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Violence and newborn health: Estimates for Colombia

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Abstract

This paper examines the relationship between maternal exposure to violence during pregnancy and newborn birthweight. The identification strategy exploits variation in the timing of exposure and in the geographic location of expectant mothers across Colombian municipalities. Exposure to violence in early pregnancy had a large negative impact on birthweight, primarily for boys, and the effect was mitigated by their mothers' education. Girls' birthweight was affected mainly by shocks in later stages of gestation. Furthermore, their mothers were more likely to engage in potentially harmful behaviors during the pregnancy. This evidence exposes the importance of parental responses in shaping the effect of exposure to violence on newborn health.

KEYWORDS
conflict, gender, health, newborn, violence

JEL CLASSIFICATION
I10, J13, J16

1 | INTRODUCTION

Armed conflict violence has effects beyond physical destruction and direct victimization. This paper investigates whether exposure of pregnant women to violence in the area where they reside affects their newborns' health; that is, the effects that may occur in the offspring even when the women themselves are not directly victimized.

The paper aims to strengthen the existing empirical evidence on the importance of the prenatal environment and shocks for early life outcomes. Early studies (Camacho, 2008; Mansour & Rees, 2012) found scarring of health of newborns exposed to violence during gestation but overlooked gender differences in the effects. Because boys are less adaptable to prenatal adversity than girls, they are at greater risk of mortality and morbidity, especially when facing early pregnancy shocks (Kraemer, 2000). Consistent with this, more recent work (Dagnelie et al., 2018; Valente, 2015) found higher fetal mortality among boys, and evidence of survival selection reflected as an absence of worse health outcomes for those alive. It is hypothesized that this selection effect dominated in more deprived contexts, such as in the less developed countries analyzed in the latter studies—Nepal and the Democratic Republic of Congo (DRC)—where baseline health is poor (Almond & Currie, 2011; Valente, 2015), but there is still a gap to assess whether this would hold in relatively more prosperous developing countries, or whether non-biological factors can shape this relationship. With this in mind, this study re-examines the case of Colombia, initially addressed by Camacho (2008), disaggregating the analysis by gender and checking for survival bias. The present study uses survey data instead of vital registration records, which has a smaller sample size and hence less precise estimates. Nevertheless, this data allows assessing the impact on fetal mortality and two additional innovative extensions. Firstly, a contribution is made by analyzing the heterogeneity in the effect by maternal education levels. Secondly, as health disparities are transmitted through biological and socio-economic mechanisms (Conti, 2013), I explore the potential role of behavioral channels in mediating the intergenerational impact of violence exposure.

The identification strategy exploits geographically and time-differentiated violence exposure in Colombia by municipality and date of occurrence. The measure to capture a local violence shock is violent attacks against civilians. The fear aroused by these attacks in the general population can affect behaviors (Becker & Rubinstein, 2011). The exact timing and location of an attack are, by definition, uncertain, even in areas with known presence of armed groups, making this a suitable measure of a shock where there is sustained armed conflict. There is exogenous variation in the individual violence exposure within municipalities resulting from the gestation stage of pregnancies when an event occurs. To obtain this high-frequency variability in the data, I link historical records of violent attacks by municipality of residence of the mother and month of occurrence with the month of gestation. Data is from the *Centro Nacional de Memoria Histórica* (CNMH),[1] and three rounds of the Demographic and Health Surveys (DHS). The outcomes assessed are weight at birth and neonatal mortality, measures that reflect the cumulative pregnancy conditions. Birthweight influences a wide range of outcomes over the life cycle, from adult disease prevalence to educational attainment, labor market outcomes, earnings and social status, highlighting its relevance (Black et al., 2007; Case et al., 2005; Currie & Hyson, 1999; Johnson & Schoeni, 2011).

Overall, I found a negative effect of exposure to violence on the health of newborn babies, but with distinctive gender patterns. For boys, exposure to violence during early gestation reduced birthweight by about 40 g, on average, and increased the probability of being born with low birthweight. The effect was more substantial for the boys of uneducated mothers, diminishing by 29 g for each additional year of education. There were mixed results for fetal mortality. The evidence for the effect of early pregnancy shocks was weak, even for the children of less-educated women, who are likely to be at the bottom end of the health distribution; however, a predominantly male increase in mortality was found for children of the least educated mothers exposed to violence in late gestation. Baby girls appear to be stronger against early pregnancy shocks, as expected, but those exposed to violence after the first trimester had a higher probability of being born with low birthweight and of dying in the neonatal period. These effects were also driven by those whose mothers had no schooling.

The differentiated gender pattern in results about early pregnancy exposure to the shock is consistent with biomedical explanations about fetal responses to shocks described earlier. However, what can explain the deterioration of health found for girls, who should be less vulnerable, exposed to violence in late pregnancy? Additional results provide suggestive, although not definitive, evidence that changes in maternal behaviors during pregnancy play a role. Women exposed to violence and pregnant with a girl were less likely to receive prenatal care, be vaccinated against tetanus and more likely to drink alcohol during pregnancy, potentially increasing their girls' vulnerability to in utero shocks. Although judgment on the role of these mechanisms connecting violence shocks and newborn health is speculative, the evidence here exposes the likely role of behavioral responses, in addition to the purely biological effects induced by violence-related stress.

Section 2 reviews empirical studies of the fetal-origins hypothesis that specifically address war-violence shocks. Section 3 gives a brief overview of the Colombian conflict. Section 4 describes the data and the methodology. The results follow, and Section 6 concludes highlighting future research opportunities.

2 | LITERATURE REVIEW

The fetal-origins hypothesis states that shocks to the environment in utero alter the physiology and metabolism of the fetus, with some effects apparent at birth and other lifelong consequences (Almond & Currie, 2011; Johnson & Schoeni, 2011). I concentrate the review on the subset of studies emphasizing violence shocks in conflict-affected countries and on the short-term impacts, although the health consequences of exposure to war can last through childhood and beyond (e.g., Akresh, Bhalotra, et al., 2012; Akresh, Lucchetti, et al., 2012; Tranchant et al., 2020).

Camacho (2008) analyzes birth records from the Colombian Vital Registration System (1998–2003). She finds that a landmine explosion occurring in a municipality during the first trimester of pregnancy reduced birthweight by 8.7 g. Mansour and Rees (2012), using DHS data, look at the al-Aqsa Intifada in the West Bank. They find that exposure to district-level fatalities caused by Israeli security forces during the last gestation trimester reduced birthweight by 2.1 g,[2] and that the odds of being born with low birthweight increased with exposure in the first trimester. The early studies overlooked the possibility of a culling or selection effect in the surviving cohort—the higher mortality from the lower end of the fetal health distribution. Valente's (2015) work in Nepal explicitly addresses this, and her results differed from the two earlier studies. She finds that violence exposure in utero increased fetal deaths, especially male's, and that the probability that a baby was considered small at birth did not rise nor neonatal mortality fell. Dagnelie et al. (2018) also evidence a stronger selection effect in a poor country, the DRC. They find a reduction in the gender ratio at birth, decreased district-level male births and no change in boys' health. Contrastingly, exposure to Euskadi Ta Askatasuna bomb casualties in Spain slightly reduced birthweight (−0.28 g) despite an increase in stillbirths (Quintana-Domeque & Ródenas-Serrano, 2017). A suggested hypothesis is that the selection effect may be weaker than the scarring in relatively more developed countries. There is still a gap in the evidence concerning the strength of the selection bias in middle-income developing countries.

This literature shares a focus on violence exposure rather than individual victimization, emphasizing the role of stress as a likely channel between violence and newborn health.[3] Animal experiments have tested the effects of in utero stress (Schneider, 1992; Schneider et al., 1992; Weinstock, 2008; Welberg et al., 2001), and the biological processes point to similar impacts on humans. Cortisol and adrenaline mediate this response; because fetuses are exposed to their mothers' stress hormones, transient high maternal stress in a sensitive period can impact fetal development. Stress hormones signal an unfavorable environment, accelerating metabolism and organ growth to increase the fetus' chances of survival if it had to escape from the harmful host environment. The trade-off is that the baby is less mature and smaller at birth than one who developed at a regular rate (Sandman & Davis, 2012). Because cortisol varies naturally through the pregnancy,[4] this response is more likely to be detrimental in early gestation (Pike, 2005). It also varies by gender as the female placenta has higher activity of 11β-HSD2, a binding protein that prevents cortisol from crossing the placental barrier, making female fetuses more adaptable to changing conditions (Sandman & Davis, 2012).

Indirect events may trigger stress responses. This is evident with indiscriminate attacks against civilians, where direct victimization is low, but the *perceived* risk is high (Becker & Rubinstein, 2011). Responses can also be behavioral. A growing literature has drawn attention to changes in, among others, cooperation, altruism, political participation and risk-seeking behaviors among populations exposed to war (Bellows & Miguel, 2009; Blattman, 2009; Moya, 2018; Voors et al., 2012). This brings the question of whether there are changes in behaviors during pregnancy, such as smoking, drinking alcohol and prenatal care-seeking, that affect early life outcomes (e.g., East et al., 2017; Jewell, 2007; Kramer, 1987; Mwabu, 2008; Popova et al., 2017; Rosenzweig & Schultz, 1982).

The impact of in utero shocks can be heterogeneous. The relationship between parents' education and children's health is well established theoretically (Grossman, 2000) and empirically (Currie & Moretti, 2003; Cutler & Lleras-Muney, 2006; Cutler et al., 2008). Education can also mediate stress responses. There can be a direct income effect, whereby more educated parents with higher incomes have more resources to cushion or compensate for the effect of a shock. Another possibility is that low-educated and socio-economic status mothers have higher baseline allostatic load from repeated or chronic stress, worse psychological well-being and more prevalence of mental health conditions (Bjelland et al., 2008; Dowd et al., 2009; Hanandita & Tampubolon, 2014; Haushofer & Shapiro, 2016; Ozer et al., 2011), intensifying the biological reaction to a shock. A third hypothesis is that mothers with higher education are less reactive to a shock than less-educated ones. For instance, in Becker and Rubinstein's (2011) study of responses to terrorism, risk is assessed more accurately by individuals with higher cognitive ability, who are consequently more likely to overcome the fear and return to their baseline behaviors after an attack.

3 | THE SHIFTING PATTERN OF 50 YEARS OF WAR

Colombia has a long-standing internal armed conflict; rooted in the 1950s bipartisan confrontation, it started in the 1960s with the emergence of guerrilla groups. It has been characterized as a struggle for local power rather than a separatist, religious or ethnic confrontation. The main guerrilla groups are *Fuerzas Armadas Revolucionarias de Colombia* (FARC), who dismantled with a peace agreement in 2017, and *Ejercito de Liberación Nacional*, still active. Paramilitary groups emerged in reaction to guerrillas in the late 1980s as private self-defense armies. Their umbrella organization, *Autodefensas Unidas de Colombia*, demobilized in 2004, but factions re-emerged as organized crime bands seeking control of drug and illicit goods' traffic (Zelik, 2015).

The conflict spread widely throughout the country, but the violence and its intensity have been geographically heterogeneous, with periods of lower and higher intensity and shifting hotspot areas. These patterns respond to the limited state presence in parts of the country, the struggle for control of strategic and war-economy areas, and pressures from the army's military operations (González et al., 2003; Gutiérrez & Sánchez, 2006). Between 1965 and 1981, violence was low and stable. It steadily increased to peak between 1996 and 2002, falling thereafter (*Centro Nacional de Memoria* Histórica

[CNMH], 2013). More recently, relatively peaceful periods associated with ceasefires during the peace negotiations with FARC were followed by violence escalations when ceasefires broke. After FARC's demobilization, violence intensified in strategic, coastal and border areas where dissident and rival groups battle for the control of vacated territory, drug cultivation and trade corridors (International Crisis Group, 2015, 2017). Geographically, in the 1990s the conflict spread from the areas of historical origin of guerrillas in peasant colonization areas to large parts of the country, including those integrated into national markets and politics. At the end of the decade, armed groups consolidated in strategic corridors, especially between the inland-Caribbean and the Andean regions, and the low-*Putumayo* and south-eastern *Orinoquía*. The peak of violence in this period resulted from a mix of the military strengthening of guerrillas, the expansion of paramilitary groups, the weakness of the state, the economic crisis and the reshuffling of drug cartels' structure (CNMH, 2013). The early 2000s, marked by the military offensive against guerrillas and the paramilitary demobilization, saw a retreat of armed groups to the areas of historical presence and new peripheral areas, particularly the Pacific south-west (Vásquez, 2014).

Armed groups have preferred different types of violent actions, with variations over time. Violent attacks against civilians were highly associated with drug cartels until 1993, but guerrilla groups picked this strategy thereafter, becoming the primary perpetrator of these attacks (CNMH, 2013). The early 2000s peak in attacks was linked to a desire to demonstrate the guerrillas' growing power, as a contention strategy against the paramilitary growth and, later on, the state's military recovery (CNMH, 2013). These attacks have been, with some notable exceptions, aimed locally.

4 | EMPIRICAL STRATEGY

4.1 | Violence data

A key challenge is to find a measure of a local violence *shock*. Measures based on victims are more likely to capture the underlying intensity *levels* of conflict in an area.[5] The approach here is to use an event that can be better characterized as exogenous. Violent attacks against civilians suit this purpose.

The definition follows the CNMH (2013, p. 101) from where the data is drawn: "all indiscriminate attack carried out with explosives, against civilian objectives, in public places, with the aim of causing high lethality and devastation upon the civil population." The key elements are: (1) events are indiscriminate rather than targeted, (2) they are not armed interventions[6] and the use of explosives implies some distance of the perpetrating actor from the scene, (3) the objectives are not military, (4) they happen in visible places rather than in private spaces or remote rural locations, (5) the intent is to affect a large number of people/civil goods as a display of potential power and to generate fear among the wider (local) population, although direct victimization is rare.[7] Even in areas where the presence of guerrillas is known, there is uncertainty about exactly where and when an attack may happen. The data comes from the compilation for the CNMH's 2013 report *Basta Ya! Memories of War and Dignity*, updated following the CNMH criteria to March 2016 from the primary source, *Noche y Niebla* online database of human rights and political violence events.[8]

The geographic variation of these attacks through the period (February 1999 to March 2016) (Figure 1, darker shades indicate more events) shows that except for the remote and low-densely populated south-east region,[9] their occurrence is scattered around the country. The map also shows their rarity, as most municipalities did not experience any attack in 16 years. The monthly evolution is in Figure 2. Most occurrences are in the mid-2000s, diminishing toward the end of that decade and coinciding with the country's pattern of conflict intensity. In the 487 municipalities included in DHS (across the three survey rounds), there were 49 attacks occurring in 29 different municipalities (6% of municipalities in the sample). The recurrence is low: 10 municipalities experienced more than one attack in the period; Tumaco and Bogotá, the capital, had the highest occurrence with six and five attacks, respectively.

4.2 | Pregnancies and births data

Violence data by municipality and month of occurrence are matched to household survey data from the DHS on the month of pregnancy (then aggregated and reported by trimester) and the mother's municipality of residence. Demographic and Health Surveys are nationally representative cross-section surveys that collect information from women of reproductive age (13–49 years old in Colombia), including the history of live births in the 5 years before each survey. I

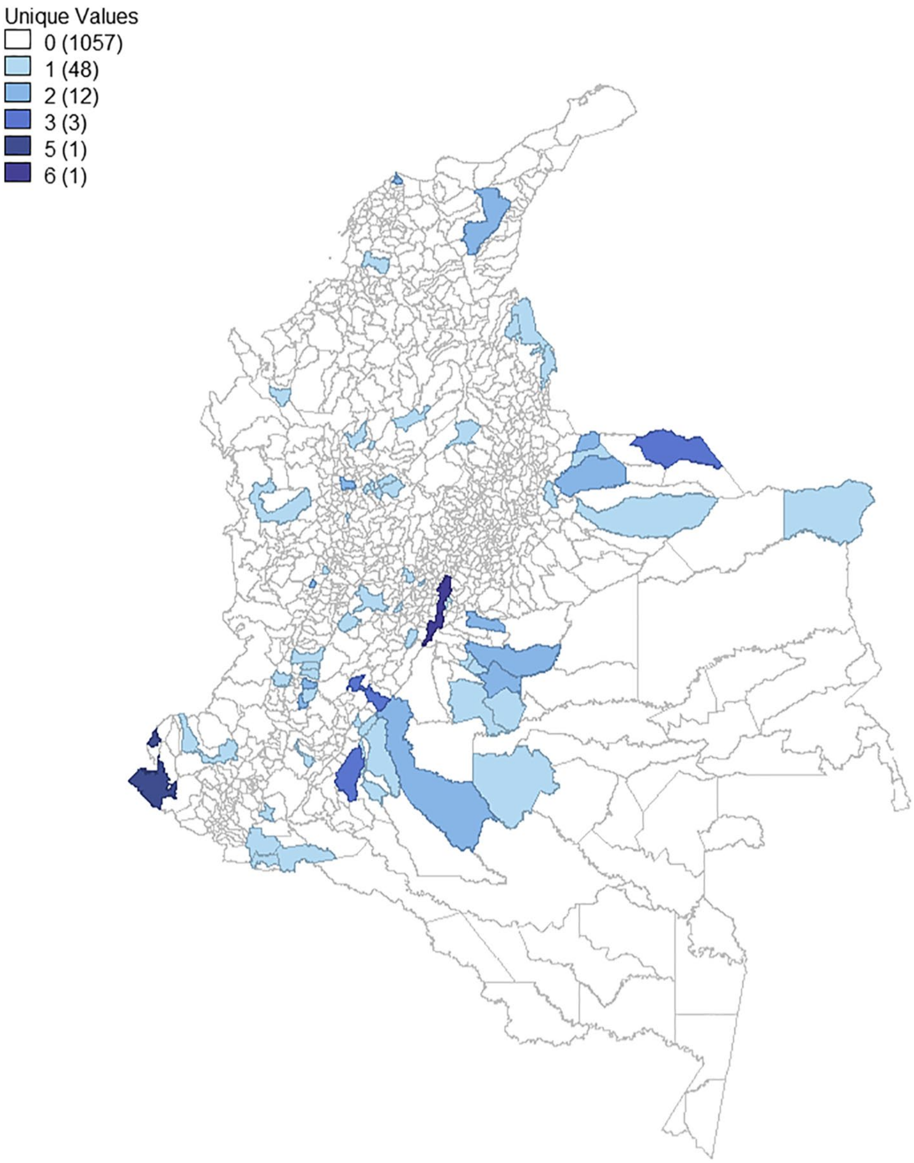

FIGURE 1 Violent attacks against civilians in Colombian municipalities (1999–2016). Number of attacks by municipality of occurrence between February 1999 and January 2016. Darker shades indicate a higher number of attacks

use rounds V to VII,[10] which account for live births between November 1999 and March 2016 (pregnancies starting in February 1999).

Demographic and Health Surveys include the children's weight at birth, the main measure of newborn health used here and in the literature to capture the overall fetal environment; other measures are underdeveloped and not widespread (Conti, 2013). The main limitation of DHS data is missing birthweight information[11]; results in the paper need to bear this data restriction in mind. I use neonatal mortality (death before the 28th day of life) as a complementary measure since this indicator also reflects the prenatal, birth and early neonatal conditions, with earlier deaths more closely associated with the pregnancy environment.[12]

The gestation period starts at conception and ends at birth. The beginning of the period is estimated by subtracting the pregnancy length[13] from the date of birth. Trimesters are calculated by sequentially adding 3-month intervals from the estimated conception date until birth.[14]

Of pregnancies ending in a live birth, 3.29% were exposed to a violent attack against civilians at any point during gestation, about 1% in each trimester, with a slightly higher share in the first one (1.31%) (Table 1). Most pregnancies were exposed once, less than 7% twice, and none more than this; hence, the analysis uses a dummy indicator of exposure.[15]

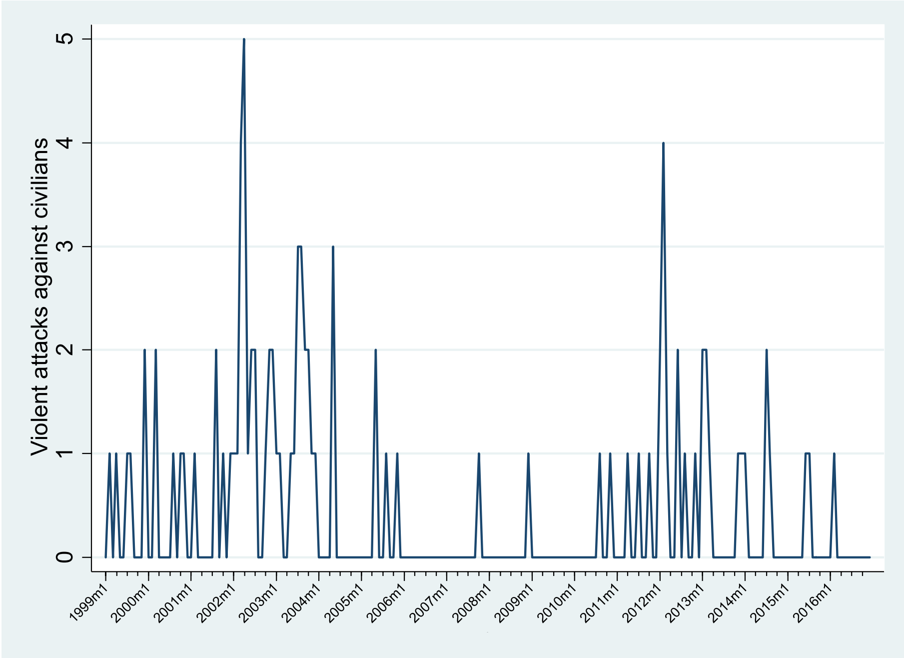

FIGURE 2 Violent attacks against civilians in Colombia by date of occurrence (1999–2016). Number of attacks by the month of occurrence between February 1999 and January 2016

TABLE 1 Exposure to violent attacks during gestation and by trimester

Trimester	% of pregnancies	Min	Max	Mean (when >0)	Standard deviation (when >0)
Any	3.29	0	2	1.07	0.25
1	1.31	0	2	1.03	0.18
2	1.08	0	2	1.01	0.12
3	1.03	0	2	1.02	0.16
N	27,183	-	-	-	-

Note: Share of births exposed to violent attacks against civilians in the municipality of residence of the mother during gestation and minimum/maximum of attacks experienced. Average number and standard deviation of attacks exposed to when the pregnancy was exposed to at least one attack. Sample of live births with reported birthweight.

4.3 | Specification

I exploit the geographic—by municipality—and temporal—by date of occurrence and gestational age—variation of attacks against civilians to identify the effect of violence on newborn health. Birthweight of child *i*, conceived at time (month-year) *t*, in municipality *m* is:

$$\begin{aligned} \text{bweight}_{i,m,t} &= \alpha + \beta_1 X^c_{i,m,t} + \beta_2 X^p_{i,m,t} + \beta_3 X^m_{m,t} + \delta_1 \text{violence}_{m,t+3} + \delta_2 \text{violence}_{m,t+6} \\ &+ \delta_3 \text{violence}_{m,t+9} + \delta_4 \text{previolence}_{m,t-36} + \gamma_{\text{year}} + \gamma_{\text{month}} + \gamma_m + \varepsilon_{i,m,t} \end{aligned} \tag{1}$$

The terms $\text{violence}_{m,t+j}$ ($j = 3, 6, 9$) represent the exposure in each trimester. Because pregnancies are typically viable from the 24th week of gestation, the last trimester could be absent.[16] To account for these early births, I interact exposure to violence in the third trimester with an indicator of the pregnancy reaching such term. This avoids assuming that these pregnancies had no exposure to violence in the trimester or correspond to events that occurred after birth.

$X^c_{i,m,t}$ and $X^p_{i,m,t}$ are vectors with standard child and mother/household characteristics known to affect newborn health: gender, parity, the birth interval from the previous live birth, multiple birth, skilled birth delivery, day of birth (before/after the 15th of the month), maternal years of education and disability prevalence, her age at birth, area of residence (urban, rural or rural disperse), and a measure of multidimensional poverty.[17] fixed-effects are included for time ($\gamma_{\text{year}}, \gamma_{\text{month}}$)[18] and municipality ($\gamma_m$).

The influence of municipal characteristics on health can be problematic. The concern is the correlation of violence with poverty, poor economic conditions and a weak local state (Collier & Hoeffler, 2004; Dube & Vargas, 2013; Fearon & Laitin, 2003; Miguel et al., 2004; Stewart, 2002), on the one hand, and with newborn health, on the other, for instance through lower state capacity to provide adequate health services[19] or via poor maternal nutrition (Amarante et al., 2016). Comparing municipalities where there was ever an attack against those that never experienced one (Appendix C in Supporting Information S1) shows a lack of significant differences in poverty (proxied by the share of unsatisfied basic needs [UBN]), fiscal performance, and basic health services for children (Diphtheria, Pertussis (whooping cough), and Tetanus [DPT] vaccination rate), but municipalities that experience attacks are larger, less rural and have fewer individuals receiving subsidized health insurance.[20] Because omitted variables can create endogeneity in municipal violence, these indicators are added as regression controls ($X^m_{i,m,t}$).[21] Nonetheless, the long span and high frequency of the data, which allows for variability in the exposure to violence during gestation and over time within municipalities, lessens the problem as potential municipal confounders would need to vary by trimester to bias the results. Following Valente (2015), I add a control for the cumulative attacks in each municipality 3 years before conception ($\text{previolence}_{i,m,t}$), which should capture any within-municipality time-trend in the occurrence of attacks; that is, any potential time-varying heterogeneity correlated with both changes in municipal violence over time, and birthweight. The sample excludes children whose mothers moved to the municipality of interview after conception.[22] Around 15% of cases are removed, although only less than 6% of the migrant mothers stated that they moved as a result of violence.[23]

5 | RESULTS

5.1 | Summary statistics

Across the three survey waves there are 37,500 births from mothers living in the municipality of interview since conception. Around 72.5% report the birthweight.[24] The average baby weighs 3.222 kg; girls are lighter than boys (Figure 3), by 110 g on average (Table 2). About 11.79% of babies are born with low birthweight.[25] Less than 1.0% of babies die within the first 28 days of life and the boys' rate of neonatal mortality is higher than the girls'. Unconditional means show that

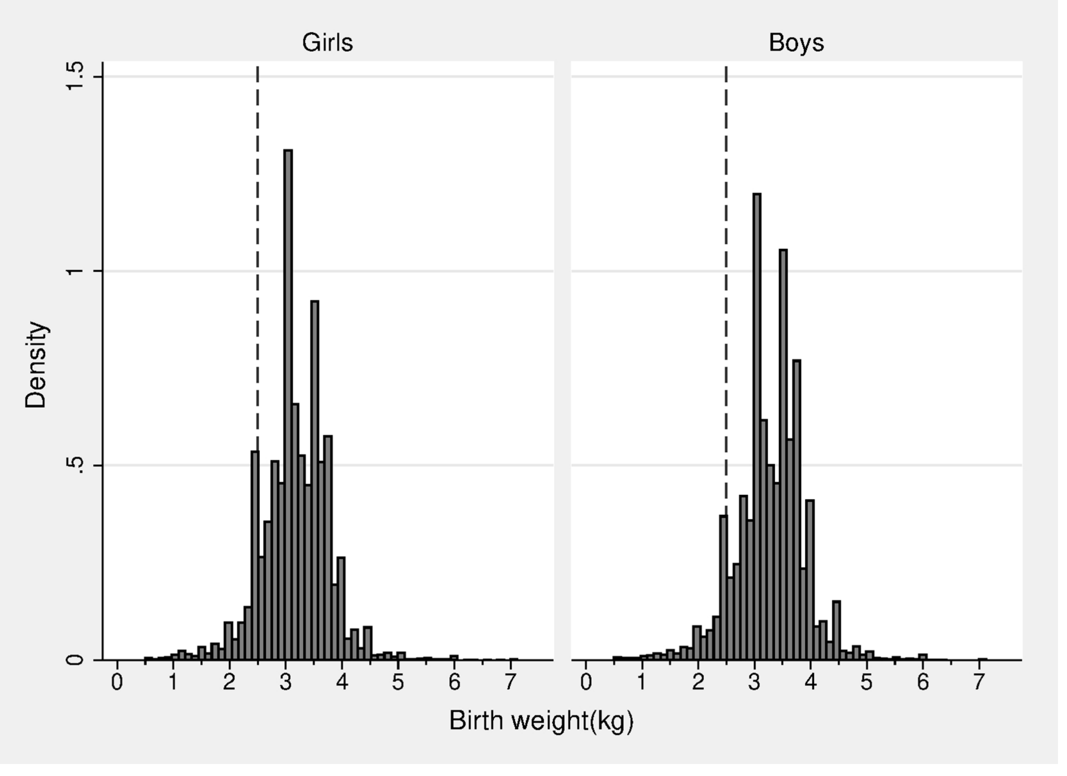

FIGURE 3 Birthweight distribution by gender. Dotted line at low birthweight threshold (2.5 kg)

TABLE 2 Summary statistics of newborn health outcomes (birthweight, low birthweight at <2.5 and ≤2.5 kg, and neonatal mortality) by the gender of the baby

	Birthweight (kg)	Low birthweight < 2.5 kg (%)	Low birthweight ≤ 2.5 kg (%)	Neonatal (% birthweight sample)	Neonatal (% full sample)
Girls					
Mean	3.17	8.92	13.22	0.48	0.94
SD	0.6	0.29	0.34	0.07	0.10
Boys					
Mean	3.28	7.46	10.43	0.64	1.27
SD	0.62	0.26	0.31	0.08	0.11
Total					
Mean	3.22	8.17	11.79	0.56	1.11
SD	0.61	0.27	0.32	0.07	0.10

Note: Samples are babies with birthweight report and from non-migrant mothers ($n = 27{,}183$), except in the last column which also includes live births without birthweight report ($n = 37{,}500$).

Abbreviation: SD, standard deviation.

TABLE 3 *T*-tests of newborn health outcomes by exposure to violence during gestation in girls and boys sub-samples

	Girls				Boys			
	Non-exposed	Exposed	Diff.	*t*-stat	Non-exposed	Exposed	Diff.	*t*-stat
Birthweight (kg)	3.169	3.077	0.092**	3.281	3.278	3.206	0.072*	2.359
Low birthweight (<2.5 kg)	8.734	13.859	−5.125***	−3.827	7.395	9.412	−2.017	−1.559
Low birthweight (≤2.5 kg)	13.050	17.910	−4.860**	−3.053	10.404	11.294	−0.890	−0.591
Neonatal mortality	0.462	0.853	−0.391	−1.207	0.643	0.471	0.173	0.440

*$p < 0.05$, **$p < 0.01$, and ***$p < 0.001$.

girls exposed to violence during gestation are on average 900 g lighter and more of them have low birthweight. There is no difference in low birthweight shares for boys, but the weight difference is about 700 g (Table 3).

There is almost parity in the sex ratio. A large percentage of births are the first for the woman (42%), reflecting the low fertility rate in Colombia (two births per woman in the latest DHS and below three births since the 1990s). Just 2% of births are multiple, and almost all (97%) are attended by doctors or nurses. Women are on average 26 years old when they give birth and have 9 years of education (completed primary but not full secondary). The majority of mothers, of girls and boys alike, have at least some primary education but no more than secondary (Table 4), although a small proportion of women (1.3%) have no education (Table C1 in Supporting Information S1). 6% of mothers had a disability, and they reported being in good health (a score of 2.9 out of 5). The average household multidimensional poverty score is 0.10.[26] Babies are born in municipalities with 38% of UBN, on average, and good municipal performance (3.2 out of 5). The provision of health services in these municipalities is good, with high coverage of social health insurance (84%) and DPT vaccination (85%).

5.2 | Violence and newborn health

The relationship between birthweight and exposure to a violence shock in each gestation trimester is in Table 5. The δ_1 coefficient in column 1 indicates an average decline in birthweight of 41 g for newborns exposed to an attack in utero in the first trimester, although only statistically significant close to the 10% confidence level. There is no apparent effect for exposure in the following trimesters. An insignificant male interaction coefficient (column 2) indicates no gender gap in the average effect.

The education of the mother strongly explains weight at birth in the base specification, and the interaction with the violence variable reveals that the negative effect of the shock varies with this characteristic (column 3).[27] The coefficient for the first trimester becomes statistically significant at the 1% level, indicating that newborns of non-educated mothers

TABLE 4 Mother's education completion level by the gender of the child

	% of women	
Education level	**Girls**	**Boys**
Primary or less	23.9	23.9
Secondary or less	55.0	54.9
More than secondary	21.1	21.1
Total women	13,235	13,948

TABLE 5 The effect of violence exposure during gestation (by exposure trimester) on birthweight

	Birthweight (kg)				
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Violence trimester 1 (δ_1)	−0.041	−0.061*	−0.159**	−0.037	−0.303*
	(0.027)	(0.027)	(0.055)	(0.096)	(0.151)
× boys	-	0.044	-	-	-
	-	(0.073)	-	-	
Violence trimester 2 (δ_2)	−0.025	−0.018	0.120	0.149	0.095
	(0.065)	(0.061)	(0.129)	(0.122)	(0.197)
× boys	-	−0.013	-	-	-
	-	(0.054)	-	-	-
Violence trimester 3 (δ_3)	0.014	0.022	−0.133	−0.103	−0.174
	(0.028)	(0.023)	(0.091)	(0.098)	(0.127)
× boys	-	−0.016	-	-	-
	-	(0.047)	-	-	-
Mother's education	0.005***	0.005***	0.005***	0.005***	0.004**
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
× violence trimester 1	-	-	0.012*	−0.003	0.029**
	-	-	(0.005)	(0.009)	(0.010)
× violence trimester 2	-	-	−0.015	−0.018	−0.014
	-	-	(0.012)	(0.013)	(0.017)
× violence trimester 3	-	-	0.015	0.011	0.019
	-	-	(0.009)	(0.010)	(0.011)
Gender sample	All	All	All	Girls	Boys
Municipal FE	Yes	Yes	Yes	Yes	Yes
Year and month FE	Yes	Yes	Yes	Yes	Yes
N	24,663	24,663	24,663	11,980	12,683
F-stat (interaction violence trim. 1)	-	3.267	4.130	3.853	7.959
F-stat (interaction violence trim. 2)	-	0.076	0.952	0.998	0.625
F-stat (interaction violence trim. 3)	-	0.446	2.098	2.271	1.282

Note: The dependent variable is birthweight (kg). Samples are live births with birthweight report excluding those from migrant mothers. δ_1, δ_2, and δ_3 are coefficients for exposure to a violent attack against civilians in the municipality of residence of the mother in the first, second, or third trimester of gestation. The last trimester ends at birth and the respective variable is interacted with an indicator for birth before the beginning of the trimester. Column 1 is the base specification. Column 2 includes an interaction with the gender of the child (boy = 1). Columns 3–6 present the effects of violence exposure in each trimester interacted with maternal years of education; in the last two columns, the results are for the subsamples of girls/boys. *F*-tests of joint significance of exposure to violence—in the first, second, or third trimester—and an indicator for boys (column 2) or maternal education (columns 3–6). All regressions include the full set of child (X_c), mother/household (X_p) and municipal (X_m) covariates. They also include municipal, year, and month FE. Standard errors clustered by municipality are in parentheses. FE, fixed effects.

*$p < 0.05$, **$p < 0.01$, and ***$p < 0.001$.

weigh 159 g less (about a quarter of a standard deviation) if exposed to a violent attack in the municipality. The interaction sign indicates a declining effect, with each additional year of education of the mother reducing the impact by 12 g. The other trimester coefficients and their interactions remain statistically insignificant.

Considering the sub-samples of boys and girls separately in the preferred model with the maternal education interaction reveals a negative impact of violence exposure in the first trimester for the boys only (columns 4 and 5). This effect is close to twice as large as the full sample effect, and the mitigating effect of the mother's education is 29 g per additional year of education. This is more clearly seen in Figure 4, which plots the estimated marginal effect for the children of women without any schooling, 5, 9, 11 and 16 years of education. For girls, the effect is small, mostly statistically insignificant and without much variation along maternal education. For boys, there is a large negative effect for the least educated mothers, albeit the sample size of this group is small, which falls quickly and toward zero for mothers with completed primary education.[28] Results in the Appendix D (Table D2 in Supporting Information S1) consider non-linearities in education by categorizing mothers into three groups: those with primary or less education, those with more than primary and up to secondary education, and those with higher education. The base coefficient for boys of mothers with primary education or less loses statistical significance, which means that the negative effects of violence exposure in the first trimester of gestation previously documented are concentrated among those whose mothers are at the lowest end of the education distribution. It also appears that children whose mothers have higher education are significantly less affected by violence exposure compared to those whose mothers have only primary or less education.

To consider the effect for babies with a greater risk of malnourishment and illness, I look at the effect on a critical point in the birthweight distribution (≤2.5 kg) (Table 6).[29] Violence exposure in the first trimester is positively associated with the likelihood of low birthweight when considering the heterogeneity with respect to the mothers' education. Heterogeneous effects are also driven by the boys' sub-sample and the lower end of the maternal education distribution. The

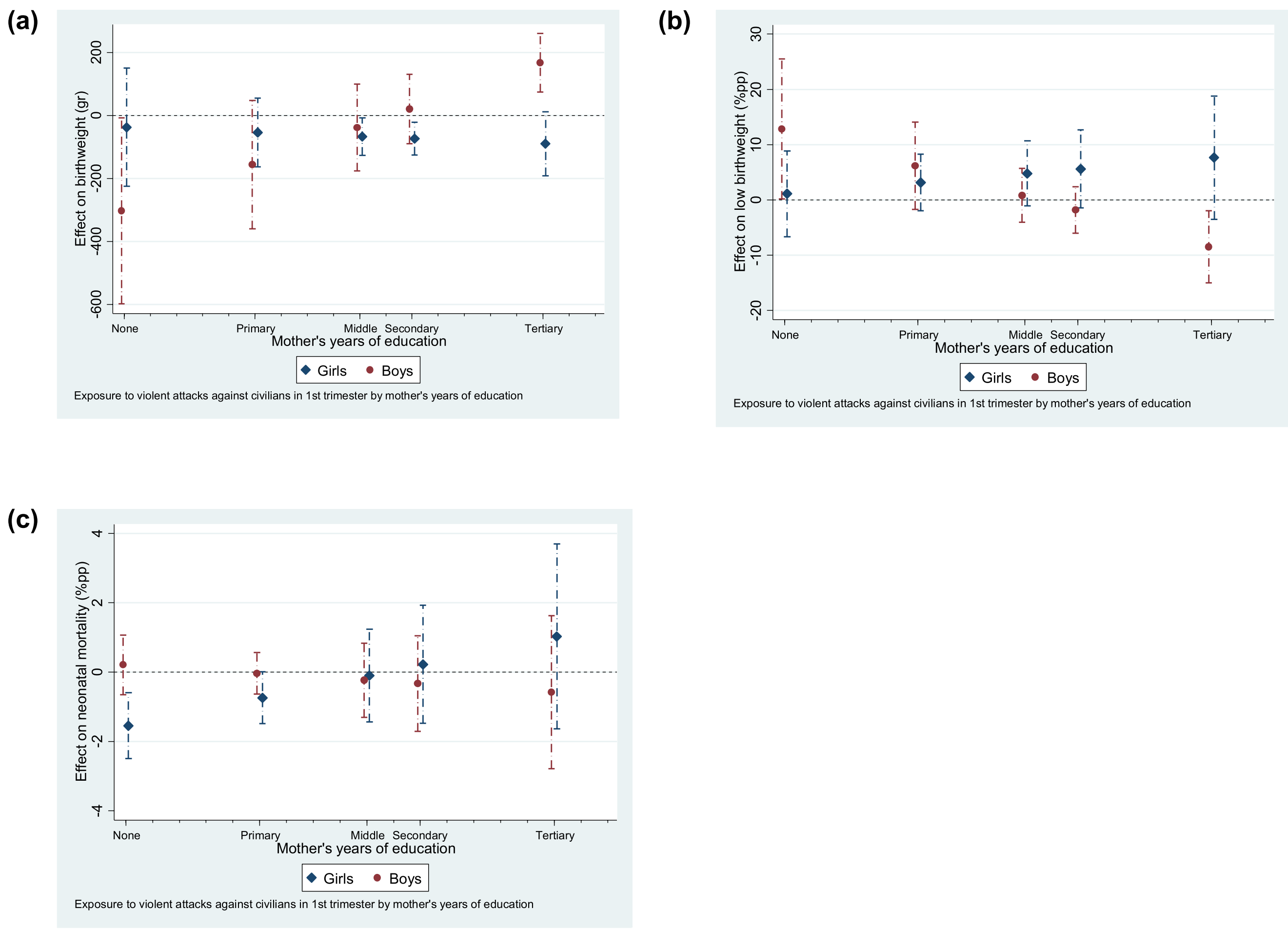

FIGURE 4 Effect of exposure to violence in the first trimester of gestation by mother's years of education on (a) birthweight, (b) low birthweight, and (c) neonatal mortality

TABLE 6 The effect of violence exposure during gestation by exposure trimester on low birthweight

	Low birthweight (≤2.5 kg)				
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Violence trimester 1 (δ_1)	0.025	0.055	0.074**	0.011	0.128*
	(0.025)	(0.034)	(0.028)	(0.040)	(0.065)
× boys	-	−0.065*	-	-	-
	-	(0.031)	-	-	-
Violence trimester 2 (δ_2)	0.034	0.047	−0.034	−0.044	−0.021
	(0.036)	(0.036)	(0.035)	(0.057)	(0.050)
× boys	-	−0.029	-	-	-
	-	(0.029)	-	-	-
Violence trimester 3 (δ_3)	−0.016	−0.017	0.09	0.136*	0.031
	(0.010)	(0.016)	(0.053)	(0.064)	(0.075)
× boys	-	0.00000	-	-	-
	-	(0.027)	-	-	-
Mother's education	−0.003***	−0.003***	−0.003**	−0.003***	−0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
× violence trimester 1	-	-	−0.005	0.004	−0.013*
	-	-	(0.004)	(0.005)	(0.005)
× violence trimester 2	-	-	0.007	0.009	0.005
	-	-	(0.005)	(0.008)	(0.005)
× violence trimester 3	-	-	−0.011*	−0.016**	−0.004
	-	-	(0.005)	(0.006)	(0.006)
Gender sample	All	All	All	Girls	Boys
Municipal FE	Yes	Yes	Yes	Yes	Yes
Year and month FE	Yes	Yes	Yes	Yes	Yes
N	24,663	24,663	24,663	11,980	12,683
F-stat (interaction violence trim. 1)	-	2.291	3.700	1.286	3.583
F-stat (interaction violence trim. 2)	-	1.142	1.077	0.898	0.503
F-stat (interaction violence trim. 3)	-	1.287	3.684	3.871	0.867

Note: The dependent variable is a dummy for low birthweight (≤2.5 kg). See other notes as in Table 5. FE, fixed effects.

added likelihood of being born with low birthweight for a boy of a low-educated mother exposed to violence in early pregnancy is 12.8 percentage points, falling by 1.3 percentage points for each additional year of education. For girls, there is no effect of exposure in the first trimester of gestation, but for the last one, there is a 13.6 percentage points increase in the likelihood of being born with low birthweight if their mothers have no education; this effect also falls by 1.7 percentage points for each additional year of maternal education. The models with non-linear mitigating effects of maternal education show that the main difference is between mothers with higher education, compared to those with primary or less.

Early exposure to violence seems to decrease the risk of neonatal mortality[30] for children of the lowest educated mothers and, on average, only for girls (Table 7).[31] The maternal education interaction coefficient is not statistically significant, but Figure 4 shows a small declining effect. This small effect on girls is unlikely to be a sign of a selection bias because an improvement in birthweight was not observed, and fetal mortality results (see below) neither support the hypothesis. Concerning a second trimester exposure to violence, a negative effect on neonatal mortality is seen for the lower end of maternal education. The impact is smaller and close to zero for boys, but the gender split shows that the increase in early life mortality associated with a second-trimester shock is driven by the girls' sub-sample and the lower end of the maternal education distribution (Figure 5) compared to those with secondary education (Table D2 in Supporting Information S1).[32] A shock in the last trimester has a similar effect, although not statistically significant.

TABLE 7 The effect of violence exposure during gestation by exposure trimester on neonatal mortality

	Neonatal mortality				
	(1)	(2)	(3)	(4)	(5)
Violence trimester 1 (δ_1)	−0.001	0.000	−0.008**	−0.015**	0.002
	(0.005)	(0.007)	(0.003)	(0.005)	(0.004)
× boys	-	−0.003	-	-	-
	-	(0.009)	-	-	-
Violence trimester 2 (δ_2)	0.001	0.010	0.039*	0.069*	0.004
	(0.004)	(0.007)	(0.017)	(0.032)	(0.006)
× boys	-	−0.019*	-	-	-
	-	(0.008)	-	-	-
Violence trimester 3 (δ_3)	0.003	0.003	0.019	0.024	0.009
	(0.007)	(0.008)	(0.018)	(0.033)	(0.006)
× boys	-	0.000	-	-	-
	-	(0.012)	-	-	-
Mother's education	0.001***	0.001***	0.001***	0.001***	0.001***
	0.000	0.000	0.000	0.000	0.000
× violence trimester 1	-	-	0.001	0.002	0.000
	-	-	(0.001)	(0.001)	(0.001)
× violence trimester 2	-	-	−0.004**	−0.006*	−0.001*
	-	-	(0.001)	(0.003)	(0.001)
× violence trimester 3	-	-	−0.002	−0.002	0.000
	-	-	(0.001)	(0.003)	(0.001)
Gender sample	All	All	All	Girls	Boys
Municipal FE	Yes	Yes	Yes	Yes	Yes
Year and month FE	Yes	Yes	Yes	Yes	Yes
N	23,698	23,698	23,698	11,491	12,207
F-stat (interaction violence trim. 1)	-	0.122	4.145	5.560	0.157
F-stat (interaction violence trim. 2)	-	10.370	5.573	2.527	7.806
F-stat (interaction violence trim. 3)	-	0.083	1.385	5.084	0.877

Note: The dependent variable is an indicator for neonatal mortality (dying before the 28th day of life). Samples are live births with birthweight report excluding births from migrant mothers and babies born less than 28 days before the interview date. See other notes as in Table 5. FE, fixed effects.

5.3 | Robustness

Robustness specifications for birthweight and by gender are in Table 8.[33] Since gestational length is negatively associated with in utero shocks, births not exposed to violence can mechanically have higher birthweight because of the longer gestational length (Matsumoto, 2018). An alternative specification using the expected date of birth at full term (Matsumoto, 2018)[34] addresses this concern. Results do not differ from the primary analysis in sign nor magnitude (column A).

The conception date can be misestimated or the effect of events happening soon before conception can linger. Coefficients for events occurring in the trimester before conception (column B), and after birth, as a falsification test (column C), are statistically insignificant, and conclusions concerning the effect of first-trimester exposure still hold.

While most potential coincident municipal shocks are unlikely to vary with such high frequency, it is still possible that an attack triggers other shocks that affect newborns. Health infrastructure destruction can disrupt health services, but in Colombia, this infrastructure has largely been spared from damage and the likelihood of giving birth in a hospital attended by skilled personnel was shown to not be lower for births exposed to violence. Another possibility is that local economic conditions deteriorate in the aftermath of an attack. Adding controls for unemployment and participation rates in the department (a higher administrative unit) results in a slightly higher coefficient for the boys' first-trimester estimate (column D).[35]

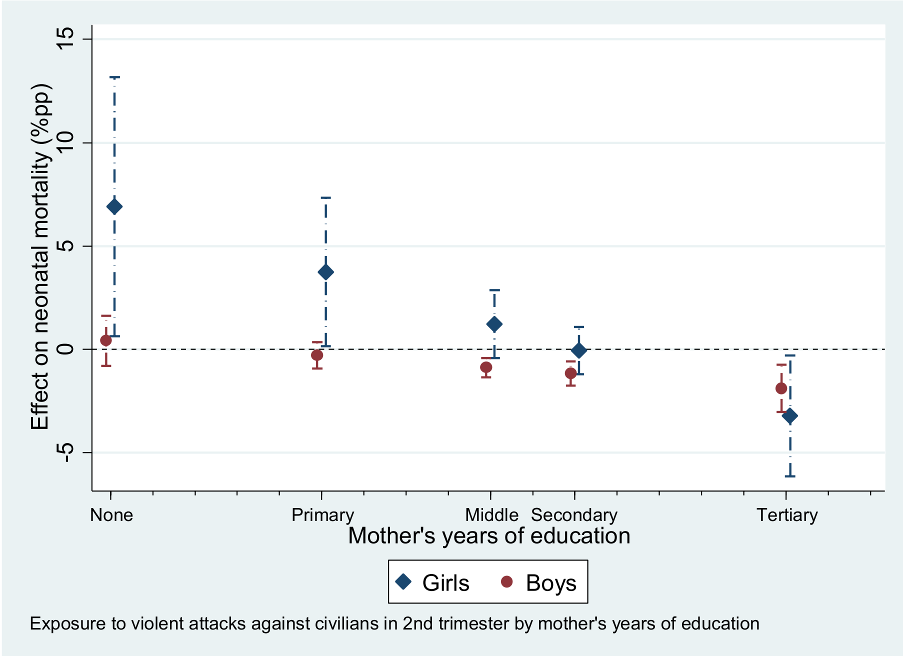

FIGURE 5 Effect of exposure to violence in the second trimester by mother's years of education on neonatal mortality

Impacts may spill over municipal borders. Coefficients for attacks in neighboring municipalities (column E) are insignificant or weak and small, overall suggesting that the effect of violence is contained within the municipality of residence.

Replacing time fixed-effects with unique identifiers for each year-month combination (column F) does not change the conclusions regarding the first-trimester coefficient, the mitigating education effect, or the gender differences.

Column G includes proxies for maternal health problems, nutrition, and domestic violence experience during pregnancy. Although adding these makes the first-trimester boys' coefficient statistically insignificant, it retains a similar magnitude as in the base results, and the low birthweight coefficient gains statistical significance. Thus, the conclusions reached so far hold, suggesting that the stress effect exists even after controlling for the nutrition and disease environment[36] and is not mediated by increased domestic violence resulting from the conflict.

Because multiple-pregnancy babies weigh less, removing them (column H) reduces the size of the coefficient and the estimate's precision, which is now significant only at the 10% level, but without altering the qualitative results. This is unsurprising because the intrauterine environment is more restricted than for singletons, so any shock is expected to be felt stronger by the multiple-pregnancy babies.

5.4 | Migration, mortality, and fertility

Selection issues can arise from migration, mortality and fertility changes. In the first case, excluding cases from mothers who arrived in the municipality after becoming pregnant discounts inward migration. But violence could trigger mass exodus. If migrants are direct victims, they could be more heavily affected by violence, but they could also be more educated, healthier or wealthier to have the capacity and resources to move. In the absence of information from women who left the municipalities surveyed,[37] a robustness specification excludes cases from 66 municipalities with a high displacement expulsion rate in any given year.[38] The sign, magnitude and statistical significance of the first-trimester coefficient remain similar, suggesting that births in these areas do not drive the results (Table 9).

I present a model using terminations as a dependent variable to check for increases in fetal mortality.[39] Because terminations mostly happen early in gestation,[40] indicators of exposure to violence in the last two trimesters are interacted with dummies for whether the pregnancy reached that stage. Results also include the alternative method using the expected full-length trimesters and a mother fixed-effects model, which is possible with the larger number of cases per woman. There is no significant effect of violence exposure in the first trimester on the likelihood of a terminated pregnancy in

TABLE 8 Robustness: The effect of violence exposure during gestation by exposure trimester on birthweight

Birthweight (kg)																
Model:	**A**		**B**		**C**		**D**		**E**		**F**		**G**		**H**	
Violence trimester 1 (δ_1)	−0.060	−0.288	−0.039	−0.306*	−0.036	−0.304*	−0.013	−0.341*	0.053	−0.032	−0.030	−0.310*	−0.046	−0.316	0.052	−0.292
	(0.095)	(0.153)	(0.095)	(0.152)	(0.099)	(0.150)	(0.087)	(0.162)	(0.082)	(0.146)	(0.083)	(0.154)	(0.088)	(0.168)	(0.072)	(0.149)
Violence trimester 2 (δ_2)	0.152	0.133	0.147	0.091	0.149	0.095	0.126	−0.061	0.101	0.152	0.156	0.100	0.114	0.085	0.193	0.130
	(0.124)	(0.191)	(0.123)	(0.198)	(0.122)	(0.197)	(0.106)	(0.131)	(0.094)	(0.144)	(0.126)	(0.200)	(0.140)	(0.233)	(0.126)	(0.212)
Violence trimester 3 (δ_3)	−0.040	−0.301	−0.100	−0.175	−0.104	−0.176	−0.027	−0.088	−0.236*	−0.105	−0.116	−0.195	−0.134	−0.314	−0.074	−0.178
	(0.100)	(0.160)	(0.098)	(0.127)	(0.098)	(0.128)	(0.097)	(0.094)	(0.099)	(0.123)	(0.099)	(0.127)	(0.175)	(0.162)	(0.095)	(0.130)
Violence trimester 0 (δ0)/ Violence trimester 4 (δ4)	-	-	−0.050	0.008	−0.009	−0.021	-	-	-	-	-	-	-	-	-	-
	-	-	(0.028)	(0.035)	(0.064)	(0.041)	-	-	-	-	-	-	-	-	-	-
Mother's education	0.004**	0.004*	0.005**	0.004**	0.005***	0.004**	0.005*	0.004*	0.005**	0.005**	0.005**	0.005*	0.007***	0.003	0.006***	0.005**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
× violence trimester 1	0.000	0.026*	−0.003	0.030**	−0.003	0.029**	−0.005	0.036**	−0.010	0.003	−0.005	0.030**	−0.005	0.029**	−0.011	0.029**
	(0.008)	(0.012)	(0.009)	(0.010)	(0.009)	(0.010)	(0.008)	(0.011)	(0.007)	(0.013)	(0.008)	(0.011)	(0.008)	(0.011)	(0.007)	(0.010)
× violence trimester 2	−0.019	−0.020	−0.018	−0.014	−0.018	−0.014	−0.020	0.000	−0.010	−0.018	−0.017	−0.015	−0.015	−0.012	−0.022	−0.017
	(0.013)	(0.017)	(0.013)	(0.017)	(0.013)	(0.017)	(0.013)	(0.013)	(0.011)	(0.013)	(0.013)	(0.017)	(0.016)	(0.020)	(0.014)	(0.018)
× violence trimester 3	−0.005	0.028*	0.011	0.019	0.011	0.019	0.004	0.014	0.025**	0.014	0.012	0.019	0.011	0.030*	0.007	0.020
	(0.011)	(0.014)	(0.010)	(0.011)	(0.010)	(0.011)	(0.010)	(0.008)	(0.009)	(0.011)	(0.009)	(0.011)	(0.017)	(0.014)	(0.009)	(0.011)
Gender sample	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys
Municipal FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year and month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Pre-violence	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
N	11,980	12,683	11,980	12,683	11,980	12,683	8894	9453	11,980	12,683	11,980	12,683	9897	10,454	11,765	12,482

Note: Dependent variable is birthweight. Samples are live births with birthweight report excluding those from migrant mothers. δ_1, δ_2, and δ_3 are coefficients for exposure to a violent attack in the first, second, or third trimester of gestation; the third trimester ends at birth except in model A where it ends at the expected date of birth. δ_0 and δ_4 refer to exposure in the trimester before conception and after birth, respectively. All regressions include the full set of child (X_c), mother/household (X_p) and municipal (X_m) covariates. They also include municipal, year, and month FE except in *F* where the last two are replaced with year–month FE. Standard errors clustered by municipality are in parentheses, except in model D where standard errors are clustered by department. For each model, the results are for the sub-samples of girls or boys. Models are as follows: A—Using expected DoB as pregnancy end. B—Including attacks occurring in the trimester before conception (δ_0). C—Including attacks occurring in the trimester after birth (δ_4). D—Including department unemployment and employment participation rates. E—Including attacks in neighboring municipalities. F—Including year-month FE. G—Including nutrition supplements, mother's subjective health, and hospitalization during pregnancy. H—Excluding multiple births. FE, fixed effects.

*$p < 0.05$, **$p < 0.01$, and ***$p < 0.001$.

TABLE 9 Robustness excluding municipalities with high IDP: Effects of exposure to violence by trimester of gestation on birthweight, low birthweight, and neonatal mortality

	Birthweight (kg)		Low birthweight (≤2.5 kg)		Neonatal mortality	
Dep var:	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Violence trimester 1 (δ_1)	−0.037	−0.155**	0.023	0.074*	−0.001	−0.007*
	(0.027)	(0.057)	(0.025)	(0.029)	(0.005)	(0.003)
Violence trimester 2 (δ_2)	−0.016	0.109	0.027	−0.026	0.001	0.039*
	(0.067)	(0.129)	(0.038)	(0.032)	(0.004)	(0.017)
Violence trimester 3 (δ_3)	0.024	−0.135	−0.022*	0.076	0.003	0.022
	(0.025)	(0.095)	(0.010)	(0.051)	(0.007)	(0.019)
Mother's education	0.005***	0.005***	−0.003***	−0.003**	0.001***	0.001***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
× violence trimester 1	-	0.012*	-	−0.005	-	0.001
	-	(0.005)	-	(0.004)	-	(0.001)
× violence trimester 2	-	−0.013	-	0.006	-	−0.004**
	-	(0.012)	-	(0.005)	-	(0.001)
× violence trimester 3	-	0.016	-	−0.010*	-	−0.002
	-	(0.009)	-	(0.005)	-	(0.002)
Gender sample	All	All	All	All	All	All
Municipal FE	Yes	Yes	Yes	Yes	Yes	Yes
Year and month FE	Yes	Yes	Yes	Yes	Yes	Yes
N	23,317	23,317	23,317	23,317	22,413	22,413

Note: Dependent variables are birthweight (kg), a dummy for low birthweight (≤2.5 kg), or an indicator for neonatal mortality (dying before the 28th day of life). Samples are live births with birthweight report excluding those from migrant mothers and excluding babies born less than 28 days before the interview date (for neonatal mortality). All samples also exclude cases in municipalities with high IDP expulsion rate. δ_1, δ_2, and δ_3 are coefficients for exposure to a violent attack against civilians in the municipality of residence of the mother in the first, second, or third trimester of gestation; the third trimester ends at birth. For each outcome, the second specification includes an interaction with maternal years of education. All regressions include the full set of child (X_c), mother/household (X_p), and municipal (X_m) covariates. They also include municipal, year, and month FE. Standard errors clustered by municipality are in parentheses. FE, fixed effects; IDP, internally displaced people.

*$p < 0.05$, **$p < 0.01$, and ***$p < 0.001$.

neither specification (Table 10). The second-trimester coefficient is negative but statistically weak and not always significant. Fetal mortality could be gender-specific, particularly affecting boys. Although the coefficient of first trimester exposure to violence in a regression of the gender ratio at birth is not statistically significant (columns 6 and 7), it is negative and large. However, exposure in the third trimester leads to a large reduction in the probability of having a boy and such reduction decreases with maternal education. This suggests that there might be some trimming of the live birth sample from the weakest boys occurring with exposure to violence in late gestation.

Violence could trigger fertility changes, and worse health among newborns could be observed because of this compositional change in who becomes a parent. It is, however, unlikely that parents predict and alter their fertility behavior in response to high-frequency variations in violence (Valente, 2015), especially with an unpredictable shock such as violent attacks against civilians. Also, the time fixed-effects in the regressions already control for trends and seasonal fertility variations, and the vector of mother characteristics captures some of this selection. Still, I assess the characteristics of the mothers exposed to violence before and during pregnancy to check for a compositional effect based on observables.

In a regression framework,[41] there is no sign of an important difference between women exposed to violence while pregnant or in the previous 9 months and those not exposed.[42] They are not older, less educated, nor come from poorer households (Table 11).[43]

Women are also asked whether the pregnancy was intended (wanted to get pregnant when they did), inconvenient (wanted it later), or unintended (did not want more children). Separating the analysis by the gender of the child, we see a change in fertility preferences driven by an increase in the stated desirability (vs. inconvenient or unintended) for boys' pregnancies by women exposed to a violence event 6–9 months before conception.

TABLE 10 Effects of exposure to violence by trimester of gestation on fetal mortality and gender at birth

	Termination					Boy			
Dep var:	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Violence trimester 1 (δ_1)	0.006	−0.022	0.006	−0.018	0.004	−0.033	−0.098	−0.033	−0.100
	(0.008)	(0.017)	(0.019)	(0.018)	(0.053)	(0.039)	(0.100)	(0.039)	(0.100)
Violence trimester 2 (δ_2)	−0.015*	0.000	−0.033	−0.016	−0.052	−0.031	0.046	−0.032	0.046
	(0.006)	(0.004)	(0.020)	(0.018)	(0.029)	(0.028)	(0.062)	(0.029)	(0.062)
Violence trimester 3 (δ_3)	0.004	−0.011***	0.012	0.022	−0.036	−0.023	−0.171**	−0.040	−0.176**
	(0.005)	(0.003)	(0.020)	(0.021)	(0.076)	(0.024)	(0.062)	(0.023)	(0.055)
Mother's education	−0.001***	−0.001***	-	0.002**	0.002**	0.001	0.000	0.001	0.000
	(0.000)	(0.000)	-	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
× violence trimester 1	-	0.003*	-	-	−0.002	-	0.007	-	0.007
	-	(0.001)	-	-	(0.005)	-	(0.007)	-	(0.007)
× violence trimester 2	-	−0.002*	-	-	0.004	-	−0.008	-	−0.008
	-	(0.001)	-	-	(0.002)	-	(0.006)	-	(0.006)
× violence trimester 3	-	0.002*	-	-	0.006	-	0.015*	-	0.014*
	-	(0.001)	-	-	(0.009)	-	(0.007)	-	(0.006)
Municipal FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year and month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother FE	No	No	Yes	No	No	No	No	No	No
N	35,771	35,771	12,810	35,771	35,771	24,663	24,663	24,663	24,663

Note: Dependent variables are terminations (pregnancies that do not end in a live birth) and gender at birth (boy = 1). For terminations, samples are pregnancies excluding those from migrant women. For gender at birth (boy), samples are live births with birthweight report excluding those from migrant mothers. δ_1, δ_2, and δ_3 are the coefficients for exposure to a violent attack against civilians in the municipality of residence of the mother in the first, second, and third trimester of gestation, respectively. In columns 1, 2 and 6, 7, the third trimester ends at birth; in columns 4, 5 and 8, 9, it ends at the expected date of birth at full term. Specifications without interactions are in columns 1, 3, 4 and 6, 8. Specifications in columns 2, 5 and 7, 9 include interaction with maternal years of education. Regressions include full set of child (X_c), mother (X_p), and municipal (X_m) covariates except for terminations, which do not include gender, multiple birth nor skilled delivery indicators. They also include municipal, year, and month FE. Specification in column 2 includes mother fixed-effects. Standard errors clustered by municipality are in parentheses. FE, fixed effects.

*$p < 0.05$, **$p < 0.01$, and ***$p < 0.001$.

5.5 | Behaviors during pregnancy

Behaviors during pregnancy can be affected by violence exposure. Following Currie et al.'s (2018), I construct an index comprised of four indicators captured from survey responses by pregnant women: smoking, drinking alcohol, (not) attending the minimum recommended prenatal care visits (eight per WHO guideline), and (not) receiving a tetanus vaccine. The index is an equally weighted average of the standardized behaviors.[44]

The discussion focuses on the results including the interaction with maternal education, since this was found to be a relevant heterogeneity in the main analysis, and it is an important known source of differences in parental investments in child health (Rosenzweig & Schultz, 1982). Exposure to violence in the second trimester is associated with increased adverse maternal behaviors during pregnancy (Table 12). The negative coefficient of the maternal education variable and the interaction with exposure to violence indicate that more educated mothers incur less on these behaviors on average and when exposed violence during pregnancy. Separating by the gender of the baby, the effect of violence exposure on the behaviors index is only present for girls. There is an increase in these behaviors for mothers of girls exposed to a violent attack against civilians in the first and the second trimester and a smaller decrease if exposed in the last trimester.

These results are driven by the increased likelihood of drinking and decreased antenatal care and likelihood of receiving a tetanus vaccination for women—particularly the least educated—exposed to violence in the first and second trimesters (individual variable results in Appendix D of Supporting Information S1). The case of tetanus vaccination is interesting because it does not directly improve the prenatal environment. Instead, its positive effect is indirect, perhaps indicating a complementarity with other parental prenatal investments. In other words, the effect on this indicator could be pointing to the desire of parents to make other unobserved investments in the child's health (Mwabu, 2008).[45]

TABLE 11 The effect of violence exposure during and before pregnancy on mothers' characteristics and pregnancy intention

Dep var:	Years of education (1)	≤Primary (2)	≤Lower sec. (3)	≤Secondary (4)	≤College (5)	Age at birth (6)	Disability (7)	MPI (8)	Wealth (9)	Intended (10)	Intended (11)
A. 9 months before pregnancy ($\delta - 9$)											
Violence pregnancy (δ)	−0.016	0.011	−0.019	0.001	−0.001	−0.190	0.006	0.002	−0.038	0.0004	−0.020
	(0.209)	(0.014)	(0.022)	(0.025)	(0.025)	(0.257)	(0.007)	(0.004)	(0.064)	(0.028)	(0.025)
Violence pre-pregnancy (δ_{-9})	−0.161	0.023	0.010	0.000	−0.000	−0.028	0.007	−0.004	−0.015	−0.014	0.0005
	(0.226)	(0.017)	(0.023)	(0.021)	(0.021)	(0.161)	(0.008)	(0.003)	(0.057)	(0.018)	(0.034)
B. Three trimesters before pregnancy ($\delta - 1, \delta - 2, \delta - 3$)											
Violence pregnancy (δ)	−0.019	0.012	−0.019	0.001	−0.001	−0.195	0.006	0.002	−0.039	−0.001	−0.021
	(0.215)	(0.014)	(0.022)	(0.025)	(0.025)	(0.255)	(0.007)	(0.004)	(0.067)	(0.029)	(0.025)
Violence pre-pregnancy (δ_{-1})	−0.199	0.015	−0.002	0.008	−0.008	0.096	−0.014**	−0.000	−0.067	0.011	−0.009
	(0.227)	(0.017)	(0.028)	(0.023)	(0.023)	(0.297)	(0.005)	(0.005)	(0.090)	(0.031)	(0.030)
Violence pre-pregnancy (δ_{-2})	0.118	0.018	−0.010	−0.008	0.008	−0.118	0.022	−0.003	0.033	−0.011	−0.070
	(0.166)	(0.016)	(0.017)	(0.023)	(0.023)	(0.390)	(0.013)	(0.004)	(0.054)	(0.022)	(0.070)
Violence pre-pregnancy (δ_{-3})	−0.175	0.015	0.029	−0.008	0.008	0.248	0.008	−0.003	−0.059	0.045	0.077***
	(0.354)	(0.035)	(0.038)	(0.028)	(0.028)	(0.256)	(0.010)	(0.005)	(0.046)	(0.042)	(0.018)
Gender sample	All	All	All	All	All	All	All	All	All	Girls	Boys
Municipal FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year and month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	24,663	24,663	24,663	24,663	24,663	24,663	24,663	24,663	24,663	11,980	12,683

Note: Dependent variables are indicators of mother's education completion, age at birth, disability, household MPI and wealth, and stated pregnancy intention (wanted to get pregnant at the time vs. wanted to get pregnant but at a later time or did not want to have any more children when got pregnant). Estimations for pregnancy intention are presented for sub-samples of girls/boys. Samples are women who had a live birth in 5 years prior to the survey and for which the birthweight was reported, excluding migrant mothers. δ is the coefficient for exposure to a violent attack against civilians in the municipality of residence of the mother during pregnancy. In panel A, δ_{-9} is the coefficient for exposure in the 9 months before pregnancy; in panel B, the coefficients for exposure in the three trimesters before pregnancy are δ_{-1}, δ_{-2}, and δ_{-3}. Regressions include full set of child (X_c) and municipal (X_m) covariates and the woman's age at birth (except in column 6). They also include municipal, year, and month FE. Standard errors clustered by municipality are in parentheses. FE, fixed effects.

Abbreviation: MPI, Multidimensional Poverty Index.

*$p < 0.05$, **$p < 0.01$, and ***$p < 0.001$.

TABLE 12 The effect of violence exposure during gestation by trimester of exposure on maternal behaviors during pregnancy

	Behaviors index			
	(1)	**(2)**	**(3)**	**(4)**
Violence trimester 1 (δ_1)	0.088**	0.161	0.225**	0.077
	(0.028)	(0.092)	(0.071)	(0.161)
Violence trimester 2 (δ_2)	0.125***	0.367***	0.517**	0.163
	(0.032)	(0.096)	(0.191)	(0.137)
Violence trimester 3 (δ_3)	0.045	−0.046	−0.192**	0.132
	(0.031)	(0.120)	(0.069)	(0.234)
Mother's education	−0.020***	−0.019***	−0.018***	−0.020***
	(0.001)	(0.001)	(0.002)	(0.002)
× violence trimester 1	-	−0.007	−0.017*	0.003
	-	(0.009)	(0.007)	(0.015)
× violence trimester 2	-	−0.026**	−0.039*	−0.007
	-	(0.008)	(0.016)	(0.013)
× violence trimester 3	-	0.009	0.025**	−0.009
	-	(0.010)	(0.008)	(0.018)
Gender sample	All	All	Girls	Boys
Municipal FE	Yes	Yes	Yes	Yes
Year and month FE	Yes	Yes	Yes	Yes
N	21,424	21,424	10,412	11,012
F-stat (interaction violence trim. 1)	-	5.611	5.436	2.465
F-stat (interaction violence trim. 2)	-	8.484	4.212	1.767
F-stat (interaction violence trim. 3)	-	2.301	3.661	0.477

Note: Dependent variable is a composite index of mother's behaviors during pregnancy; it is comprised of indicators of smoking, drinking alcohol, (non-attendance to) prenatal care visits, and (lack of) tetanus immunization during pregnancy. Samples are live births with birthweight report excluding those from migrant mothers. δ_1, δ_2, and δ_3 are the coefficients for exposure to a violent attack against civilians in the municipality of residence of the mother in the first, second, or third trimester of gestation; the third trimester ends at birth. Main effects without interactions are in column 1. Specifications in remaining columns include interaction with maternal years of education. *F*-tests of joint significance of exposure to violence—in the first, second, or third trimester—and maternal education. For each dependent variable, specifications in the last two columns are for sub-samples of girls/boys. All regressions include the full set of child (X_c), mother/household (X_p), and municipal (X_m) covariates. They also include municipal, year, and month FE. Standard errors clustered by municipality are in parentheses. FE, fixed effects.

*$p < 0.05$, **$p < 0.01$, and ***$p < 0.001$.

Even though the survey data regarding these behaviors has limitations, primarily the prevalence of the behaviors before conception and the timing during the pregnancy are not known,[46] the results are suggestive of changes in a negative direction in maternal behaviors important for newborn outcomes, particularly for the mothers of baby girls. Potential explanations are beyond the data analysis but emerge from the literature. Parents may respond differently to shocks depending on the gender of the baby, for example, if they knew that male fetuses are more vulnerable and need more protection (Bharadwaj & Lakdawala, 2013), or if they held skewed gender preferences leading them to invest more in the human capital of their preferred children (e.g., Do & Phung, 2010). Hence, it would be possible that, as the behaviors reflect investments in newborn health, the results are indicating biased gender preferences held by parents. This would be hard to corroborate, not least because, to my knowledge, there is no systematic evidence of boy preference in Colombia to substantiate the claim easily. Although DHS lacks information to know if these changes occurred before or after knowing the gender of the baby, it is likely, as most of the changes were associated with exposure to violence in the later stages of pregnancy, when the gender of the fetus is mostly known.[47]

Finally, Table 13 incorporates the maternal behaviors index as an explanatory variable in the birth outcomes regressions. These behaviors have a negative impact on birth outcomes, lowering birthweight and increasing the chances of dying in early life,[48] but the impact of violence exposure during pregnancy does not disappear with this introduction, leaving the main results presented earlier in the paper qualitatively and quantitatively comparable. This suggests

TABLE 13 The effect of violence exposure during gestation by trimester of exposure on birth outcomes, controlling for maternal behaviors during pregnancy

	Birthweight (kg)			Low birthweight (≤2.5 kg)			Neonatal mortality		
Dep var:	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Violence trimester 1 (δ_1)	−0.158*	−0.027	−0.329*	0.079*	0.012	0.148*	−0.006*	−0.009**	−0.000
	(0.068)	(0.087)	(0.163)	(0.034)	(0.042)	(0.067)	(0.003)	(0.004)	(0.004)
Violence trimester 2 (δ_2)	0.112	0.129	0.096	−0.021	−0.005	−0.035	0.028	0.051	0.001
	(0.142)	(0.139)	(0.228)	(0.035)	(0.081)	(0.049)	(0.016)	(0.030)	(0.006)
Violence trimester 3 (δ_3)	−0.204	−0.121	−0.309	0.128	0.167	0.086	0.000	−0.007	0.005
	(0.142)	(0.171)	(0.165)	(0.081)	(0.109)	(0.094)	(0.003)	(0.007)	(0.005)
Behaviors index	−0.066***	−0.057***	−0.076***	0.031***	0.031***	0.031***	0.002	0.003	0.000
	(0.008)	(0.011)	(0.011)	(0.004)	(0.006)	(0.006)	(0.001)	(0.002)	(0.001)
Mother's education	0.003*	0.005**	0.002	−0.002*	−0.003**	−0.001	0.001***	0.001***	0.001**
	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
× violence trimester 1	0.011*	−0.006	0.032**	−0.005	0.005	−0.015**	0.001	0.001	0.000
	(0.005)	(0.008)	(0.011)	(0.004)	(0.005)	(0.006)	(0.001)	(0.001)	(0.001)
× violence trimester 2	−0.014	−0.016	−0.012	0.006	0.005	0.006	−0.003	−0.005	−0.001
	(0.014)	(0.016)	(0.020)	(0.006)	(0.010)	(0.005)	(0.002)	(0.003)	(0.001)
× violence trimester 3	0.018	0.009	0.029*	−0.013	−0.016	−0.008	−0.000	0.000	−0.001*
	(0.012)	(0.016)	(0.014)	(0.007)	(0.010)	(0.008)	(0.000)	(0.001)	(0.000)
Gender sample	All	Girls	Boys	All	Girls	Boys	All	Girls	Boys
Municipal FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year and month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	21,424	10,412	11,012	21,424	10,412	11,012	20,525	9951	10,574

Note: Dependent variables are birthweight (kg), a dummy for low birthweight (≤2.5 kg), or an indicator for neonatal mortality (dying before the 28th day of life). Samples are live births with birthweight report excluding those from migrant mothers and excluding babies born less than 28 days before the interview date (for neonatal mortality). δ_1, δ_2, and δ_3 are the coefficients for exposure to a violent attack against civilians in the municipality of residence of the mother in the first, second, or third trimester of gestation; the third trimester ends at birth. For each outcome variable, the specifications in the last two columns are for sub-samples of girls/boys. Behaviors index is a composite index of mother's behaviors during pregnancy; it is comprised of indicators of smoking, drinking alcohol, (non-attendance to) prenatal care visits, and (lack of) tetanus immunization during pregnancy. All models include interaction with maternal years of education. All regressions include the full set of child (X_c), mother/household (X_p), and municipal (X_m) covariates. They also include municipal, year, and month FE. Standard errors clustered by municipality are in parentheses. FE, fixed effects.

$^*p < 0.05$, $^{**}p < 0.01$, and $^{***}p < 0.001$.

that violence exposure during pregnancy has an additional independent effect on birth outcomes beyond that working through the maternal behaviors.

6 | CONCLUSION

This study set out to analyze one indirect effect of war on early life health, emphasizing the impact of distress, fear and anxiety caused by exposure to violence in utero. The main finding was that mothers exposed to violence during early pregnancy gave birth to babies who weighed less and had higher odds of being underweight. This effect was visible mainly for baby boys and for newborns whose mothers had the least education. This finding has implications for the intergenerational transmission of disadvantage. Pregnancy is a key developmental stage, and the poorer health at birth of babies of disadvantaged women can result in lifelong disparities in health and other well-being areas. Policies that reduce the incidence of low birthweight have multiple benefits (Alderman & Behrman, 2006). Thus, a priority to reduce these disparities would be to protect vulnerable expecting mothers from shocks or provide avenues to alleviate the adverse effects.

The main results were unlikely to be driven by a change in the composition of mothers, either because of migration or fertility changes. Although caution should be taken given that the relatively small sample sizes may render some coefficients too imprecisely estimated to be statistically significant, the headline results here were consistent with previous work in Colombia (Camacho, 2008). They were also robust to various alternative specifications, albeit the significance of the effect diminished when focusing only on singletons. Given this, the known problems with birthweight reporting in household surveys, and the low sample sizes at disaggregated levels (for instance, the group of low educated mothers), future work may validate the headline findings with administrative data from birth records.

Other important results were the absence of change in fetal mortality and, likely, in the gender ratio at birth associated with a shock exposure in early gestation. Nonetheless there was evidence of increased male fetal mortality associated with exposure in late gestation for the boys of the least educated mothers. These results leave open the debate about the balance between scarring and selection effects in a middle-income developing country such as Colombia. The scarring of health caused by a violence shock can be stronger in early gestation than in later stages.

It has been hypothesized that the mechanism for the intergenerational transmission of exposure to violence is the hormonal imbalance resulting from the maternal experience of stress early in the pregnancy. A gender split in the results aligns with the well-established knowledge that male fetuses are more vulnerable to shocks experienced early in gestation. But here, in utero violence exposure was also found to increase girls' likelihood of being born with low birthweight, although this was related to late-gestation exposure, which is at odds with a purely biological explanation of the transmission mechanism of the shock.

I used information about maternal behaviors during pregnancy as an attempt to disentangle other possible channels. The nature of the data warrants care in the interpretation, but the exploratory analysis presented here is worth continuing in future work. I found that exposure to violence led to an increase in a negative pregnancy behaviors index, reflecting a reduction in the chance of attending antenatal care and receiving a tetanus vaccination, as well as an increase in alcohol consumption. These changes were significant for women pregnant with girls and were visible for exposure in the second trimester of gestation. Since in this gestation period the biological channel of stress hormones is weaker, there is more room for other environmental factors to affect the pregnancy outcomes. The increase in these behaviors during late gestation creates a harsher intrauterine environment for girls, leaving them more vulnerable to environmental stressors and thus to scarring.

Although we cannot be conclusive with respect to whether this pattern of behaviors reflects a parental preference for boys over girls, this explanation would be consistent with the literature on skewed parental investments beginning in the womb (Bharadwaj & Lakdawala, 2013). Such patterns may accentuate in times of conflict, intensifying son preference in periods of hardship (e.g., In East Asia, Tajikistan and Rwanda: Das Gupta & Shuzhuo, 1999; Kraehnert et al., 2017; Shemyakina, 2011; Verwimp & Van Bavel, 2005). This could be related to a desire to continue the family line in patrilineal societies,[49] from expected higher returns or lower perceived riskiness of male human capital investments, if parents use transfers to children as a form of old-age income insurance (Quisumbing, 1994; Rosenzweig, 1988; Schultz, 1997), or to compensate for expected higher male mortality (Kraehnert et al., 2017; Schultz, 1969; Verwimp & Van Bavel, 2005).[50] Consistent with this literature, in our data, the stated desire of pregnancies when the offspring was a boy rose for mothers exposed to violence around the time of conception.[51]

Particular attention should be placed on intrahousehold disparities along gender lines in parental inputs to newborn health, as the results here suggest it is possible that expecting parents compensate for the adverse effects of shocks for boys but not for girls, even in a country such as Colombia, where the evidence on biased gender preferences is scarce. Further investigating why and when parents react to shocks differently and whether exposure to a conflict environment changes parental preferences for their offspring are emerging research agendas worth continuing.

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CONFLICT OF INTEREST

The author does not have conflicts of interests to disclose.

DATA AVAILABILITY STATEMENT

The primary data that support the findings of this study are openly available from the websites of the Demographic and Health Surveys (http://dhsprogram.com/data/available-datasets.cfm) and the Centro Nacional de Memoria Histórica (http://www.centrodememoriahistorica.gov.co/micrositios/informeGeneral/basesDatos.html). The violence data update and the municipal spatial weights created by the author are made available through the Mendeley Data repository (Rodríguez, Laura. 2021, *Violence and newborn health*, Data update. Mendeley Data, v3, http://doi.org/10.17632/zwwrzptd36.3). Replication codes for the paper are available through the Mendeley Data repository (Rodriguez, Laura (2021), *Violence and newborn health*. Replication codes. Mendeley Data, V1, http://dx.doi.org/10.17632/wmngxyyvj7.1).

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ENDNOTES

1. National Centre of Historical Memory.
2. Although not in a restricted sibling sample.
3. Mechanisms linked to healthcare disruptions or food availability are possible, but unlikely to be those picked-up by the empirical strategy used by this literature.
4. Increased exposure to cortisol in late-gestation helps the lungs, the central nervous system and other organs to mature and precipitate birth when it is time.
5. Landmine explosions, used by Camacho (2008), are more akin to a victim count as landmines are triggered by victims. Although not targeted in advance, the victim profile is distinct: disproportionately children, people working as manual eradicators of illicit crops, and indigenous (Centro Nacional de Memoria Histórica, Fundación Prolongar, 2017). Also, 98% of minefields are in rural areas, and heavily concentrated in a few municipalities, especially those with high conflict intensity and armed group presence (ibid).
6. Ruling out guerrilla incursions (*toma guerrillera*).
7. Similar to the terrorist attack definition in the United States: "Premeditated politically motivated violence perpetrated against non-combatant actors by sub-national groups or clandestine agents, usually intended to influence an audience" (U.S. Department of State 1983, in Becker & Rubinstein, 2011).
8. Details in Appendix A of Supporting Information S1.
9. Demographic and Health Surveys (DHS) are representative of 99% of the country. Uncovered areas are disperse rural areas in this region, which is dominated by rainforest.
10. Earlier rounds lack crucial pregnancy-related information or municipal identifiers.
11. Alternative indicators such as birth length or the mother's assessment about the relative size of their child (smaller/larger than average) in the data are, however, worse or unavailable. See Appendix B in Supporting Information S1.
12. In the sample, 80% of neonatal deaths occur by the first week of life.
13. Since conception occurs about 2 weeks after the last menstrual period, I subtract two further weeks to more accurately capture the gestation period. Recall error in both the date of birth and the pregnancy length, may lead to imprecise determination of the conception date.
14. The birth month is the concurrent one if delivery was before the 15th day, or the subsequent month if delivery was after.
15. Analysis based on the number of victims is available upon request.
16. In the sample, only 154 cases (0.52%).
17. DHS lack income or expenditure information. I calculate the Multidimensional Poverty Index following international United Nations Development Programme guidelines and use the household deprivation score, without capping it for households below the poverty threshold.
18. Survey round fixed-effects are also included.
19. In Colombia, healthcare provision is a core local government function.
20. Suggests either less eligible population or lower resources for health.
21. They vary by year or by survey round because of limited municipal data reported with higher frequency. Yearly variables are linked on the year and month of birth (the concurrent year for a child born after June or the previous year for those born before).
22. DHS do not identify the municipality of residence at the time of pregnancy.

[23] The most stated reasons were "economic" and "family" (44% of the responses each).

[24] No difference in birthweight, and only a very small one in the share of low birthweight when reports use the mother's recall or a birth certificate.

[25] Of which 8% weight 2.5 kg. Because of the tendency to report birthweight in round multiples, it is preferred to include threshold cases in the low birthweight indicator (Blanc & Wardlaw, 2005).

[26] The index ranges from zero to one.

[27] Interacting instead with multidimensional poverty or with the wealth index (Table D1 in Supporting Information S1) shows that while both are important determinants of birthweight on their own, neither mitigates the effect of violence exposure. These are crude measures of family resources but suggest that the protecting effect of education is unlikely to be linked to lower credit constraints.

[28] It is even positive for the highest-educated mothers.

[29] Low birthweight and neonatal mortality are estimated here as linear probability models and robustness analysis shows non-linear probability (logit) estimations (Appendix E, column I in Supporting Information S1). Conclusions with regards to low birthweight are similar in the non-linear model.

[30] Excluding children born less than 28 days before the survey.

[31] A non-linear probability model does not show this significant impact of first trimester exposure to violence on girls' neonatal mortality (Table E2 in Supporting Information S1). The second trimester effect is considerably smaller in magnitude.

[32] This result holds in a logit model (Table E2 in Supporting Information S1) albeit the magnitude of the impact is much smaller considering the very low prevalence of neonatal mortality. They indicate that girls exposed to a violence shock in the second trimester are 40 percent (0.19 percentage points) more likely to die before the first month of life.

[33] Low birthweight and neonatal mortality results are in Appendix E of Supporting Information S1.

[34] Implying that last trimester lasts always three full months, making this estimate an intention to treat rather than an average treatment effect.

[35] There is only employment data for the largest municipalities and that for departments varies only yearly and has some data gaps.

[36] Consistent with research showing that these factors are important in late rather than early gestation (Almond & Mazumder, 2011; Almond et al., 2011; Amarante et al., 2016; Currie et al., 2018).

[37] Newcomer migrants are not significantly different in education, disability prevalence, household multidimensional poverty nor wealth (Appendix C in Supporting Information S1).

[38] A per capita expulsion rate above a standard deviation from the national average. Only two excluded municipalities (Tumaco and Puerto Rico) had an attack in the period, reinforcing the idea that these events are lowly correlated with persistent violence.

[39] Not controlling for gender or multiple pregnancy. 18% of pregnancies do not end in a live birth.

[40] In the sample, terminated pregnancies last 2.4 months on average, 91.3% of pregnancies that reach the seventh month are live births.

[41] Appendix C in Supporting Information S1 has mean comparison tests.

[42] The sample size would be too small for reasonable estimation with mother fixed-effects given the low fertility rate and live births per woman in our data. A further robustness check excludes from the control group (those not exposed to the shock in utero) cases from municipalities where there was an attack within 3 years before conception. This leads to virtually equal conclusions about the effect on birthweight.

[43] There is only a reduction in the likelihood of having a disability when exposed in the trimester immediately before conception.

[44] Subtracting the mean and dividing by the standard deviation of the behavior in non-exposed pregnancies. Positive indicators (prenatal visits and tetanus vaccinations) are inverted to indicate a negative outcome.

[45] The vaccine prevents infection during delivery increasing the survival chance after birth. Hence, parents are motivated to invest in this input only if complementary inputs are available.

[46] For instance, we do not know when in the pregnancy smoking occurred nor if it also happened before conception. Also, these survey questions are only asked to women who had a live birth, impeding the assessment for pregnancies where the fetus did not survive to birth.

[47] Prenatal ultrasounds are common and widely accessed in Colombia.

[48] The effects on neonatal mortality are not statistically significant.

[49] Verwimp and Van Bavel (2005) note that the diminished survival of refugees' daughters but not of their sons suggests an increase in parental investments in boys' health as a way to shield them and ensure the passing on of land rights, which follow the male line.

[50] Another possibility not formalized in the literature is the increased desire for males as perceived providers of security in a conflict environment.

[51] Although preliminary work in Colombia (Camacho & Gerardino, 2018) shows the opposite for populations exposed to homicide violence: a decrease in overall actual and desired fertility, and a relative decrease in the desire for boys.

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