the long term (Akresh et al. (2012); Leon (2012); Justino et al. (2013); Akbulut-Yuksel (2014); Kesternich et al. (2014); Akbulut-Yuksel (2017); Singhal (2018)), and may also have inter-generational spillovers (Akresh et al. (2017); Phadera (2019)). Gestational length and birth weight are significant predictors of child mortality and morbidity and of later-life health, education, and well-being (Record et al. (1969); McCormick (1985); Barker (1998); Ashworth (1998)). Our findings add to this growing literature. We show that a mother's exposure to unfortunate news of mass shootings even before a child is born can have long-lasting impact on the well-being of the child. The results also contribute to the strand of literature that finds important effects of mass media reporting on general well-being of the population.[4]

The heterogeneity analysis attempts to further our understanding of the mechanisms through which exposure to extreme events during *in utero* period might have long-term effects. Multiple studies that examine the impact of unexpected tragic events, extreme violence, or natural disasters on later-life well-being have posited psychological stress as a pathway (Glynn et al. (2001); Camacho (2008); Torche (2011); Mansour and Rees (2012); Black et al. (2016); Duncan et al. (2017); Persson and Rossin-Slater (2018)). But as pointed out by Black et al. (2016), these studies could not distinguish the effects due to mental stress from direct consequences of physical harm, changes in incomes, destruction of physical and human capital, and changes in access to health and educational infrastructure. Compared to over 300,000 births per month in the United States, the average number of fatalities and injuries in mass shooting incidents per month in our data is 2 and 6, respectively. It is unlikely that these incidents, which were almost always limited to a small geographic area, affected the well-being of a sizable number of pregnant women in the county directly. But the extensive media coverage these events receive might have lead to elevated levels of stress. The news report often described the events for days in gruesome detail, which could have triggered

[4]For example, electronic media reports influence teenage pregnancies (Kearney and Levine (2015)), marital stability (Chong and Ferrara (2009)), terrorism (Jetter (2017a)), public choice processes (DellaVigna and Kaplan (2007)), and economic development (La Ferrara (2016)).

elevated levels of anxiety, stress, terror or grief in pregnant women. The finding that the effects are smaller when other international news events might compete for and shorten the screen time for mass shooting coverage supports the possibility of mental stress as a pathway through which the effects operate.

The study is closely related to Black et al. (2016) and Persson and Rossin-Slater (2018). Both studies examine the impact of the death of a family member during pregnancy on birth and later-life outcomes. Black et al. (2016) find a small negative effect on birth outcomes and no significant impact on later-life outcomes and Persson and Rossin-Slater (2018) find effects on mental health in childhood and adulthood. Our findings complement their findings but also differs from these studies in a few ways. First, compared to the death of a relative that is often a non-random event, the timing of a mass shooting incident vis-à-vis pregnancies and births is, arguably, more exogenous. Second, the psychological effect of the death of a family member during pregnancy might be different, in its nature and intensity, from the effect of the news of a mass shooting. Shooting incidents are also different from deaths in the family in terms of the assistance that might be available to cope up with the grief. For example, the death of a family member is often followed by a period of bereavement where the family members might come together and support each other. This might aggravate or alleviate the mental stress. For individuals not directly or adjacently affected by a shooting event, whose exposure to the event is through the news alone, it might be difficult to identify the elevated levels of anxiety or stress, let alone seek assistance to deal with it. Next, it is difficult to rule out the possibility that the deaths of a family member was not preceded by a longer-term illness, physical or mental, or other changes within the households. In comparison, the location and timing of mass shooting incidents are unexpected.

An important difference arises from our focus on the United States of America. Unlike the deaths of family members during pregnancy in Norway (Black et al. (2016)) or Sweden (Persson and Rossin-Slater (2018)), shooting incidents in the United States can insinuate the possibility of such incidents in the future. In fact, evidence suggest that such mass shooting incidents and their coverage in media can encourage future mass shootings (Jetter and Walker (2018)). If so, these incidents might trigger a fear in people, a perception of persistent danger to themselves, their families, or their unborn children, that might be absent in event of a death of a family members due to natural and accidental reasons.

Our results have important policy implications. The results suggest there may be benefits to identifying and treating psychological effects of such incidents. Next, as Jetter and Walker (2018) emphasizes, it might be prudent for the media to reconsider its approach in reporting mass shootings incidents. The government and medical service providers might also advise viewers to exercise discretion when watching news coverage of such incidents. Weak gun ownership laws are often related with gun-related violence including mass shootings (Luca et al. (2017); DiMaggio et al. (2019); Webster et al. (2020)). Our results inform the policy discussion around gun ownership laws by highlighting an additional indirect cost that may affect human capital formation across generations.

2 Data

We obtain the information on birth outcomes for all births and infant mortality in the United states in the 2003-2017 period from the National Vital Statistics System. The state and the federal laws require every birth and death in the United States to be registered with the state. The National Center for Health Statistics then compiles the data at the federal level. The Centers for Disease Control and Prevention routinely publishes this information on the National Vital Statistics System portal. As a result, the data are the universe of all births recorded in the country year after year. Among other details, the birth data contain information on the number of births, average birth weight, average gestation length, and proportion of of all babies born with low birth weight at the county-month level. The county identified in the data is the mother's county of residence. As mentioned before, birth weight and gestational length are significant predictors of child mortality and morbidity and of later-life health, education, and well-being.[5]

We use two measures of gestational age.[6] Historically, the Center for Disease Control and Prevention's National Center for Health Statistics (NCHS) had measured gestational age based primarily on the difference between the date of the last normal menstrual period (LMP) self-reported by the expecting mother and the date of an infant's birth. This LMP-based measure serves as our first measure of gestational age. However, due to imperfect maternal recall, misinterpretation of bleeding early in pregnancy, irregular menstrual cycles, and data entry errors, this method resulted in mis-classification of gestational age, particularly for preterm and post-term births (See the ev-

[5]In addition to the studies cited in the introduction, see People (2020).

[6]To be more precise, the information available is the average gestational age for all children born in the county in a month.

idence cited in Martin et al. (2015)). In response, 2007 onward the NCHS started reporting an alternative measure called the obstetric estimate of gestation at delivery (OE), "the best estimate of the infant's gestation in completed weeks based on the birth attendant's final estimate of gestation" (National Center for Health Statistics (2012)). Studies find OE gestational measure was more consistent with the birth weight, the estimates of gestational age based on early ultrasounds, and when using assisted reproductive technology with well-documented dates of conception (Callaghan et al. (2007); Callaghan and Dietz (2010); Barradas et al. (2014)). Therefore, we use the OE gestational measure as the second and preferred measure of gestational age. Low birth weight is a term used to describe babies born weighing less than 2,500 grams.

For every state, data from all counties with a population of less than 100,000 are pooled together and designated as from 'unidentified counties'. We report our results with and without including information from these unidentified counties. In the former specification, we match the month-year birth data from all unidentified counties in a state with the mass shooting incidents that occurred in the state but not in the identified counties. For confidentiality purposes, the sources report infant mortality rates yearly and identify the county of death only if the county has a population above 250,000. This greatly reduces the sample size for the infant mortality analysis.

We get information related to mass shootings from Wikipedia listings of mass shooting incidents in the United States. Wikipedia compiles this list from multiple sources - the Stanford MSA Data Project, the Mass Shooting Tracker, the Gun Violence Archive/Vox, Mother Jones data on mass shootings, Washington Post reports, and the Congressional Research Service. The resulting data is a compilation of incidents where three or more civilians, excluding the perpetrator, got shot at one location at roughly the same time that were not related to organized crime and gang-related shootings. We provide a more detailed description of each of these sources in the Online Appendix. We check the robustness of our results to using information from one of the most-widely used of these sources - Mother Jones data on mass shootings. We geo-code the mass shooting incidents based on the location information. For the few incidents that started at one location but spilled over to others, we use the first reported location. Since the events differed considerably in their intensity - the number of injuries and fatalities - we use the total number of fatalities as our main independent variable. We check the robustness of our results to using injuries or victims (fatalities and injuries) as the independent variable. To rule out issues related to omitted variables, we use, as additional controls, yearly county-level data on unemployment and net international and domestic migration from the Economic Research Service of the U.S. Department of Agriculture and temperature from the Global Historical Climatology Network.

Following earlier studies on the impact of US electronic media on different outcomes (Eisensee and Strömberg (2007); Durante and Zhuravskaya (2018); Jetter (2017b); Jetter and Walker (2018)), we obtain information on daily television news coverage of shooting from the Vanderbilt Television Network Archive. The Vanderbilt Television News Archive, started in August 1968, is the most extensive and complete archive of US television news. Following Jetter and Walker (2018), we select the *ABC World News Tonight* for our analysis. The 30-minute flagship evening television news of ABC News is the most-watched among all evening news programs (Joyella (2019)). To the extent that media outlets are substitutes, the coverage on the *ABC World News Tonight* should be a good proxy for the overall media coverage of an incident. We use international disaster-related deaths as an exogenous source of variation in the media coverage of shooting events. We obtain the information from the international disasters database (EM-DAT) maintained by the Centre for Research on the Epidemiology of Disasters at the University of Louvain. EM-DAT records mass disasters around the world from 1900 to the present day with information compiled from various sources, including UN agencies, non-governmental organizations, insurance companies, research institutes and press agencies.

3 Identification

The mass shooting incidents may themselves be unexpected. But some regions could be more vulnerable to such incidents than others. For example, such incidents may be more likely in regions with low levels of education or economic growth. Similarly, some years, perhaps due to worse economic conditions, may have more of such incidents than others. These regions or years could also have a higher number of infants with low birth weights and shorter gestation periods. For this reason, we must account for the differences across regions and across year using relevant fixed effects. We estimate the following equation.

$$BW_{cmy} = \alpha + \beta \times Fatalities_{cmy} + \delta_{cm} + \gamma_{my} + \theta_{sy} + \lambda_c * t + \varepsilon_{cmy} \tag{1}$$

BW_{cmy} is the average birth weight (or other birth outcomes) of all live births in month m of year y in county c. $Fatalities_{cmy}$ is the total number of fatalities of mass shootings in county c in the 9 months prior to month m of year y.[7] δ_{cm} is the county-month of birth fixed effects, γ_{my} is the month-year fixed effects and θ_{sy} is the state-year fixed effects. In addition, we also control for county level linear trends in $\lambda_c * t$.

The county-month of birth fixed effects control for all observable and observable differences at the county-month level. For example, this will control for unobserved factors that drive seasonality of birth outcomes. The month-year fixed effects will control for all factors that affected children born in that month year, like general inflation, national political factors and federal policies that change across time. The state-year level fixed effects control for state-year level factors like state-wide gun control policies and change in state-level criminal laws.

Thus, our identification strategy compares children born within counties in the same month of different years while allowing for differences across children born in different years at the state level. We relate the year-to-year variation in average birth outcomes within a county-month with year-to-year variations in fatalities due to mass shooting incidents. Our identification strategy thus assumes, year to year variation in mass shootings within a county-month is exogenous to birth outcomes after controlling for nationwide shocks particular to the month year (month-year fixed effects) and state level shocks particular to that year (state-year fixed effects). We conduct our analysis with and without information from the 'unidentified counties' described in Section 2. When including them, we match the birth and death data from the undisclosed county with the average level of mass shooting variables in counties of the state that are included in mass shooting data but not in the natality or mortality data.

Since the infant mortality rate is available yearly at the county level, to examine the impact of mass shootings on IMR we estimate:

$$IMR_{cy} = \alpha + \beta \times Fatalities_{cy} + \theta_{sy} + \lambda_c * t + \varepsilon_{cy} \tag{2}$$

The fixed effect definitions are the same as before. In all our specifications, we cluster the standard errors of estimation at the county level.

[7] These include the month of birth. Redefining the 9 months to exclude the month of birth does not affect our results. Please note that we do not have data on individual gestational age, thus we cannot calculate the exact duration of the pregnancy.

4 Results

4.1 Birth Outcomes

We look at four birth-related outcomes - average birth weight of all children born in a particular county-month-year, average gestation period, percentage of children born with low birth weight and percentage of children born with very low birth weight. In Figure 1, we begin by examining the extent of association between mass shooting fatalities during the *in utero* period of babies born in different months of different years in different counties in the United States and their birth outcomes. As is clear from the figure, a higher number of mass shooting fatalities in the *in utero* period is associated with a decrease in the average weight of the children born and in the average gestation period. It is also associated with an increase in the incidence of low birth weight.

It is possible that regions and years with worse economic performance in the months leading to the incident may witness both worse birth outcome and a high number of mass shooting incidents. To test whether the mass shooting incidents have a causal effect on the birth outcomes, we turn to estimates from equation (1). We report the results in Table 1. As mentioned in the previous section, in all our regressions we control for county-month fixed effects, month-year fixed effects, state-year fixed effects, and county specific linear trend.

The independent variable in top panel of Table 1 is number of fatalities from mass shootings during pregnancy. The dependent variable in the first column is average birth weight in a county-month-year. As the results indicate, we find a negative effect of number of victims of mass shootings on average birth weight measured at the county-month-year level. In our data, conditional on having a mass shooting incident during pregnancy, an average pregnancy witnesses 6.73 fatalities. Thus, compared to cohorts (county-month-year level cohorts) that did not have any shootings during their *in utero* period, cohorts that had any incident of shooting have, on average, 1.10 grams lower birth weight.[8] Bharadwaj et al. (2018), using data from Swedish twins, finds a 1 percent increase in birth weight leads to a 0.1 percent increase in permanent income. Black et al. (2007) uses data from Norway. In addition to finding similar effects on earnings, the authors also find 0.2

[8]The effects while small compared to other *in utero* shocks like fasting during Ramadan (Almond and Mazumder (2011)), bereavements (Black et al. (2016)), predicted climate change (Deschênes et al. (2009)) and maternity leaves (Rossin (2011)) are still meaningful. In addition, since we are measuring effects on county level cohort averages, the estimates are intent-to-treat effects (ITT). The true impact on affected mothers must have been much higher than the ITT effects. It is also possible that mass shooting incidents in far away counties also leads to stress. In that case we are capturing the differential effect of mass shooting in the county of residence.

percent effect on birth weight of the future generation (first child born). Bharadwaj et al. (2014) finds effects of birth weight on labour income are larger in times of macroeconomic crisis. Our effects on birth weight are about 0.03 percent of the mean. If we use the estimates from Sweden and Norway, this would imply a 0.003 percent reduction in permanent income and about 0.006 percent reduction in birth weight of future generations. While the magnitudes may appear small, it is important to remember that the estimates reflect the average impact on every child born in the county. Therefore, to understand the overall economic cost of such incidents, one must aggregate the effect on each child.

In columns (2) and (3), we examine the impact on the average gestational age of children born. We find a small negative effect of mass shootings on gestational age. The effect is insignificant when we use the LMP gestational measure but is significant when we use the arguably more accurate OE gestational measure. One more fatality due to a county mass shooting incident during pregnancy is associated with 0.0007 weeks decrease in the OE gestational age. Thus, compared to cohorts (county-month-year level cohorts) that did not have any shootings during the pregnancy period, the gestation length for cohorts exposed by such an incident is 0.005 weeks shorter. This effect is small compared to effects of bereavement (0.08 weeks, Black et al. (2016)) , 9/11 dust (0.484 weeks for boys exposed in 1^{st} trimester, Currie and Schwandt (2016)) or maternity leave (0.017 weeks, Rossin (2011)).

In columns (4), we examine the impact of mass shooting on the percentage of children born with low birth weight. As the results indicate, we find that more fatalities during pregnancy lead to a higher percentage of children born with low birth weight. The estimates suggest for every additional fatality during pregnancy, the percentage of children born with low birth weight increases by 0.005 percentage. Conditional on having a mass shooting incident during pregnancy, this translates into a 0.03 percentage increase in children born with a low birth weight, a magnitude that is 2.4 percent of the mean. The effect is comparable to the effect of prenatal exposure to Super Bowl where, as in the case of mass shootings, the effect appears to operate through the emotions the media coverage triggers (0.13 percent point, is 1.8 percent of the mean, Duncan et al. (2017)) but smaller than effect of bereavements (0.4 percent points, 12 percent of mean, Persson and Rossin-Slater (2018)).

In the bottom panel of Table 1, we examine the impact of county mass shooting incidents on the infant mortality rate in the county. According to column (1), the higher the number of mass shooting victims in a county in a year, the higher is the infant mortality rate. Conditional on having a mass shooting incident in a year, an average shooting has 13.28 victims. Compared to not having a shooting incident in a year, a shooting incident with an average number of victim leads to 2.7 children dying as infants per 100000 births, 0.4 percent of the mean. We must exercise caution in interpreting these result. The infant mortality rate is available only yearly and cannot be matched with the shooting incidents with the pregnancy period with precision. This, combined with the fact that counties with less than ten infant deaths in an year are not identified by name, greatly reduces our sample size. We also cannot account for any unobservable confounding factors at the county-month or year-month level. However, the observed associations suggest that mass shooting might have not only impacted birth weight and gestational age but also the chances of the survival of children exposed to mass shooting incidents in their *in utero* period.

In addition, we also look at the effect of mass shootings on the distribution of birth weight. Online Appendix Figures A3 and A4 and Online Appendix Table A1 show, there is an increase in percentage of children born below 2100 grams, 2400 grams, and 2500 grams. This suggests that mass shootings incidents affected the most vulnerable babies and exacerbated the effect on their birth weight. Finally, in Online Appendix Table A2 we look at the effect of being born with a weight greater than 4500 grams. The condition, referred to as fetal macrosomia is associated with health complications in later life. We find mild positive effects of mass shootings on an percentage in the of children born with a weight of 4500 grams or more, though the effects are not robust across specifications.

4.2 Media

One likely pathway through which such mass shooting incidents may affect the health of people is through the psychological stress that hearing about such incidents generate (Lowe and Galea (2017)). Rossin-Slater et al. (2020) find that local exposure to fatal school shootings increases youth antidepressant use by 21.4 percent in the two years following the incident. Such psychological effects may not be limited to the youth. Pregnant women may be particularly vulnerable. Levels of estrogen and progesterone rise during the course of pregnancy. Higher levels of these hormones are associated with hyper-vigilant processing of emotional signals of threat. Hyper-vigilant processing of such emotional signals lead to higher levels of anxiety (Blake and Reimann (1993); Pearson et al. (2009)). People not directly involved in the mass shooting incidents usually get to know of it through media reports, especially electronic media reports. Therefore, the psychological impact of such incidents may be affected by the coverage they receive in the electronic media. Incidents that get a higher level of media coverage may reach a greater number of people and may repeatedly display distressing images. Thus, the increased media coverage may exacerbate the psychological distress from shooting incidents. Using data from ABC World News Tonight, Online Appendix Figure A1 and Online Appendix Table A3, shows that more severe incidents, measured by the number of fatalities, injuries, or victims, receive greater coverage in electronic media.

One cannot rule out the possibility that severe mass shooting incidents may have a direct effect on the pregnant mother. This may be because the severity of the incident in itself might lead to a higher level of salience. Severe incidents are more likely to be noticed and are more likely to have a larger psychological impact, irrespective of the media coverage it receives. This makes the task of separating the effect of the severity of the incident from intensity of the media coverage challenging. To get around this issue, we employ a strategy similar to Eisensee and Strömberg (2007) and Jetter and Walker (2018) - we use the variation in the coverage of mass shooting events due to news about unexpected international natural disaster that compete for screen time with the coverage of the shooting incident. International natural disasters are unexpected events that are unlikely to be related to the severity of mass shootings or have a direct effect on birth outcomes. But such events compete with reports about mass shooting coverage for screen time in electronic media. If the timing of a mass shooting coincides with an international natural disaster, it will receive less coverage compared to a mass shooting event on a day with no international natural disaster. In addition, competition for screen time from the international disaster will also depend on the severity of the disaster. International natural disasters that claim more lives in their wake will be more likely to receive greater coverage in US media reports. On days of such events, the coverage of any concurrent mass shooting event would be shorter. Using data from EM-DAT, we verify this is in Table 2 and Online Appendix Figure A2. The results show a negative relationship between number of deaths in natural disaster and coverage of mass shooting.

Finally, we examine the role of media in moderating the effect of mass shooting. We split the natality data into two sub-samples based on whether the number of deaths due to international natural disaster during the gestational period of children was above or below the median. Since the coverage of the natural disaster will decrease the coverage of the mass shooting, we expect it to moderate the negative effect of the mass shooting. The top panel of Table 3 reports the results. The odd (even) numbered columns present the estimated effect for births that had more (less) than the median number disaster-related deaths.

The association between the number of mass shooting fatalities during pregnancy and the birth outcomes is statistically significant only for births that had witnessed less than median number of disaster-related deaths during pregnancy and, as a result, most likely, a higher level of exposure of media reports of the shooting incidents. In the bottom panel of Table 3, we examine the heterogeneity in the impact of mass shootings on the infant mortality rate by the number of disaster-related deaths in the year of birth. Again, we find that the positive relationship between shooting events and the infant mortality rate holds only for years with less than median number of disaster-related deaths. Taken together with the decreased coverage of mass shooting events during periods of higher number of natural disaster-related deaths, these result suggest that exposure to media reports on shooting events might be a potential pathway through which mass shooting events affect birth outcomes. [9] [10]

4.3 Robustness

We conduct two main robustness check. First, we check if our results are confounded by a general trend driven by unobservable factors. In Figure 2, we present the estimates from a modified version of equation (1). Along with the number of fatalities of mass shooting events during the pregnancy period, we include the number of fatalities in months prior to conception and after birth. As the figure indicates, broadly only mass shooting fatalities during the pregnancy period have a consistent impact on the average birth outcomes in the county. Most reassuringly, such incidents have no effect on birth weight if they occur after pregnancy. Therefore, it is unlikely that unobserved trends in other omitted variables drive the results.

[9] However, there are two concerns with the above argument. First, change in national news topics affects the coverage of the incident for the entire nation. We argue, that though the coverage changes for the entire nation, we believe individuals are affected more by incidents that happen in their county. To that extent, a change in the national news coverage affects the mothers of these counties more than of far away counties. Second, it is possible mothers may also gather information about these incidents from local news. We believe the effect of media does not operate only through communication of the news itself, but through the repetition and the gruesome detail of the coverage. Though we do not have data, it is possible the intensity of local news coverage is also partially affected by international news. Also, on the margin there are possibly some households that solely rely on national news outlets.

[10] We also check whether mass shootings effects operated via their effect on maternal risk factors. We examine the association between mass shootings and changes in five maternal risk factors available in the data - share of mothers who suffered from chronic hypertension, diabetes, eclampsia, pregnancy-related hypertension, or who smoked. Online Appendix Table A11 reports the results. We do not find any effect on these markers. But since these markers are self reported, and thus may be measured with error, the findings do not entirely rule out the possibilities. In particular, mother's from lower socio-economic sections may not have ever been diagnosed formally even if they suffered form one of the conditions. On the other hand, it is also possible that maternal stress do not manifest themselves in these markers.

Second, we address the concern of other changes at the county-month-year level that may simultaneously affect shooting incidents and birth outcomes. For example, an increase in unemployment may reduce the opportunity cost of crime, increase psychological stress and may increase the probability of a mass shooting incident. At the same time, unemployment can have a direct effect on birth outcomes. Similarly, increased migration can lead to social tensions that may lead to shooting incidents. Migration can also put a strain on scarce health resources in the county and can affect birth outcomes. Considering studies have found significant associations between temperature and human conflict (Hsiang et al. (2013); Burke et al. (2015)) and also between temperature and infant health (Deschênes et al. (2009)), it is important to control for temperature during gestation. In Table A4, we repeat the analysis, this time including controls for yearly county-level unemployment, net yearly domestic and international migration, and temperature levels during pregnancy. Our results remain qualitatively unchanged. Overall, the impact of county mass shooting on birth outcomes appears to be reasonably robust.

In addition, we do a series of other robustness checks that we report in the Online Appendix. The results are robust to alternative definitions of the independent variable, exclusion of smaller counties that with a population of less than 100,000 classified as 'unidentified counties' in the data, and use of an alternative data set for mass shootings. Mothers may selectively abort their pregnancies in response to the mass shooting leading to a bias in the estimated effect. We check that selective fertility is not driving our results by showing in Appendix Table A9 that mass shootings had no effect on the number of children born and the average age of the mothers in the county. To check for the balance between the exposed and unexposed groups, we look into other birth characteristics, like percentage of female children born and percentage of mothers with a college degree, in Online Appendix Table A10. We find no association between these birth characteristics and mass shootings.

5 Conclusion

There has been a surge in mass shooting incidents in the United States. In this paper, we study the effect of exposure to mass shooting incidents during pregnancy on birth outcomes. Mass shootings may indirectly increase the stress level of individuals, particularly for individuals living in the same county. This may result from witnessing stressful images in the television and/or from the fear of such incidents in the future. Increased stress levels may have significant negative effect on the health of the pregnant mothers and their *in utero* children. Since early-life conditions are a key determinant of long-term health and well-being, the indirect effects of mass shootings may persist for years after the incidents.

We use county-level monthly vital statistics data from 2003 to 2017 and data on mass shooting incidents to examine the hypothesis. Our preferred empirical specification controls for county-month level fixed effects, month-year level fixed effects, state-year level fixed effects and also account for county-level linear trends. We find an increase in the number of fatalities of mass shooting during pregnancy leads to reductions in average birth weight and gestational length, an increase in the percentage of babies born with low birth weight, and an increase in incidence of infant mortality. Our results are robust to alternate definition of mass shootings and to the inclusion of additional controls like unemployment, migration, and temperature. We also find no evidence of selective abortions driving our results. We provide suggestive evidence of stress being the likely mechanism driving these effects. We find the effects are larger when shooting incidents receive more media coverage.

In recent years, there have been intense discussions in media and policy circles about the causes, effects and measures to control such mass shootings incidents. This paper highlights an indirect and often overlooked cost of these mass shooting incidents that should inform policy decisions. There are two additional policy implications. First, the results highlight the importance of stress as a transmission channel. Policy makers and medical practitioners can provide additional mental health support to pregnant mothers following such incidents. Second, the results also show news coverage in media can exacerbate the stress. News coverage of such incidents can be provided with appropriate guidelines and warnings.

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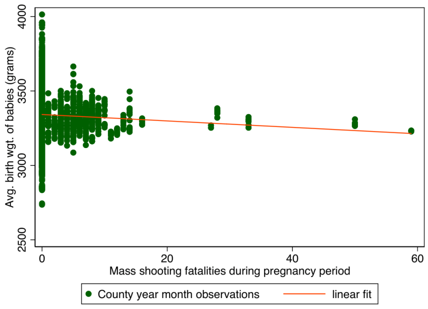
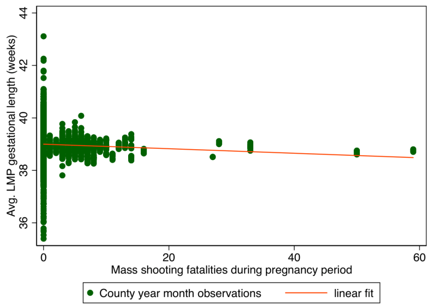
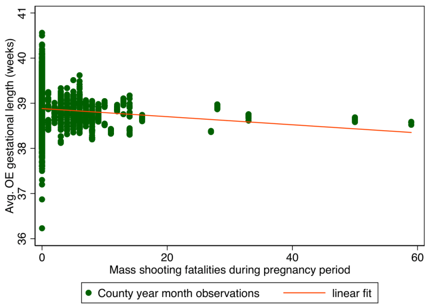
Figure 1: County-wise mass shootings and birth-related outcomes



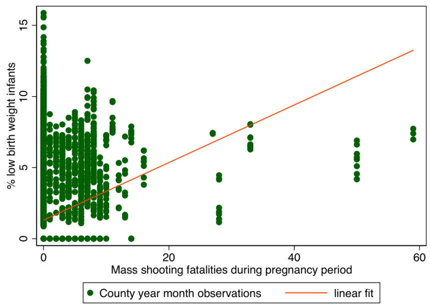
(a) Average birth weight in grams



(b) Average LMP gestational age in weeks



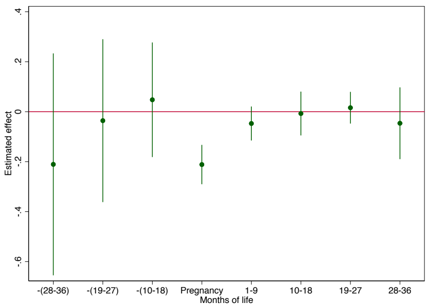
(c) Average OE gestational age in weeks



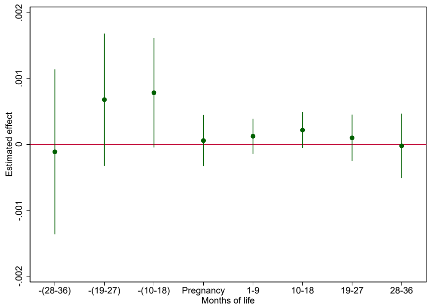
(d) % low birth weight babies

Note: The figures plot the correlation between fatalities due to mass shooting incidents in U.S. counties in the nine months prior to a birth month-year and (a) average birth weight, in grams, (b) average last-menstrual-period based gestational period, in weeks, (c) average obstetrician estimate gestational period, in weeks, (d) percentage of all births with birth weight lower than 2500 grams for births in the county in the month-year. The red line indicates a linear fit. Each point on the scatter plots represents a county-year-month observation. We exclude outliers where the number of mass shooting related fatalities in the nine months exceeded 300.

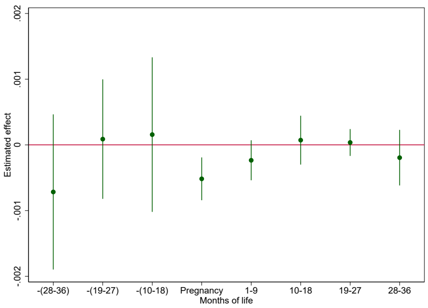
Figure 2: Exposure to mass shootings at different times



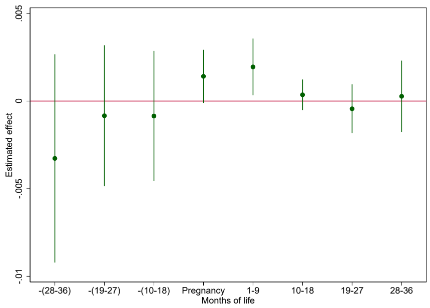
(a) Average birth weight in grams



(b) Average LMP gestational age in weeks



(c) Average OE gestational age in weeks



(d) % Low Birth Weight

Note: The point coefficient estimates report the effect of the number of mass shooting fatalities in the indicated period on the (a) average birth weight in grams, (b) average LMP gestational period in weeks, (c) average OE gestational period in weeks, and (d) percentage of low birth weight babies. All specifications in the top panel include state-year FE, county-month FE, year-month FE, and county-specific linear time trends. Whiskers represent 90% confidence intervals based on robust standard errors clustered at the level of the county.

Table 1: Impact of mass shootings on birth outcomes

VARIABLES	(1) Birth weight	(2) LMP gestational period	(3) OE gestational period	(4) % low birth weight
# fatalities during pregnancy	-0.1641*	0.0003	-0.0007*	0.0048*
	(0.0926)	(0.0005)	(0.0004)	(0.0026)
Month-Year FE	Y	Y	Y	Y
County-Month FE	Y	Y	Y	Y
State-Year FE	Y	Y	Y	Y
County-specific time trend	Y	Y	Y	Y
Unit	grams	weeks	weeks	%
Mean of DV	3341.76	39.00	38.88	1.32
Observations	103,647	103,647	76,532	103,647
	(5)	(6)	(7)	(8)
VARIABLES	Infant Mortality Rate			
# fatalities in the birth year	0.0099*		0.0091	
	(0.0055)		(0.0064)	
# victims in the birth year		0.0017**		0.0015*
		(0.0007)		(0.0009)
State-Year FE	Y	Y	Y	Y
County FE	Y	Y	Y	Y
County-specific time trend	Y	Y	Y	Y
Sample	Full	Full	Identified Counties	Identified Counties
Mean of DV	6.25	6.25	6.21	6.21
Observations	4,096	4,096	3,294	3,294

Note: The outcome variables in the top panel are (1) average birth weight in grams, (2) average LMP gestational period in weeks, (3) average OE gestational period in weeks, and (4) % births with birth weight $<$ 2500 grams, in a county in a month-year. The independent variable is the number of mass shooting fatalities in counties in the nine months prior to a birth month-year. All specifications in the top panel include state-year FE, county-month FE, year-month FE, and county-specific linear time trends. The outcome variable in the bottom panel is the infant mortality rate in counties in different years and the independent variable is, in columns (5) and (7), the number of fatalities and, in (6) and (8), the number of victims (deaths or injuries) due to mass shooting incidents in the county in the year. Columns (5) and (6) use the full sample and (7) and (8) use the sample of identified counties only. All specifications in the bottom panel include state-year FE, county FE, and county-specific linear time trends. Robust standard errors, in parentheses, are clustered at the county-level.

Table 2: Coverage of mass shooting on *ABC World News Tonight* on days with natural disaster deaths

	(1)	(2)	(3)	(4)
VARIABLES	Coverage length (%) of the mass shooting			
International natural disaster-related deaths	-0.0003**	-0.0121***	-0.0002***	-0.0081**
	(0.0001)	(0.0046)	(0.0001)	(0.0033)
Month FE	Y	Y	Y	Y
Day of the month FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Deaths range	Full range	Deaths $\leq$ 100	Full range	Deaths $\leq$ 100
Coverage range	Full range	Full range	Coverage $\leq$ 50%	Coverage $\leq$ 50%
Mean of DV	0.75	0.75	0.62	0.63
Mean of Ind. V	10.19	1.57	10.20	1.57
Observations	17,489	17,338	17,458	17,307

Note: The table reports the correlation between the percentage time devoted to the coverage of a mass shooting incident on the *ABC World News Tonight* episode of the day with the number of deaths due to natural disasters internationally. Different columns use either the full sample of observations for international disaster related deaths and coverage of mass shooting incidents or a sub-sample that excludes extreme observations. All specifications include day of the month FE, month of the year FE, and year FE.

Table 3: Heterogeneous impact on birth outcomes by international natural disasters-related deaths during pregnancy

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Birth weight		LMP gestational period		OE gestational period		% low birth weight	
# of fatalities during pregnancy	0.1255	-0.2188*	0.0011	-0.0009*	0.0004	-0.0014**	-0.0063	0.0133***
	(0.2205)	(0.1253)	(0.0013)	(0.0005)	(0.0009)	(0.0006)	(0.0078)	(0.0031)
Disaster deaths during pregnancy	$\geq$ median	$<$ median	$\geq$ median	$<$ median	$\geq$ median	$<$ median	$\geq$ median	$<$ median
Month-Year FE	Y	Y	Y	Y	Y	Y	Y	Y
County-Month FE	Y	Y	Y	Y	Y	Y	Y	Y
State-Year FE	Y	Y	Y	Y	Y	Y	Y	Y
County-specific time trend	Y	Y	Y	Y	Y	Y	Y	Y
Unit	grams	grams	weeks	weeks	weeks	weeks	%	%
Mean of DV	3339.7932	3337.8917	38.9725	38.9965	38.8707	38.8753	1.4280	1.3944
Observations	40,852	45,295	40,852	45,295	22,921	41,510	40,852	45,295

	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
VARIABLES	Infant Mortality Rate		Infant Mortality Rate		Infant Mortality Rate		Infant Mortality Rate	
# fatalities in the birth year	-0.0060	0.0142**			-0.0060	0.0123**		
	(0.0188)	(0.0057)			(0.0188)	(0.0062)		
# victims in the birth year			-0.0004	0.0022***			-0.0004	0.0014***
			(0.0059)	(0.0006)			(0.0059)	(0.0005)
State-Year FE	Y	Y	Y	Y	Y	Y	Y	Y
County FE	Y	Y	Y	Y	Y	Y	Y	Y
County-specific time trend	Y	Y	Y	Y	Y	Y	Y	Y
Disaster deaths during pregnancy	$\geq$ median	$<$ median	$\geq$ median	$<$ median	$\geq$ median	$<$ median	$\geq$ median	$<$ median
Sample	Full				Identified Counties			
Mean of DV	6.40	6.10	6.40	6.10	6.40	6.05	6.40	6.05
Observations	1,523	2,170	1,523	2,170	1,523	1,744	1,523	1,744

Note: The outcome variables in the top panel are month-year average birth weight in (1) and (2), month-year average LMP gestational age (3) and (4), month-year average OE gestational age (5) and (6), month-year % births with birth weight $<$ 2500 grams in (7) and (8), and yearly infant mortality rate in (9)-(16) across counties. The independent variable, in (1)-(10) and (13)-(14), is the number of fatalities and, in (11)-(12) and (15)-(16), the number of victims due to mass shooting incidents in the county in the relevant nine months pregnancy period or the year of birth. Except columns (13)-(16) that use identified counties only, all specifications use the full sample. Odd-numbered (even-numbered) columns estimate the relationship for the sub-sample where the number of deaths due to international natural disaster during the relevant time period was above (below) the median number of disaster-related deaths in the sample. All specifications in the top panel include state-year FE, county-month FE, year-month FE, and county-specific linear time trends, and in the bottom panel include state-year FE, county FE, and county-specific linear time trends. Robust standard errors, in parentheses, are clustered at the county-level.

A1 Online Appendix

A1.1 Data Description

We get information related to mass shootings from Wikipedia listings of mass shooting incidents in the United States. Wikipedia compiles this list from multiple sources - the Stanford MSA Data Project, the Mass Shooting Tracker, the Gun Violence Archive/Vox, Mother Jones data on mass shootings, Washington Post reports, and the Congressional Research Service.

The Stanford Geospatial Center started the Stanford Mass Shootings of America data project in 2012 in response to the shooting in Sandy Hook, Connecticut. The database categorized as mass shooting any event where more than three people were shot in one incident, at one location, at roughly the same time, excluding organized crime, as well as gang-related and drug-related shootings.

Mass Shooting Tracker is a volunteer website that used crowd sourcing to maintain a record of mass shooting incidents. The website counts an event as a mass shooting if at least three people were shot in one incident, at one location, at roughly the same time.

Gun Violence Archive is a nonprofit research group that catalogs every incident of gun violence in the United States since 2014. It compiles information from law enforcement, media and government sources. It counts any incident with four or more people shot in one incident, excluding the perpetrator(s), at one location, at roughly the same time as a mass shooting.

Mother Jones, an American magazine published by The Foundation for National Progress, focuses on news, commentary, and investigative reporting on topics including politics, the environment, human rights, health and culture. It collates and publicly releases data on mass shooting incidents on its website. Events with at least three people shot and killed, excluding the perpetrator(s), at a public place, excluding gang-related killings, are counted as mass shootings.

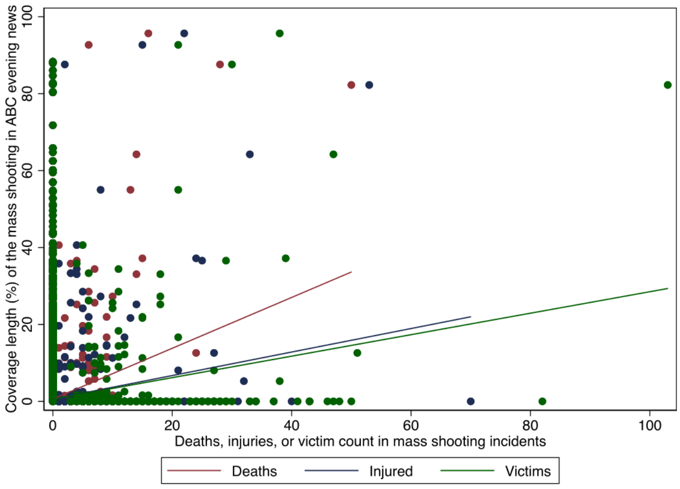
The Washington Post, an American daily newspaper, maintains a mass-shooting database where it counts as a mass shooting any event in which four or more people are shot and killed in one incident, excluding the perpetrator(s), at a public place, excluding gang-related killings.

The Congressional Research Service (CRS) is a public policy research institute of the United

States Congress that works for Members of Congress, their Committees and staff on a confidential, nonpartisan basis. In their reports, they count any event with four or more people shot and killed in one incident, excluding the perpetrator(s), at a public place, excluding gang-related killings, acts carried out that were inspired by criminal profit, and terrorism, as a mass shooting.

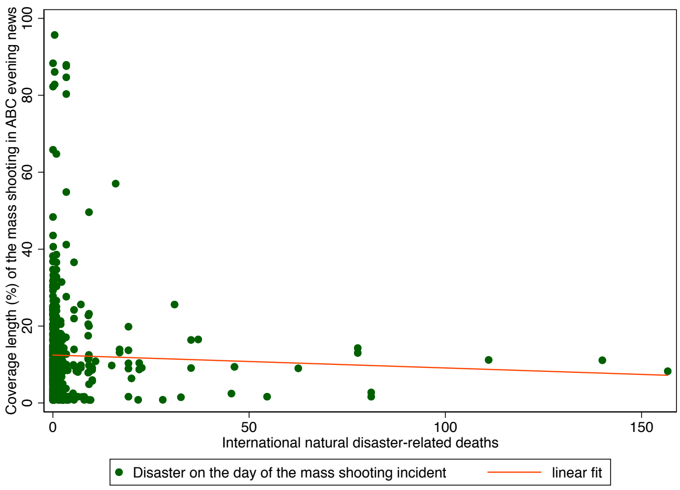
A1.2 Figures

Figure A1: Coverage of mass shooting incidents on *ABC World News Tonight*



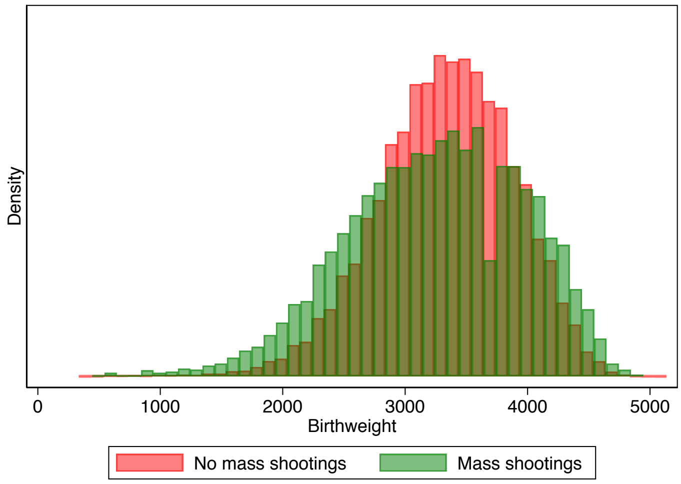
Note: The figure plots the correlation between the percentage time devoted to the coverage of a mass shooting incident on the *ABC World News Tonight* episode of the day with the number of deaths (red), injuries (blue), or victims (green) in the incident.

Figure A2: Coverage of mass shooting incidents on days with international natural disasters



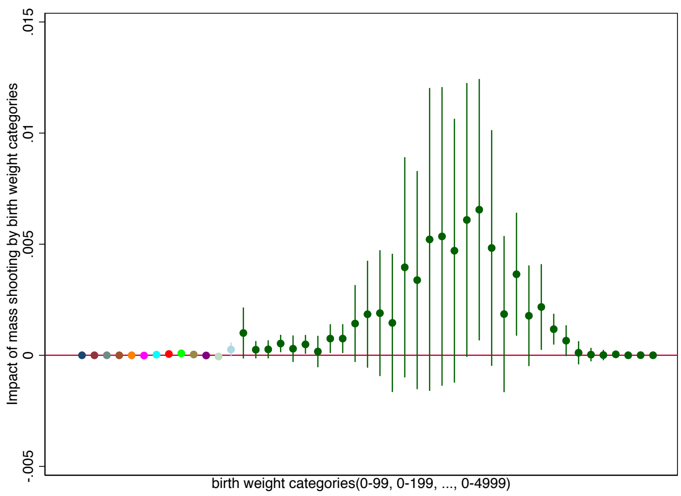
Note: The figure plots the correlation between the percentage time devoted to the coverage of a mass shooting incident on the *ABC World News Tonight* episode of the day with the number of deaths due to natural disasters internationally.

Figure A3: Distribution of birth weights



Note: The figure presents the distribution of percentage births in each weight category by whether there was a mass shooting incident in the county in the nine months prior to the birth month.

Figure A4: Impact of mass shooting on average weight by birth weight categories



Note: The point coefficient estimates report the effect of the number of mas shooting fatalities on the percentage of total births in indicated birth-weight category. All specifications in the top panel include state-year FE, county-month FE, year-month FE, and county-specific linear time trends. Whiskers represent 90% confidence intervals based on robust standard errors clustered at the level of the county.

A1.3 Tables

Table A1: Impact of mass shootings by low birthweight categories

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	% births with birth weight [...] grams							
	< 1800	< 1900	< 2000	< 2100	< 2200	< 2300	< 2400	< 2500
# of fatalities	-0.0001	0.0011	0.0010	0.0023**	0.0017	0.0029	0.0048*	0.0062**
	(0.0008)	(0.0011)	(0.0015)	(0.0011)	(0.0018)	(0.0022)	(0.0026)	(0.0027)
Month FE	Y	Y	Y	Y	Y	Y	Y	Y
County-Month FE	Y	Y	Y	Y	Y	Y	Y	Y
State-Year FE	Y	Y	Y	Y	Y	Y	Y	Y
County-specific time trend	Y	Y	Y	Y	Y	Y	Y	Y
Mean of DV	0.00	0.08	0.15	0.24	0.45	0.71	1.32	2.06
Observations	103,647	103,647	103,647	103,647	103,647	103,647	103,647	103,647

Note: The outcome variables are the percentage births in birth weight less than the indicated upper bound in a county in a month-year. The independent variable is the number of mas shooting fatalities in counties in the nine months prior to a birth month-year. All specifications include state-year FE, county-month FE, year-month FE, and county-specific linear time trends. Robust standard errors, in parentheses, are clustered at the county-level.

Table A2: Impact of mass shootings on high birth weight

	(1)	(2)	(3)	(4)
VARIABLES	Birth weight $\geq$ 4500 grams			
# fatalities during pregnancy	0.0000		0.0010**	
	(0.0006)		(0.0004)	
# victims during pregnancy		0.0000		0.0001
		(0.0001)		(0.0001)
Month-Year FE	Y	Y	Y	Y
County-Month FE	Y	Y	Y	Y
State-Year FE	Y	Y	Y	Y
County-specific time trend	Y	Y	Y	Y
Sample	Full	Full	Identified Counties	Identified Counties
Mean of DV	0.01	0.01	0.00	0.00
Observations	103,647	103,647	95,359	95,359

Note: The outcome variables are the percentage births with birth weight greater than or equal to 4500 grams in a county in a month-year. The independent variable is, in columns (1) and (3), the number of fatalities and, in (2) and (4), the number of victims (deaths or injuries) due to mass shooting incidents in the county in the year. Columns (1) and (2) use the full sample and (3) and (4) use the sample of identified counties only. All specifications include state-year FE, county-month FE, year-month FE, and county-specific linear time trends. Robust standard errors, in parentheses, are clustered at the county-level.

Table A3: Coverage of mass shooting incidents on *ABC World News Tonight*

VARIABLES	(1)	(2)	(3)	(4)
	Coverage length (%) of the mass shooting			
# died in mass shootings incidents	0.92***		0.62***	
	(0.03)		(0.04)	
# injured in mass shootings incidents		0.72***	0.40***	
		(0.03)	(0.04)	
# victims of mass shootings incidents				0.50***
				(0.02)
Month FE	Y	Y	Y	Y
Day of the month FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Mean of DV	0.75	0.75	0.75	0.75
Mean of Ind. V	0.06	0.06		0.12
Observations	17,489	17,489	17,489	17,489

Note: The table reports the correlation between the percentage time devoted to the coverage of a mass shooting incident on the *ABC World News Tonight* episode of the day with the number of deaths (1), injuries (2), or victims (4) in the incident. Different columns use either the full sample of observations for international disaster related deaths and coverage of mass shooting incidents or a sub-sample that excludes extreme observations. All specifications include day of the month FE, month of the year FE, and year FE.

Table A4: Impact of mass shootings on birth outcomes with economic and temperature controls

VARIABLES	(1) Birth weight	(2) LMP gestation period	(3) OE gestation period	(4) % low birth weight
# of fatalities during pregnancy	-0.2899*	-0.0008	-0.0011**	0.0045
	(0.1720)	(0.0006)	(0.0005)	(0.0042)
Month-Year FE	Y	Y	Y	Y
County-Month FE	Y	Y	Y	Y
State-Year FE	Y	Y	Y	Y
County-specific time trend	Y	Y	Y	Y
Unit	grams	weeks	weeks	%
Mean of DV	3342.30	39.04	38.90	1.02
Observations	45,562	45,562	45,562	45,562

Note: The outcome variables (1) month-year average birth weight, (2) month-year average LMP gestational age, (3) month-year average OE gestational age, (4) month-year % births with birth weight $<$ 2500 grams across counties. The independent variable is the number of fatalities due to mass shooting incidents in the county in the nine months prior to the month-year. All specifications include state-year FE, county-month FE, year-month FE, county-specific linear time trends, controls. Additional controls include yearly unemployment rate, yearly net domestic and international migration rate, and weighted average monthly temperature in nine months of pregnancy in the county. Robust standard errors, in parentheses, are clustered at the county-level.

Table A5: Robustness of the impact of mass shootings using the number of victims

VARIABLES	(1) Birth weight	(2) LMP gestation period	(3) OE gestation period	(4) % low birth weight
# of victims during pregnancy	-0.0451**	0.0001	-0.0001	0.0015**
	(0.0227)	(0.0001)	(0.0001)	(0.0006)
Month-Year FE	Y	Y	Y	Y
County-Month FE	Y	Y	Y	Y
State-Year FE	Y	Y	Y	Y
County-specific time trend	Y	Y	Y	Y
Unit	grams	weeks	weeks	%
Mean of DV	3341.76	39.00	38.88	1.32
Observations	103,647	103,647	76,532	103,647

Note: The outcome variables are (1) average birth weight in grams, (2) average LMP gestational period in weeks, (3) average OE gestational period in weeks, and (4) % births with birth weight < 2500 grams, in a county in a month-year. The independent variable is the number of mass shooting victims in counties in the nine months prior to a birth month-year. All specifications in the top panel include state-year FE, county-month FE, year-month FE, and county-specific linear time trends. Robust standard errors, in parentheses, are clustered at the county-level.

Table A6: Robustness of the impact of mass shootings using identified counties only

VARIABLES	(1) Birth weight	(2) LMP gestation period	(3) OE gestation period	(4) % low birth weight
# of fatalities during pregnancy	-0.2032*	0.0002	-0.0010***	0.0047
	(0.1132)	(0.0005)	(0.0004)	(0.0032)
Month-Year FE	Y	Y	Y	Y
County-Month FE	Y	Y	Y	Y
State-Year FE	Y	Y	Y	Y
County-specific time trend	Y	Y	Y	Y
Unit	grams	weeks	weeks	%
Mean of DV	3342.97	39.01	38.89	1.08
Observations	95,359	95,359	70,452	95,359

Note: The outcome variables are (1) average birth weight in grams, (2) average LMP gestational period in weeks, (3) average OE gestational period in weeks, and (4) % births with birth weight < 2500 grams, in a county in a month-year. The independent variable is the number of mass shooting fatalities in counties in the nine months prior to a birth month-year. All specifications in the top panel include state-year FE, county-month FE, year-month FE, and county-specific linear time trends and use information from identified counties only. Robust standard errors, in parentheses, are clustered at the county-level.

Table A7: Robustness of the impact of mass shootings using all incidents within a radius of 25 kms

VARIABLES	(1) Birth weight	(2) LMP gestation period	(3) OE gestation period	(4) % low birth weight
# of fatalities during pregnancy	-0.1408	-0.0002	-0.0005**	0.0021*
	(0.1156)	(0.0003)	(0.0002)	(0.0011)
Month-Year FE	Y	Y	Y	Y
County-Month FE	Y	Y	Y	Y
State-Year FE	Y	Y	Y	Y
County-specific time trend	Y	Y	Y	Y
Unit	grams	weeks	weeks	%
Mean of DV	3342.97	39.01	38.89	1.08
Observations	95,355	95,355	70,448	95,355

Note: The outcome variables are (1) average birth weight in grams, (2) average LMP gestational period in weeks, (3) average OE gestational period in weeks, and (4) % births with birth weight $<$ 2500 grams, in a county in a month-year. The independent variable is the number of mass shooting fatalities within 25 kilometers of the county center in the nine months prior to a birth month-year. All specifications in the top panel include state-year FE, county-month FE, year-month FE, and county-specific linear time trends. Robust standard errors, in parentheses, are clustered at the county-level.

Table A8: Robustness of the impact of mass shootings using Mother Jones data

VARIABLES	(1) Birth weight	(2) LMP gestation period	(3) OE gestation period	(4) % low birth weight
# of fatalities during pregnancy	-0.1227	0.0003	-0.0005	0.0024*
	(0.1232)	(0.0004)	(0.0003)	(0.0013)
Month-Year FE	Y	Y	Y	Y
County-Month FE	Y	Y	Y	Y
State-Year FE	Y	Y	Y	Y
County-specific time trend	Y	Y	Y	Y
Unit	grams	weeks	weeks	%
Mean of IV	0.21	0.21	0.26	0.21
Mean of DV	3342.9703	39.0060	38.8923	1.0797
Observations	95,359	95,359	70,452	95,359

Note: The outcome variables are (1) average birth weight in grams, (2) average LMP gestational period in weeks, (3) average OE gestational period in weeks, and (4) % births with birth weight $<$ 2500 grams, in a county in a month-year. The independent variable is the number of mass shooting fatalities in counties in the nine months prior to a birth month-year obtained from *Mother Jones* mass shooting incidents database. *Mother Jones*, an American magazine published by The Foundation for National Progress, focuses on news, commentary, and investigative reporting on topics including politics, the environment, human rights, health and culture. It collates and publicly releases data on mass shooting incidents on its website. All specifications in the top panel include state-year FE, county-month FE, year-month FE, and county-specific linear time trends. Robust standard errors, in parentheses, are clustered at the county-level.

Table A9: Selection checks

VARIABLES	(1) Total births	(2) Average Age of Mother
# of fatalities during pregnancy	0.9181	0.0000
	(0.7307)	(0.0069)
Month-Year FE	Y	Y
County-Month FE	Y	Y
State-Year FE	Y	Y
County-specific time trend	Y	Y
Unit	count	years
Mean of DV	515.49	27.76
Observations	103,647	103,647

Note: The outcome variables are (1) total number of births and (2) average age of mother who delivered live babies in a county in a month-year. The independent variable is the number of mass shooting fatalities in counties in the nine months prior to a birth month-year. All specifications in the top panel include state-year FE, county-month FE, year-month FE, and county-specific linear time trends. Robust standard errors, in parentheses, are clustered at the county-level.

Table A10: Other birth characteristics

VARIABLES	(1) % female babies	(2) % unmarried mothers	(3) Day of the week	(4) % mothers with college degree
# of fatalities during pregnancy	-0.00003	-0.0001	0.0001	0.0003
	(0.0001)	(0.0001)	(0.0002)	(0.0003)
Month-Year FE	Y	Y	Y	Y
County-Month FE	Y	Y	Y	Y
State-Year FE	Y	Y	Y	Y
County-specific time trend	Y	Y	Y	Y
Mean of DV	0.47	0.37	0.09	0.27
Observations	110,352	110,352	20,592	105,576

Note: The outcome variables are (1) percentage of female babies born in the country in the month-year (2) percentage of babies with unmarried mothers (3) day of the week when the babies were born (4) percentage of babies whose mothers had a college degree. The independent variable is the number of mass shooting fatalities in counties in the nine months prior to a birth month-year. All specifications include state-year FE, county-month FE, year-month FE, and county-specific linear time trends. Robust standard errors, in parentheses, are clustered at the county-level.

Table A11: Maternal risk factors as potential mechanisms

	(1)	(2)	(3)	(4)	(5)
	% mothers who had				
VARIABLES	used tobacco	chronic hypertension	diabetes	eclampsia	pregnancy-related hypertension
# of fatalities during pregnancy	-0.00006	-0.00005	-0.00001	-0.00001	-0.00003
	(0.00024)	(0.00004)	(0.00007)	(0.00002)	(0.00006)
Month-Year FE	Y	Y	Y	Y	Y
County-Month FE	Y	Y	Y	Y	Y
State-Year FE	Y	Y	Y	Y	Y
County-specific time trend	Y	Y	Y	Y	Y
Mean of DV	0.07	0.00	0.04	0.00	0.03
Observations	110,352	110,352	110,352	110,352	110,352

Note: The outcome variables are percentage of mothers who (1) used tobacco in any form (2) suffered from chronic hypertension (3) suffered from diabetes (3) suffered from eclampsia (4) suffered from pregnancy-associated hypertension. The independent variable is the number of mass shooting fatalities in counties in the nine months prior to a birth month-year. All specifications include state-year FE, county-month FE, year-month FE, and county-specific linear time trends. Robust standard errors, in parentheses, are clustered at the county-level.