Hunting Militias at All Cost

Effect of an Urban Military Operation on Birth Outcomes

Author

Gabriel Suárez

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Advisors

Darwin Cortés, Christian Posso

Department of Economics

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Gabriel Suárez[1]

ADVISORS

Darwin Cortés and Christian Posso

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Abstract

While the literature has documented the harmful effects of war and civil conflict on health outcomes at birth, there is little evidence of the impact of a considerable urban intervention on infants' birth weight. We fill this gap by providing evidence that the urban military intervention called Orion, carried out in the Commune 13 of Medellin in 2002, caused a significant reduction in birth weight in the neighborhoods affected by the intervention relative to other areas. Furthermore, we found that the effects concentrate on married and less educated mothers. Also, we found a reduction in height at birth and a considerable increase in the probability of having a low Apgar score. Although we could not test stress as the primary channel that drove our results, we conclude that stress is possibly one of the mechanisms affecting birth outcomes. These results suggest that it is crucial to analyze the potential unintended effects of urban military interventions.

[1] Suárez: *Universidad del Rosario* (gabrielj585@gmail.com). I am grateful to Darwin Cortés and Christian Posso for their guide and support, to Mounu Prem, Paul Rodriguez, Santiago Saavedra, Sanislao Maldonado, Jorge Gallegos, Arlen Guarin, and Catalina Gómez Toro for helpful comments and suggestions, and to participants of the RATA Workshop at Universidad del Rosario. All errors are my own.

1. INTRODUCTION

Colombian internal armed conflict has affected nine million individuals (16% of its population).[2] Although the conflict was more intense in rural areas or small municipalities, during the mid-90s, it severely impacted the main cities of Colombia, particularly Medellin. By 2000, the most representative guerrilla groups had a strong presence in Medellin, mainly in commune 13-San Javier, where there was an evident absence of the state. To regain control of the area, in October 2002 -two months after the presidency of Alvaro Uribe took possession- the President ordered the most significant urban military operation in the history of Colombia: The *Orion Operation*. It began on October 16, 2002, and lasted approximately one week. Many police and army men were involved with sophisticated weapons, helicopters, and other vehicles (Memoria Histórica, 2011). The government qualified the operation as successful, but little is known about the consequences for unborn babies. In this paper, we study whether the Orion Operation has extended impacts on those in utero.

We focus on the causal relationship between intrauterine exposure to this urban military operation and birth outcomes. We focus on birth weight because it is the typically proxy for short-term nutritional status, and it is a crucial characteristic for long-run development (Almond and Currie 2011). Several mechanisms can explain this underlying relationship: On the one hand, the operation implied a forced lockdown for the residents that possibly affects nutrition or access to health services, negatively affecting birth outcomes because of lack of food or due to an absence of medical advice and control; on the other hand, the operation possibly increased the levels of stress in pregnant women, increasing levels of Corticotrophin-Releasing Hormone (CRH), which controls the duration of pregnancy and fetal maturation and thus increases the probability of adverse birth outcomes (Wadhwa et al. 1993).

Our primary source of identification is a difference-in-differences strategy across areas and time. In practice, we control for common time effects across neighborhoods to compare mothers exposed to the Orion operation during pregnancy to otherwise similar mothers residing in the same or other areas but not affected by the military intervention. We exploit Colombia's Vital Statistics Reports (VSR, from now on) collected by the Administrative Department of Statistics (DANE) to address our empirical analysis. VSR corresponds to more than 3.6 million birth certificates filed in hospitals within 1,118 municipalities in Colombia from 2000 to 2004 and has information about the birth outcomes, newborns' characteristics, and mothers' socioeconomic variables. We focus on birth registries in Medellin, the second most important city in the country, and where the Orion operation took place. In addition, we identify the neighborhoods affected by the operation, which allows us to establish the treated and control groups among pregnant women before and after the intervention.

We provide evidence that birth weight was not systematically different between pregnant women from treated and control neighborhoods. We ran a falsification test, assuming that the operation occurred one year before the actual date, and we found no significant effects.

[2] Source: https://www.unidadvictimas.gov.co/es/registro-unico-de-victimas-ruv/37394.

Furthermore, through an event study regression, we found evidence that the pre-trends in our primary outcome (birth weight) were parallel before Orion. Similarly, we also found that our results are robust to the wild-bootstrap proposed by MacKinnon and Webb (2019; 2020) and implemented by Roodman et al. (2019) to control for few treated clusters. The results suggest that Orion reduced the average birth weight by 2.1% (64 grams on a base of 3,055 grams) in children whose mothers experienced the intervention. Also, results show that Orion decreased the probability of being born with an APGAR score (1 min) greater than seven in 3.3% (3 percentage points [pp] relative to a pre-intervention mean of 92 pp). In addition, Orion increased the probability of being born with an APGAR score (1 min) lower than five by more than 40% (0.7 pp relative to a mean of 1.7 pp). Finally, we also found a reduction in height by 1% (.5 cm relative to an average of 49.1 cm), but this effect is not robust to the wild-bootstrap exercise.

Our paper contributes in several ways to the existing literature. First, our study provides new evidence by extending the analysis of the effects of the Colombian internal armed conflict (Angrist and Kugler 2008; Camacho 2008; Camacho and Rodriguez 2013; Dube and Vargas 2013; Vargas 2012), which is unprecedented and massive in scale and scope, on the realm of early life shocks. Also, this paper complements the only two pieces of evidence associated with the Colombian conflict and infants' health outcomes. Camacho (2008) analyses the effects of landmine explosions on birthweight, while Duque (2017) analyses the exposure to terrorism attacks on height-for-age. None of the above cases focuses on the urban effects of the Colombian conflict, our second contribution to the literature. This paper is the first evidence of the impact of the Colombian internal armed conflict on early life outcomes in large cities. Our paper contributes to the literature that analyses the effects of wars on urban areas, mainly cities. We complement the previous findings of Mansour and Rees (2012) for Gaza and three of the eleven districts of the West Bank Palestina and Foureaux & Manacorda (2016) in Brazil's larger cities. Third, we can better isolate the effect of the military operation from indirect channels in other shocks such as landmine explosions (Camacho 2008), terrorism (Duque 2017), nutritional effects in Mansour and Rees (2012), etc.

The rest of the paper is organized as follows. First, section 2 provides a brief background. Next, section 3 describes the data sources and provides descriptive statistics. Then, section 4 describes the identification strategy to estimate the effect of the operation Orion on birth outcomes. Finally, the main findings and robustness are in section 5, and section 6 concludes.

2. BACKGROUND

Colombia has been one of the countries most affected by violence during the second half of the 20th century, having an internal conflict that has lasted more than fifty years and has left thousands of victims during the journey. The internal conflict started in the mid-1960s with the foundation of the left-wing guerrilla groups *Revolutionary Armed Forces of Colombia* (FARC from the Spanish acronym) and the *National Liberation Army* (ELN, the Spanish acronym). These guerrillas stated they aimed to overthrow the government. As a military strategy, the guerrillas sought to populate areas with a markable absence of the state, thus achieving the control of a consolidated location that increases their ability to expand and extract rents through crime (Aricapa, 2005).

Several guerrillas settled in impoverished areas of Medellín, the second most important city of Colombia, where the lack of government authorities and social problems such as poverty and insecurity were evident. In particular, communes such as San Javier (Commune 13) and Popular (Commune 1) were the main target of the ELN and FARC. In the mid-1990s, the ELN coordinated the land invasion of the *El Salado* neighborhood, located in the board between San Javier and San Cristobal (rural town), providing plots of land and construction materials to displaced people from Urabá (Antioquia) and Chocó (Memoria Histórica, 2011). Eventually, the independent militias also exercised control over the people and territory, assigning land plots and distributing food and goods from the assault of transporting vehicles. Furthermore, both ELN and militias were the authority that punished inappropriate behavior such as domestic violence, rapes, drug consumption, or violent behavior against other residents. In addition, the FARC militias were also present towards the end of the 1990s, consolidating an urban area of high risk, difficult to control at the view of the state.

Since 1997, several groups of the right-wing guerrilla *Autodefensas Unidas de Colombia* (AUC) had tried to establish in the zone to dispute control over territory. By 2002, the situation worsened because the left-wing militias: prohibited people from outside the neighborhood, held checkpoints on buses, and paralyzed schools. Consequently, public transport stopped arriving at the zone, and some businesses closed. During confrontations, the AUC broke into some homes to look for militiamen; and they knocked down doors, mistreated residents, burned nine houses, and forcibly displaced several families (Memoria Histórica, 2011). These confrontations led to a series of military interventions across different neighborhoods of Commune 13. One to recall is the Mariscal operation that left a total of nine civilians dead (including several minors), more than 37 injured, 55 residents arbitrarily detained, eight members of the Public Force injured, and possibly six dead among them (CINEP and Justicia y Paz, 2003).

Despite efforts to regain sovereignty over the territory, the situation did not change. On May 31, 2002, only ten days after the Mariscal operation, the mayor of Medellín -Luis Pérez Gutierrez- inaugurated the new bus terminal in the *San Javier* neighborhood. However, guerrilla groups from FARC attacked the bus where the mayor was going; although he did not get hurt, the attack triggered several measures to regain control of the area. The policies were constructing a new military base in *El Corazón*, reinforcing the force with 300 police officers equipped with specialized equipment and weapons, and a 500 million COP fund to pay informants (Aricapa, 2005).

In August 2002, after the possession of Alvaro Uribe as the new President, the mayor of Medellín, Luis Pérez, requested an intervention directly from the national government. Some weeks later, in October 2002, the military and police authorities planned a decisive move: The Orion operation. This unexpected intervention aimed to end the violence that negatively affected the civilian population, especially the most vulnerable such as children and pregnant women. Unfortunately, however, the foray into the neighborhood was violent and generated fear among the inhabitants.

According to interviews and testimonies, the Orion Operation inflicted intense psychological pressure on the inhabitants who lived in the affected areas (Aricapa, 2005). Memoria Histórica (2011) highlights several testimonies of the victims. For instance, an adult woman victim of the intervention stated that she believed "*they* [the police] *will kill us all here*" after hearing the gunshots from the army's helicopter. She asked herself, *"why do they shoot here knowing that there are so many houses, so close together?"* (Page 82). Her daughter also felt fear, as she said, *"Mommy, they are going to kill us."* To summarize, residents felt fear because many illegal raids and indiscriminate shootings are alleged to have been committed, showing their shock during the confrontations between the official authorities and guerrilla groups.

2. DATA

2.1. Births' data

We used the Vital Statistics Reports (VSR) collected by the Administrative Department of Statistics (DANE). The data set has information about date, hospital, sex, weight, height, and Apgar score of each birth registry and some variables with information about the mothers: department and municipality of residence, neighborhood, age, educational attainment, type of health insurance, marital status, number of children, and number of pregnancies. We focused on birth registries in Medellin, where there are 176 thousand birth certificates from 2000 to 2004. The VSR has about 67,000 birth registries from 2002 to 2003 of Medellin residents; however, only registries from May to August of 2003 report the neighborhood of residence, so we got about 39,000 applicable registries to establish our main sample.

2.2. Orion

The operation Orion began on October 16, 2002, in the commune 13-San Javier of Medellin. Although there is no consensus about its duration, most sources said it lasted around one week. We use the investigation report of Memoria Histórica (2011) to define the set of neighborhoods where the operation Orion took place. The commune 13 had 19 neighborhoods by 2002. From those, six neighborhoods were intervened: *Belencito*, *Corazón*, *20 de Julio*, *El Salado*, *Nuevos Conquistadores*, and *Las independencias*. This information, alongside the operation's dates, allows us to build a repeated cross-section of births in Medellin from 2002 to 2003. Figure A1 shows in dark gray the six neighborhoods that were intervened by the Orion operation. The rest of the commune 13-San Javier neighborhoods are in light gray, and the rest of the districts of Medellin are in white.

2.2. Main sample

We approximate the conception date for each newborn subtracting the gestational length from the birth date.[3] Then, we identified newborns both conceived before and born after Orion, which results in around 10,200 registries: 5,800 from 2002, potentially exposed to Orion during the third trimester of pregnancy; and near 4,400 from 2003, potentially exposed during the first trimester of pregnancy. Our focus is the 4,400 births from 2003, as they were exposed during the first trimester of pregnancy. Furthermore, we include in our sample the deliveries

[3] We subtract two weeks from gestational age as conception usually occurs two weeks after the last normal menstrual period (definition of gestational age).

corresponding to the exact dates of each group, but one year before. For instance, infants exposed to Orion in the first trimester of pregnancy were born between May 1-July 30, 2003 (see Table A1 in the appendix)[4], so we added the births from May 1-July 30 of 2002 in our sample. It is essential to clarify that we cannot identify newborns exposed to the military intervention in the second trimester of pregnancy; therefore, we decided to estimate separate regressions for the available groups (first and third trimester). Hereafter, we will present the results for the set of newborns potentially exposed to Orion during the first trimester of pregnancy. However, output using the third-trimester sample will be analyzed and is available in the appendix.

We also focus on first-trimester exposed newborns because previous evidence has shown that the effects concentrate on those affected during the first trimester of pregnancy (see, for example, Mansour & Rees, 2012 or Camacho, 2008). The final data set has 11,388 observations (birth registries) classified into treated or control according to the area of residence reported in the hospital by their mothers. Each observation corresponds to a child i, in cohort t, in neighborhood n.

2.3. Descriptive statistics

Table 1 presents the summary statistics of the cohort born during 2002 before the operation in Medellin. As shown in the table, infants weigh, on average, 3,056 grams, with a standard deviation of 472 grams. Infants have an average height of 49.1 centimeters, with a standard deviation of 2.5 centimeters. 92% of the births had an Apgar score of seven or more. Concerning the socioeconomic variables, 24% of the deliveries are from mothers with primary or lower educational attainment, more than 70% are from married mothers or mothers in a consensual union, and the average age of the mothers is 25.5 years old (standard deviation of 6.8 years). Finally, about 3 percent of the births are from mothers living in neighborhoods affected by the Orion operation.

Column (7) shows the mean level differences in birth weight, height, and Apgar equal and higher than seven between neighborhoods exposed and non-exposed to Orion's operation before starting the military intervention. In particular, infants from intervened neighborhoods weigh, on average, 37.3 grams more than infants from other neighborhoods; but this difference is not statistically significant. In the same line, infants from treated neighborhoods are 0.27 centimeters taller, and this difference is not statistically significant either. In the same way, there are no significant differences in the probability of having an Apgar score equal to or higher than seven between treated and controls.

[4] Table A1 describes the weeks remaining to be born for the newborns potentially exposed to Orion during the first trimester of pregnancy and expected delivery date.

TABLE 1. SUMMARY STATISTICS - PRE INTERVENTION								
	Full sample		Treated		Controls		Difference (Treated-Controls)	
	(1) Mean	(2) S.D.	(3) Mean	(4) S.D.	(5) Mean	(6) S.D.	(7) Difference	(8) P-value
Birth Outcomes								
Birthweight	3,056.2	472.502	3,092.449	515.195	3,055.141	471.146	37.308	0.263
Low birth beight	0.099	0.299	0.101	0.303	0.099	0.299	0.002	0.909
Height	49.056	2.479	49.295	2.515	49.049	2.478	0.246	0.160
Gestational length (weeks)	38.592	1.675	38.560	1.708	38.593	1.674	-0.032	0.784
Premature	0.083	0.276	0.106	0.309	0.083	0.275	0.024	0.226
APGAR 1 minute ≥ 7	0.920	0.271	0.932	0.252	0.920	0.271	0.012	0.521
APGAR 1 minute 5 or 6	0.041	0.198	0.053	0.225	0.041	0.198	0.012	0.373
APGAR 1 minute < 5	0.017	0.129	0.010	0.098	0.017	0.130	-0.007	0.412
APGAR 5 minutes ≥ 7	0.967	0.179	0.981	0.138	0.966	0.180	0.014	0.257
APGAR 5 minutes 5 or 6	0.004	0.066	0.005	0.070	0.004	0.066	0.000	0.925
APGAR 5 minutes < 5	0.003	0.050	0.005	0.070	0.002	0.050	0.002	0.511
Birth and pregnancy characteristics								
Prenatal visits	5.410	2.382	5.000	2.595	5.422	2.374	-0.422	**0.017**
Female	0.492	0.500	0.464	0.500	0.492	0.500	-0.029	0.417
Number of pregnancies	2.220	1.488	2.317	1.522	2.217	1.487	0.100	0.341
Number of previously born alive	2.020	1.303	2.151	1.418	2.016	1.299	0.136	0.142
Mother and Father characteristics								
Mother's age	25.507	6.807	25.150	7.092	25.518	6.799	-0.368	0.444
Father's age	29.437	8.016	27.747	7.470	29.487	8.026	-1.740	**0.003**
Mother's educational attainment								
None	0.014	0.119	0.019	0.138	0.014	0.119	0.005	0.554
Primary	0.227	0.419	0.348	0.477	0.223	0.417	0.124	**0.000**
Secondary	0.605	0.489	0.580	0.495	0.606	0.489	-0.026	0.450
Higher	0.127	0.333	0.039	0.193	0.130	0.336	-0.091	**0.000**
Father's educational attainment								
None	0.016	0.124	0.029	0.168	0.015	0.122	0.014	0.115
Primary	0.199	0.400	0.329	0.471	0.195	0.397	0.133	**0.000**
Secondary	0.511	0.500	0.415	0.494	0.514	0.500	-0.098	**0.005**
Higher	0.123	0.328	0.048	0.215	0.125	0.331	-0.077	**0.001**
Mother's type of insurance								
Private	0.506	0.500	0.353	0.479	0.511	0.500	-0.158	**0.000**
Public	0.207	0.405	0.290	0.455	0.204	0.403	0.086	**0.003**
Other	0.287	0.452	0.357	0.480	0.285	0.451	0.073	**0.023**
Mother's marital status								
Single	0.265	0.441	0.251	0.435	0.266	0.442	-0.014	0.643
Married	0.289	0.453	0.237	0.426	0.291	0.454	-0.054	**0.092**
Widow	0.004	0.062	0.005	0.070	0.004	0.062	0.001	0.814
Free union	0.413	0.492	0.483	0.501	0.411	0.492	0.072	**0.037**
Divorced	0.008	0.087	0.005	0.070	0.008	0.088	-0.003	0.635
Neighborhoods	238		6		232		238	
Observations	7043		207		6836		7043	

Notes: This table presents summary statistics for the outcomes and covariates of birth registries before Orion's operation (May, June, and July 2002) in control and treated neighborhoods. Low birth weight is a dummy that takes the value of one if birthweight<2500 grams, and premature is a dummy that takes the value of one of the gestational lengths lower than 37 weeks.

3. EMPIRICAL STRATEGY

Our identification strategy exploits the timing of the Orion operation on October 16, 2002, and the violence exposure of the operation across neighborhoods. In particular, we first identify all the births from pregnant mothers during the Orion operation in their first trimester of gestation. The deliveries potentially exposed to the intervention were born between May 1, 2003, to July 30, 2003; we defined this sample as cohort 2003. Second, we identify all the births born in the sample dates but one year before, i.e., those born between May 1, 2002, to July 30, 2002, not exposed to the operation. We defined this sample as cohort 2002. Finally, we know the neighborhood where the mothers lived at the moment of birth; then, we defined treated neighborhoods as those where the operation Orion took place. Control neighborhoods are the rest neighborhoods in Medellin.

Now, using the sub-index i to denote children, n to denote neighborhoods, and t to mark cohort, we estimate the following difference-in-differences model:

$$Weight_{int} = \alpha + \delta_t + \gamma_n + \beta \cdot Int \times Orion_{tn} + \theta X_i + \varepsilon_{int} \quad (3.1)$$

where $Weight_{int}$ is the birth weight in grams of child i whose mother resided in the neighborhood n from cohort t. Int_t, it is a dummy that takes the value of one for the cohort 2003 (May 1, 2003, to July 30, 2003), and zero for the cohort 2002 (May 1, 2002, to July 30, 2002), before the Orion operation. $Orion_n$, it is a dummy that takes the value of one for neighborhoods where the Orion operation was carried out and zero otherwise. δ_t and γ_n represent the fixed effects by cohort and neighborhood, respectively. X_i includes a set of covariates: mother's and father's educational attainment, marital status, type of health insurance, mother's and father's age, mother's number of previous pregnancies and alive children, and newborn's sex. Finally, ε_{int} is the error term, which we cluster at the neighborhood level. Our coefficient of interest, β, captures the differential change in birth weight before and after the Orion operation in neighborhoods exposed to Orion versus those not exposed to the Orion operation.

3.1. **Identifying assumption**

The central identifying assumption behind our difference-in-differences strategy is that in the absence of the Orion operation, average birth weight in neighborhoods exposed to the intervention would have evolved similarly to average birth weight in municipalities non-exposed the intervention. Unfortunately, we cannot test this assumption. Still, we partially prove that this is a plausible assumption by testing whether the trends before the operation were similar between treated and control neighborhoods. Specifically, we estimate the following equation:

$$Weight_{int} = \alpha + \sum_{j \in T} \beta_j \left(Orion_n \times Cohort_j\right) + \gamma_n + \delta_t + \theta X_i + \varepsilon_{int} \quad (3.2)$$

where T includes the cohorts for all years in our sample except from 2002, the cohort before the operation. Therefore, the parameters β_j can be interpreted as the difference in birth weight between neighborhoods exposed to the Orion operation and the rest, for the cohort j relative to the cohort at the end of Orion.

To evaluate the internal validity of our identification strategy, we implement the following falsification tests. First, we assign "false treatment" to the newborns that show up in the VSR one year before the Orion Operation. Then, using the birth registries from 2001 to 2002 instead of 2002 and 2003, we run equation (3.1) in the same conditions used for the primary sample. Here we test whether this placebo treatment group for the Orion operation significantly impacts birth weight. If it does, then the impact we found must come from some underlying difference in trends between treated and control neighborhoods rather than from Orion.

3.2. **Unconditional quantile regression**

It is helpful to know to what extent the Orion operation changed the birth weight distribution. To compute that, we run the unconditional quantile regression proposed by (Firpo, Fortin, and Lemieux (2009) and implemented by Rios-Avila (2020). The results will let us know whether the effects concentrate on certain parts of the birth weight distribution.

The specification is as follows:

$$RIF\left(y_{int};\ q_{\tau}, F_y\right) = \alpha + \delta_t + \gamma_n + \beta \cdot Int \times Orion_{tn} + \theta X_i + \varepsilon_{int} \quad (3.3)$$

where q_{τ} denote the τth percentile, F_y represents the marginal (unconditional) distribution, and the recentered influence function is defined as follows:

$$RIF\left(y_{int};\ q_{\tau}, F_y\right) = q_{\tau} + (\tau - \mathbb{1}\{y_{int} < q_{\tau}\})/f_Y(q_{\tau})$$

4. RESULTS

4.1. Main Results on birth weight

Table 2 reports the effect of the operation Orion on birth weight with and without covariates in the regressions, using equation (3.1). Results suggest that infants that were born in treated neighborhoods and who were exposed to the intervention during the first trimester of pregnancy weigh, on average, 64 grams less than the rest of births. This effect corresponds to a significant reduction of 2.1% in the average baseline weight (3,055 grams) and 0.136 standard deviations. In addition, we show that our estimates are similar without the inclusion of covariates at the mother level that could explain differences between birthweight of treated and control births. Moreover, we found no significant effects of the intervention for low birth weight, suggesting that the results we found do not concentrate on the birthweight distribution's left side. For further analysis, we run an unconditional quantile regression; we plot the results in Figure 4. As we can observe from the figure, the effects focus on the median of birthweight distribution, around 3100 grams.

Table A2 in the appendix shows the results for exposure during the third trimester of pregnancy. In the same line with previous findings in the literature, exposure to Orion during the third trimester is not statistically significant for birth weight or low birth weight. The same is true for other outcomes such as prematurity, prenatal visits, height, and Apgar score.[5]

The operation Orion was conducted after a long period of absence of state and urban armed conflict. This scenario led to fear and stress on the commune 13's population, especially in pregnant women, causing reductions in birth weight much more prominent than other effects from previous studies. For instance, for Colombia, Camacho (2008) found a significant decrease of 0.24% in birth weight (7.7 grams relative to an average of 3153 grams) for children born in a municipality with landmine explosions during early pregnancy. For Palestine, Mansour and Rees (2012) found that exposure to the average conflict-related casualties did not reduce birth weight but increased the probability of low birth weight by 18.4% (2.2 pp relative to a baseline probability of 12 pp). For Spain, Quintana-Domeque and Ródenas-Serrano (2017) found that the Hipercor bombing terrorist attack of 1987 significantly reduced birth weight by 11.5 and 13.5 grams in the first and third-trimester pregnancy, which represents a decrease of 0.35% and 0.41% of the baseline average birth weight, respectively.

Our results are similar to those found by Torche (2011) and de Oliveira, Lee, and Quintana-Domeque (2021) for natural disasters. For example, Torche (2011) found a significant reduction of 51 grams due to a major earthquake in Chile. de Oliveira, Lee, and Quintana-Domeque (2021) found that newborns exposed to Hurricane Catarina experienced an average reduction of 44 grams in birth weight, representing -0.09 standard deviations or -1.34% effect of the pre-hurricane average birth weight.

TABLE 2. BIRTH WEIGHT AND THE OPERATION ORION

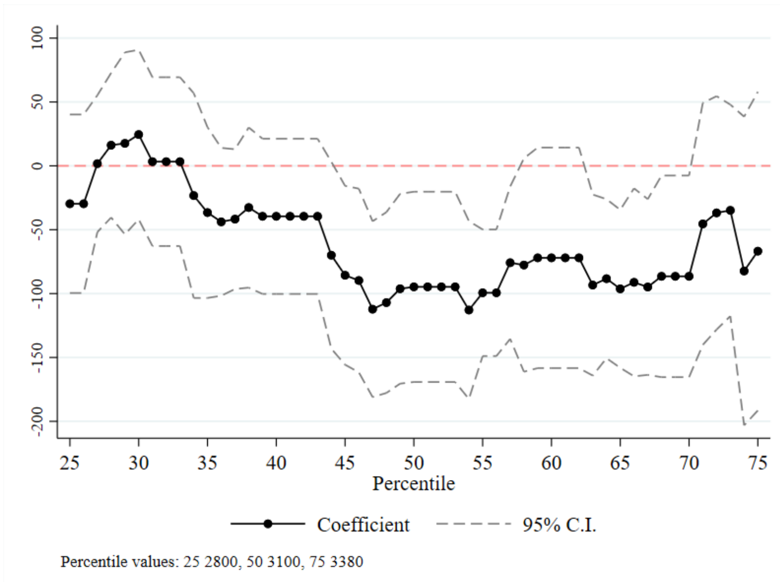
Dependent variable	Birth Weight		Low Birth Weight	
	(1)	(2)	(3)	(4)
Orion	-67.23**	-63.73**	-0.032	-0.031
	(31.35)	(27.84)	(0.022)	(0.024)
	[0.039]	[0.028]	[0.318]	[0.379]
Controls	No	Yes	No	Yes
Observations	11388	11388	11388	11388
Neighborhoods	244	244	244	244
Mean DV	3,055.14	3,055.14	0.099	0.099
SD DV	471.15	471.15	0.299	0.299

Notes: This table presents the results from OLS regressions with birth weight and low birth weight as the dependent variable using data from 2002 and 2003 (May, June, July). Orion is a dummy that takes the value of one for treated neighborhoods after exposure to the intervention. All columns include year-month and neighborhood fixed effects. Controls in columns (2) and (4) include mother's and father's age, dummies for the type of insurance, dummies for mother's and father's educational attainment, dummies for mother's marital status, number of previously born alive, number of pregnancies, and whether the newborn if female. Robust standard errors clustered by neighborhood reported in parenthesis. P-values using wild cluster bootstrap with 9999 replications reported in brackets. Significance levels: 1% ***, 5% **, 10% *.

[5] Results of exposure during the third trimester of pregnancy in additional outcomes are available upon request.

We explore whether prematurity, prenatal visits, and a proxy for nutrition were plausible mechanisms that explain the reduction in birth weight caused by Orion's operation. We present the results in Table 3. As observed, none of the measures for prematurity were significantly affected by the intervention (gestational length and premature), suggesting that lower birth weight of newborns is not caused because of a reduction in the gestational length. On the other hand, the intervention did not significantly affect the access to medical care (prenatal visits) nor the proxy of poor nutritional status (small for gestational age). Hence, we can infer that the increase in stress levels is the primary plausible mechanism underlying the negative relationship between exposure to violence and birthweight.

Figure 4. Unconditional Quantile Regression – Operation Orion and Birthweight



Notes: This figure shows the results from unconditional quantile regressions with birth weight as the dependent variable. Each point is an independent regression coefficient of the intervention on a particular percentile of the birth weight distribution. The estimations include year-month and neighborhood fixed effects and control for mother's and father's age, dummies for the type of insurance, dummies for mother's and father's educational attainment, dummies for mother's marital status, number of previously born alive, number of pregnancies, and whether the newborn if female.

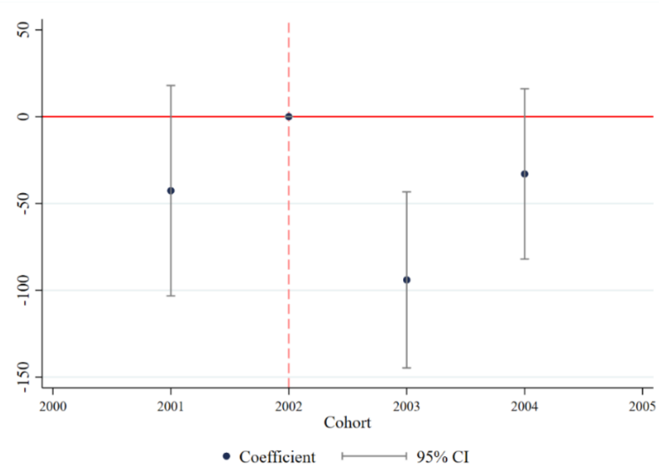
TABLE 3. PREMATURITY, PRENATAL VISITS, AND THE OPERATION ORION					
Dependent variable	Gestational length	Premature	Prenatal Visits	Prenatal Visits ≥ 4	Small for Gestational Age
	(1)	(2)	(3)	(4)	(5)
Orion	0.143	-0.037	-0.197	-0.056	0.015
	(0.213)	(0.039)	(0.331)	(0.045)	(0.011)
	[0.808]	[0.625]	[0.603]	[0.303]	[0.332]
Observations	11388	11388	10210	10210	11388
Neighborhoods	244	244	242	242	244
Mean DV	38.59	0.08	5.410	0.801	0.036
SD DV	1.68	0.28	2.382	0.399	0.188

Notes: This table presents the results from OLS regressions with gestational length, premature, prenatal visits, and more than four prenatal visits as the dependent variable using data from 2002 to 2003 (May, June, July). All columns include year-month and neighborhood fixed effects and controls (see notes in Table 2). Robust standard errors clustered by neighborhood in parenthesis. P-values using wild cluster bootstrap with 9999 replications reported in brackets. Significance levels: 1% ***, 5% **, 10% *.

4.2. Identifying assumption

Using the sample in Table 2, we ran the dynamic point estimates of equation (3.2). We show the results in Figure 5. The treatment interaction is not statistically significant for cohorts of years before the operation Orion, 2001, relative to the 2002 cohort. On the other hand, for the 2003 cohort, the effect is significant as expected. In contrast, the results for future cohorts (significant2004) are not statistically significant, as expected, since those cohorts were not exposed to the Orion operation. This result supports the use of a difference-in-differences empirical strategy to estimate the effect of the Orion operation on birth weight in Medellin.

Figure 5: Dynamic Point Estimates - Parallel Trends



Notes: This figure shows the results from event study regressions with birth weight as the dependent variable. Each point is a coefficient from the interaction between treatment status and each specific cohort, as described in equation (3.2). The estimations include year-month and neighborhood fixed effects and control for mother's and father's age, dummies for the type of insurance, dummies for mother's and father's educational attainment, dummies for mother's marital status, number of previously born alive, number of pregnancies, and whether the newborn if female.

4.3. Falsification test

We run the falsification test of equation (3.1) but using a placebo operation Orion. The results are in Table 4. We find that the placebo Orion operation has no significant effect on birth weight, suggesting that underlying differences in trends between treated and control neighborhoods do not drive our results. Hence, we provide evidence that our estimates from Table 2 are reliable.

TABLE 4. FALSIFICATION TEST - BIRTH WEIGHT AND THE OPERATION ORION

Dependent variable	Birth Weight		Low Birth Weight	
	(1)	(2)	(3)	(4)
Fake Orion	-10.45	-10.71	-0.004	-0.007
	(13.65)	(14.01)	(0.017)	(0.015)
	[0.479]	[0.494]	[0.847]	[0.717]
Controls	No	Yes	No	Yes
Observations	12696	12696	12696	12696
Neighborhoods	244	244	244	244
Mean DV	3,083.03	3,083.03	0.091	0.091
SD DV	492.89	492.89	0.288	0.288

Notes: This table presents the results from OLS regressions with birth weight and low birth weight as the dependent variable using data from 2000 to 2001 (May, June, July) to simulate the placebo intervention two years before the real one. All columns include year-month and neighborhood fixed effects (See notes in Table 2). Robust standard errors clustered by neighborhood in parenthesis. P-values using wild cluster bootstrap with 9999 replications reported in brackets. Significance levels: 1% ***, 5% **, 10% *.

4.3. Intra-urban Migration

A critical concern about our results is that migration can lead to bias. In particular, if women that migrate to other neighborhoods have infants with higher or lower birth weight than non-migrant women, then our estimates would be biased. However, if there were selected migration of mothers, the number of births would have changed due to the operation Orion. We test this hypothesis using the neighborhood-cohort panel resulting from summing all the birth registries in the VSR on each neighborhood by cohort. Results are shown in Table 5; as can be seen, the number of births by district did not change due to the operation Orion, providing evidence that there was not selected migration of mothers that could bias our estimates.

4.4. Heterogeneous effects

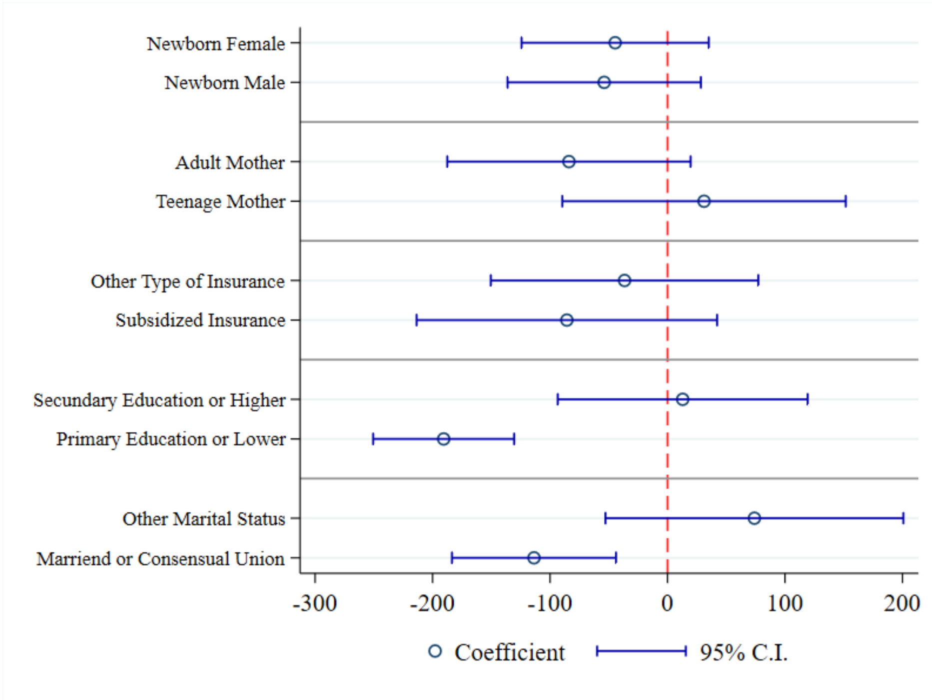
In Figure 6, we explore the heterogeneous effect of the operation Orion on birth weight. The results show no significant differences for teenagers (aged 19 or less) or adults (aged 20 or more). We find that the effect concentrates on newborns from married mothers or in a consensual union. In addition, we find that the result focuses on newborns whose mother has primary or lower educational attainment, which can be considered a proxy of poverty. We expected the heterogeneous effects of education because mothers with lower educational attainment are more vulnerable to violent shocks. The impact on marital status can be explained by the fact that a woman with a partner is more likely to be stressed during a violent event that puts her partner's life at risk. Finally, we did not find significant differences between females and males.

TABLE 5. NUMBER OF NEWBORNS AND THE OPERATION ORION

Dependent variable	Number of Newborns	
	(1)	(2)
Intervention × Orion neighborhood	-0.18	0.42
	(1.78)	(0.46)
	[0.92]	[0.47]
Controls	No	Yes
Observations	1129	1129
Neighborhoods	244	244
Mean DV	11.144	11.144
SD DV	15.196	15.196

Notes: This table presents the results from OLS regressions with the number of newborns per neighborhood as the dependent variable using data from 2002 and 2003 (May, June, July). Orion is a dummy that takes the value of one for neighborhoods where the Orion operation took place for the cohort affected by the intervention. All columns include year-month and neighborhood fixed effects. Robust standard errors clustered by neighborhood in parenthesis. P-values using wild cluster bootstrap with 9999 replications reported in brackets. Significance levels: 1% ***, 5% **, 10% *.

Figure 4: Heterogeneous Effects on Birth Weight



Notes: This figure shows the results from OLS regressions with birth weight as the dependent variable. Each point is the estimated coefficient of the intervention using the subsample described in the y-axis. The estimations include year-month and neighborhood fixed effects. Controls include mother's and father's age, dummies for the type of insurance, dummies for mother's and father's educational attainment, dummies for mother's marital status, number of previously born alive, number of pregnancies, and whether the newborn is female.

4.5. Height and Apgar score

In this section, we explore the effects of the Orion Operation on other outcomes. Table 6 reports the impact of the operation Orion on birth height and several dummy variables related to Apgar score, a proxy of the vitality of the newborn. Column 1 reports the estimated coefficient using height as the dependent variable. Results suggest that children born in a treated neighborhood who were exposed to the intervention during the first trimester of pregnancy have a height, on average, 0.5 centimeters lower than the rest of births. This effect corresponds to a reduction of 1% in the average baseline height, although it is not statistically significant using bootstrap to control for few clusters in our sample.

In columns 2 and 4 of Table 6, we show the results for the probability of birth with an Apgar score greater than seven (normal delivery) and the likelihood of being born with a low Apgar score, defined as lower than five. The results show a significant reduction of 3 percentage points in the probability of born with a high Apgar score, which means a decrease of 3.3% in the baseline average probability of birth with standard delivery, and it is statistically significant at 5% level (see p-value). The results are similar when we focus on the probability of birth with a low Apgar score (lower than 5); we found an increase of 40% in the likelihood of being born under a complicated delivery (0.7 pp compared with a pre-intervention mean of 1.7 pp). Finally, we find no statistical relationship between the operation and the probability that a child born with an Apgar score at 5 minutes above or below certain thresholds. This result suggests that the Orion operation does not impact the vitality of the children at birth at five minutes.

TABLE 6. APGAR, HEIGHT, AND THE OPERATION ORION

Dependent variable	**Height**	**Apgar 1 min > 7**	**Apgar 1 min 5-6**	**Apgar 1 min < 5**	**Apgar 5 min > 7**	**Apgar 5 min 5-6**	**Apgar 5 min < 5**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intervention × Orion neighborhood	-0.50**	-0.03*	-0.017	0.007**	-0.027*	-0.004	-0.004
	(0.24)	(0.01)	(0.010)	(0.003)	(0.016)	(0.003)	(0.004)
	[0.145]	[0.041]	[0.443]	[0.048]	[0.172]	[0.536]	[0.792]
Observations	11388	11388	11388	11388	11388	11388	11388
Neighborhoods	244	244	244	244	244	244	244
Mean DV	49.05	0.92	0.041	0.017	0.966	0.004	0.002
SD DV	2.48	0.27	0.198	0.130	0.180	0.066	0.050

Notes: This table presents the results from OLS regressions with birth weight and low birth weight as the dependent variable using data from 2002 and 2003 (May, June, July). All columns include year-month and neighborhood fixed effects. Controls include mother's and father's age, dummies for the type of insurance, dummies for mother's and father's educational attainment, dummies for mother's marital status, number of previously born alive, number of pregnancies, and whether the newborn is female. Robust standard errors clustered by neighborhood in parenthesis. Significance levels: 1% ***, 5% **, 10% *.

5. CONCLUSION

In this paper, we study the effects of the efforts by the state to end the armed conflict with the guerrillas in commune 13 in 2002 on newborns' birth weight. Our results show that the exposition to the Orion operation triggered a considerable differential reduction in birth weights in the neighborhoods intervened relative to other areas. In particular, we find that neighborhoods eventually exposed to the Orion operation experience a 2.1% reduction in average birth weight after the Orion operation compared to other areas and an increase of 40% in the probability of being born with a low Apgar score 1 minute. The possible primary mechanism is the increased stress of pregnant women exposed to the operation, leading to reductions in birth weight and vitality. One particular issue about our results is that migration due to the Orion operation may bias our estimated coefficients. This is possible if pregnant women who migrate to non-treated neighborhoods had children with different birth weights than women who stayed in the treated neighborhoods. We show that the number of births by area did not change due to Orion's operation, providing evidence that migration is not biasing our estimates.

In the specific case of the Orion operation, our findings highlight the importance of studying the unintended consequences of violent military interventions in urban areas. In this paper, we provided evidence of the high costs of the operation for children's health, implying that the opportunity cost of that military operation was, therefore, more extensive than expected. Meaning that future state intervention should consider that violence exposure generated by the confrontation with illegal armed groups negatively impacts the children's birth weight and vitality. Therefore, a less violent intervention or intervention strategy other than the military can solve the unintended consequences of this type of intervention.

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Appendix

Figure A1: Neighborhoods of Medellin and the Orion operation

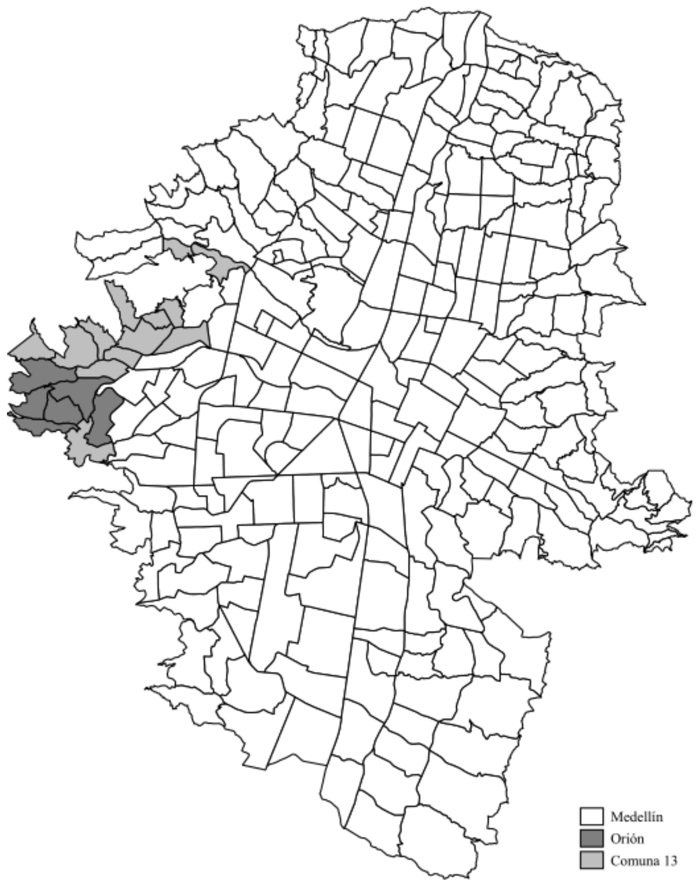

Table A1. Birthdates in the cohort affected by Orion

Date				Weeks remaining to be born at the time of Orion													
2002	Oct	16	22	29	30	31	32	33	34	35	36	37	38	39	40	41	42
2002	Oct	23	29	28	29	30	31	32	33	34	35	36	37	38	39	40	41
2002	Oct-Nov	30	5	27	28	29	30	31	32	33	34	35	36	37	38	39	40
2002	Nov	6	12	26	27	28	29	30	31	32	33	34	35	36	37	38	39
2002	Nov	13	19	25	26	27	28	29	30	31	32	33	34	35	36	37	38
2002	Nov	20	26	24	25	26	27	28	29	30	31	32	33	34	35	36	37
2002	Nov-Dec	27	3	23	24	25	26	27	28	29	30	31	32	33	34	35	36
2002	Dec	4	10	22	23	24	25	26	27	28	29	30	31	32	33	34	35
2002	Dec	11	17	21	22	23	24	25	26	27	28	29	30	31	32	33	34
2002	Dec	18	24	20	21	22	23	24	25	26	27	28	29	30	31	32	33
2002	Dec	25	31	19	20	21	22	23	24	25	26	27	28	29	30	31	32
2003	Jan	1	7	18	19	20	21	22	23	24	25	26	27	28	29	30	31
2003	Jan	8	14	17	18	19	20	21	22	23	24	25	26	27	28	29	30
2003	Jan	15	21	16	17	18	19	20	21	22	23	24	25	26	27	28	29
2003	Jan	22	28	15	16	17	18	19	20	21	22	23	24	25	26	27	28
2003	Jan-Feb	29	4	14	15	16	17	18	19	20	21	22	23	24	25	26	27
2003	Feb	5	11	13	14	15	16	17	18	19	20	21	22	23	24	25	26
2003	Feb	12	18	12	13	14	15	16	17	18	19	20	21	22	23	24	25
2003	Feb	19	25	11	12	13	14	15	16	17	18	19	20	21	22	23	24
2003	Feb-Mar	26	4	10	11	12	13	14	15	16	17	18	19	20	21	22	23
2003	Mar	5	11	9	10	11	12	13	14	15	16	17	18	19	20	21	22
2003	Mar	12	18	8	9	10	11	12	13	14	15	16	17	18	19	20	21
2003	Mar	19	25	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2003	Mar-Apr	26	1	6	7	8	9	10	11	12	13	14	15	16	17	18	19
2003	Apr	2	8	5	6	7	8	9	10	11	12	13	14	15	16	17	18
2003	Apr	9	15	4	5	6	7	8	9	10	11	12	13	14	15	16	17
2003	Apr	16	22	3	4	5	6	7	8	9	10	11	12	13	14	15	16
2003	Apr	23	29	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2003	Apr-May	30	6	1	2	3	4	5	6	7	8	9	10	11	12	13	14
2003	May	7	13		1	2	3	4	5	6	7	8	9	10	11	12	13
2003	May	14	20			1	2	3	4	5	6	7	8	9	10	11	12
2003	May	21	27				1	2	3	4	5	6	7	8	9	10	11
2003	May-Jun	28	3					1	2	3	4	5	6	7	8	9	10
2003	Jun	4	10						1	2	3	4	5	6	7	8	9
2003	Jun	11	17							1	2	3	4	5	6	7	8
2003	Jun	18	24								1	2	3	4	5	6	7
2003	Jun-Jul	25	1									1	2	3	4	5	6
2003	Jul	2	8										1	2	3	4	5
2003	Jul	9	15											1	2	3	4
2003	Jul	16	22												1	2	3
2003	Jul	23	29													1	2
2003	Jul-Agu	30	5														1

Table A2. Birth weight and the operation Orion during the third trimester of pregnancy

Dependent variable	Birth Weight		Low Birth Weight	
	(1)	(2)	(3)	(4)
Orion	3.76	2.97	-0.039	-0.041
	(66.97)	(67.31)	(0.037)	(0.037)
	[0.962]	[0.968]	[0.360]	[0.341]
Controls	No	Yes	No	Yes
Observations	11902	11902	11902	11902
Neighborhoods	245	245	245	245
Mean DV	3,076.56	3,076.56	0.091	0.091
SD DV	483.70	483.70	0.288	0.288

Notes: This table presents the results from OLS regressions with birth weight and low birth weight as the dependent variable using data from 2001 and 2002 (October, November, Dicember). Orion is a dummy that takes the value of one for treated neighborhoods after exposure to the intervention. All columns include year-month and neighborhood fixed effects. Controls in columns (2) and (4) include mother's and father's age, dummies for the type of insurance, dummies for mother's and father's educational attainment, dummies for mother's marital status, number of previously born alive, number of pregnancies, and whether the newborn if female. Robust standard errors clustered by neighborhood reported in parenthesis. P-values using wild cluster bootstrap with 9999 replications reported in brackets. Significance levels: 1% ***, 5% **, 10% *.