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The impacts of armed conflicts on prenatal and delivery care utilization

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ABSTRACT

This study investigates the extent to which exposure to armed conflicts during pregnancy influences women's utilization of prenatal and delivery care in 35 developing countries between 1990 and 2018. Exploiting the variation across residential districts and conception months-years in a difference-in-differences framework, we find that women exposed to armed conflicts during pregnancy tend to receive insufficient prenatal and delivery care evident by the declines in the composite indices of Prenatal Care and Delivery Care by 6.76 and 6.83% compared to the sample averages, respectively. Given the importance of prenatal care and delivery care to the health of mothers and newborns, our findings call for effective interventions to support mothers and babies during and after conflicts.

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Prenatal care; delivery care; armed conflicts

1. Introduction

The world has witnessed an increasing trend in armed conflicts since the mid-2000s (Cederman & Pengl, 2019). Not only do armed conflicts lead to humanitarian crises but they also depress the economy (Dunne, Hoeffler, & Mack, 2013; United Nations (UN), 2016). Specifically, it is documented that armed conflicts devastate production capacity, destroy infrastructure, and impose deaths/injuries on the workforce (Bruck, De Groot, & Bozzoli, 2012; Dunne et al., 2013; Sachs, 2008). Alamir, Bozzoli, Bruck, and De Groot (2018) show that the total GDP loss due to armed conflicts during the period of 1960–2014 amounted to US\$26.8 trillion (in 2010 prices), corresponding to 33% of global GDP in 2014. Besides these apparent costs, armed conflicts also leave less salient yet detrimental ramifications on human development. In particular, armed conflicts are documented to lower educational outcomes in both quantity and quality dimensions among those exposed (Bruck, Di Maio, & Miaari, 2019; Le & Nguyen, 2020a). Furthermore, pregnant women experiencing armed conflicts tend to face higher risks of pregnancy-related deaths and are more likely to give birth to unhealthy babies (Brown, 2020; Kotsadam & Ostby, 2019; Quintana-Domeque & Ródenas-Serrano, 2017).

Our study investigates the extent to which exposure to armed conflicts during pregnancy influences women's utilization of prenatal and delivery care in 35 developing countries between 1990 and 2018. The study makes three contributions. First, whereas

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prior studies focus on the more salient and immediate impacts of armed conflicts (Bruck, Justino, & Martin-Shields, 2017), our study evaluates the less visible yet non-negligible cost. Second, we rigorously analyze various aspects of women's health care utilization during both prenatal and delivery periods, while prior studies tend to concentrate on only one aspect such as institutional delivery (Chandrasekhar, Gebreselassie, & Jayaraman, 2011; Ostby et al., 2018). Finally, we quantify the impacts of interest for a sample of 35 developing countries over nearly 30 years. With such a wide coverage in both time and space dimensions, our findings can be generalized to many contexts and can provide meaningful implications for many governments.

In the paper, we employ the Demographic and Health Surveys (DHS) for the detailed information on women's prenatal and delivery care utilization for each birth case. Data on armed conflict are obtained from the Uppsala Conflict Data Program Geo-referenced Event Dataset (UCDP-GED). The richness of the DHS allows us to construct two composite indices (Prenatal Care Index and Delivery Care Index) that capture women's utilization of prenatal and delivery care based on a variety of item questions on numerous aspects of care. The detailed information in the UCDP-GED enables us to determine if armed conflicts ever took place in the woman's district of residence during her pregnancy interval. Our identification strategy is the difference-in-differences model which exploits the differences in the prenatal and delivery care utilization of women exposed to armed conflicts during pregnancy with the outcomes of women unexposed to armed conflicts during pregnancy living in the same district, relative to the analogous differences for women residing in other districts.

Our findings can be summarized as follows. Exposure to armed conflicts during pregnancy reduces women's utilization of prenatal care and delivery care indicated by the declines in the composite indices of Prenatal Care and Delivery Care by 6.76 and 6.83% compared to the sample averages, respectively. Exploring the items underlying the Prenatal Care Index, we find that conflict exposure decreases the probabilities of women having a sufficient number of four prenatal visits as recommended by the WHO (World Health Organization (WHO), 2006), obtaining prenatal care from formal sources (from doctor, nurse/midwife, obstetrician/gynecologist, or other trained professionals), having their blood pressure measured, having urine tests, having blood tests, and taking iron supplements during pregnancy by 7.56, 4.54, 7.76, 9.52, 6.52, and 7.78% compared to the sample averages, respectively. Examining the items underlying the Delivery Care Index, we detect the reductions in the probabilities of having a skilled attendant at delivery, giving birth in an official health facility, having Cesarean delivery, and receiving vitamin supplement after delivery by 6.16, 9.18, 7.23, and 8.99% compared to the sample means, respectively.

Our study emphasizes the less discernible yet non-negligible consequences of armed conflicts. The cost of conflicts extends beyond the immediate loss of life and permanent injuries to the exacerbation of women's utilization of prenatal and delivery care. To the extent that insufficient care during pregnancy and delivery raises the risk of pregnancy-related morbidity for the mothers and the risk of poor birth outcomes for the babies (Conway & Kutinova, 2006; Gajate-Garrido, 2013; Wehby, Murray, Castilla, Lopez-Camelo, & Ohsfeldt, 2009), our findings imply that armed conflicts could hinder our progress toward not only the Sustainable Development Goal 16 (SDG-16, peace, justice, and strong institutions) but also

SDG-3 (good health and well being). The study implies that it is necessary to have policy interventions to improve maternal health during conflicts. Post-conflict assistance programs targeting women and children affected by armed conflicts are also important to alleviate the atrocious cost to human development.

The study proceeds as follows. [Section 2](#) summarizes related literature. [Section 3](#) describes the data, variable constructions, and estimation sample. [Section 4](#) presents the empirical methodology. [Section 5](#) discusses the results. [Section 6](#) concludes the paper.

2. Literature review

This study is related to the strand of literature that focuses on the cost of armed conflicts. In particular, the salient and devastating repercussions of armed conflicts range from battle-related deaths to hidden casualties as it might take years for people to die after the end of a conflict (Dunne et al., 2013). The cost of armed conflicts also lies in the depression of production capacity and output loss (Dunne et al., 2013; Sachs, 2008). Besides, armed conflicts leave less visible yet serious consequences on human development. Individuals exposed to armed conflict in early life end up with poorer health, lower educational attainment, and declining earnings in the long run (Bundervoet, Verwimp, & Akresh, 2009; Leon, 2012; Shemyakina, 2011). Women experiencing violent conflicts during pregnancy are reported to have unfavorable birth outcomes such as low birth weight and premature babies (Brown, 2020; Mansour & Rees, 2012). Closest to our paper are the studies exploring the impacts of conflicts on maternal health utilization. Specifically, Chandrasekhar et al. (2011) document a decrease in the number of births in health facilities during a conflict in Rwanda. In the context of Africa, Ostby et al. (2018) show that organized violence events lead to the reduction in the likelihood that a child is born in a health facility.

Our study also fits into the line of literature that explores factors determining women's utilization of health care during pregnancy and delivery periods. Specifically, education is found to be an important determinant of women's utilization of prenatal and delivery care in multiple settings. In the context of Ghana, Yakong, Rush, Bassett-Smith, Bottorff, and Robinson (2010) document that education is consistently associated with women's tendency to obtain prenatal care and skilled attendance at birth delivery. Kifle, Azale, Gelaw, and Melsew (2017) show that literate Ethiopian women and those with formal education are more likely to utilize prenatal care services and obtain institutional delivery. Le and Nguyen (2020b) also find that educated women tend to have more prenatal visits, acquire prenatal care from formal sources, have institutional delivery, have delivery assisted by professionals in developing countries. Not only does women's own education but the husband's education also has an effect on women's maternal and reproductive health care utilization. Particularly, women whose husbands have formal education are more likely to obtain institutional delivery compared to women with uneducated husbands (Kifle et al., 2017). Besides, son preference can affect prenatal care utilization because the strong preference for sons could enable women who are pregnant with male fetuses to obtain more proper care (Lhila & Simon, 2008; Nguyen & Le, 2022). Furthermore, nurses' relational practices is another factor influencing women's utilization of health care. For example, Yakong et al. (2010) report that inadequate

relational practices by nurses such as intimidation, silent treatment, inattention to women's privacy put a significant constraint to women's health care utilization during pregnancy.

3. Data

3.1. Demographic and health surveys

We draw from the Demographic and Health Surveys (DHS) for the data on pregnant women. The DHS is managed by the Inner City Fund International and funded by the World Health Organization and other parties.¹ The DHS offers rich information on women of reproductive ages (between 15 and 49 years old) regarding various aspects such as demographics, fertility, health, among others. We mainly depend on the Woman File of the DHS for detailed information on women's utilization of prenatal care and delivery care services, as well as information on their child (e.g., gender, birth month-year, birth order, among others).

To determine whether an armed conflict occurred in the woman's place of residence, we need to match the conflict data with the woman data, which requires the geographic locations of participating women. Therefore, we utilize the Global Positioning System (GPS) components in the DHS. In the DHS waves which are accompanied by the GPS dataset, the woman's residential cluster can be located with latitude and longitude coordinates. The lowest administrative level into which the lat-long coordinates fall is the district.

3.2. Uppsala conflict data program geo-referenced event dataset

We utilize the Uppsala Conflict Data Program Geo-referenced Event Dataset (UCDP-GED) for a comprehensive record of armed conflicts worldwide. The UCDP-GED which contains information on global conflicts since 1989 is compiled by the Department of Peace and Conflict Research of Uppsala University. According to UCDP-GED's definition, an event of conflict refers to an event of violence that involves the use of weapons by an "organized actor" against another "organized actor" or against civilians and causes at least one direct death (Stina, 2019; Sundberg & Melander, 2013). The UCDP-GED provides the occurrence location and time for each event of conflict. Each location is described by latitude and longitude coordinates. The lowest level of time recorded is the day.

Next, we merge the UCDP-GED with the DHS-GPS by assigning armed conflict events to the corresponding residential district of women. We place four restrictions to the data to construct our sample. First, we restrict our sample to DHS countries experiencing armed conflicts that are reported in the UCDP-GED. Besides, we only utilize DHS waves that have the GPS components so that we can identify the geographic locations of women. Furthermore, only data waves with information on women's utilization of prenatal and delivery care can enter our sample since these are our outcomes of interest (Section 3.3). Finally, our sample includes women who have always lived in their current places of residence because women's migration history is not available in the data. Given these restrictions, we end up with over 650,000 women

¹Other funders include the United Nations Children's Fund, the United States Agency for International Development, the United Nations Population Fund, and the Joint United Nations Program on HIV and AIDS

from 35 developing countries. Our estimation data also have complete information on the record of armed conflicts for the woman's residential district and the birth month-year of the child which allows us to infer the gestation period. The information enables us to determine whether the woman was exposed to armed conflicts during pregnancy.

3.3. Variable construction

Explanatory Variables — Our main explanatory variable is the indicator for whether the woman was exposed to armed conflicts during pregnancy (*Exposed*). From the birth month-year of the child, we can calculate the conception month-year and identify the woman's pregnancy interval. From the conflict record of the woman's district, we know if armed conflicts occurred during the woman's pregnancy interval. The variable *Exposed* takes the value of one if the woman was exposed to armed conflicts during pregnancy, and zero otherwise. For example, suppose a child was born in July 2010, it means the mother was pregnant from November 2009 to July 2010. If armed conflicts occurred in her district between November 2009 and July 2010, she was considered exposed to armed conflict during pregnancy (*Exposed* = 1). However, if armed conflicts occurred in December 2010, the woman was unexposed to conflicts during pregnancy (*Exposed* = 0). Approximately, 8.1% of women in our sample experienced armed conflicts in their residential district during gestation (Panel A, [Table 1](#)).

Besides the main explanatory variable, we also include other control variables, the summary statistics of which are provided in Panel A of [Table 1](#). The mean age of women at the time of conception is 25.92. Women complete 4.9 years of education on average.

Table 1. Summary Statistics.

	Average	SD	Sample Size
	(1)	(2)	(3)
Panel A: Controls			
Exposed	0.081	0.272	656,307
Age at Conception	25.92	6.328	656,307
Years of Education	4.898	5.022	656,051
Living in Urban Area	0.289	0.453	656,307
Being Married	0.847	0.360	656,307
Birth of Male Baby	0.510	0.500	656,307
Plural Birth	0.011	0.104	656,307
Birth Order	3.342	2.273	656,307
Panel B: Outcomes			
Prenatal Care Index	43.37	40.95	656,307
Sufficient Visits	0.476	0.499	496,360
Formal Sources of Care	0.749	0.434	499,046
Blood Pressure	0.464	0.499	656,307
Urine Test	0.378	0.485	656,307
Blood Test	0.399	0.490	656,307
Iron Supplement	0.424	0.494	656,307
Delivery Care Index	36.17	32.19	650,846
Skilled Attendant	0.617	0.486	635,782
Institutional Delivery	0.403	0.491	643,524
Cesarean Delivery	0.083	0.276	646,586
Vitamin after Delivery	0.289	0.453	204,430

Roughly 28.9% of women live in an urban area. The majority of women are married (84.7%). The proportions of male babies and plural birth are 51% and 1.1%, respectively. The average value for birth order is 3.34.

Outcome Variables — To assess women's utilization of prenatal care and delivery care, we draw from women's responses to various questions on different components of care they received during pregnancy and delivery. Regarding prenatal care, we look at: (i) whether the woman received prenatal care at least four times during pregnancy (Sufficient Visits) as recommended by the WHO (World Health Organization (WHO), 2006), (ii) whether the woman sought care from formal sources such as services provided by doctor, nurse/midwife, obstetrician/gynecologist, or other trained professionals (Formal Sources of Care), (iii) whether the woman had her blood pressure measured during pregnancy (Blood Pressure), (iv) whether the woman had urine test during pregnancy (Urine Test), (v) whether she had blood test during pregnancy (Blood Test), and (vi) whether the woman took iron supplement during pregnancy (Iron Supplement). In other words, the variables Sufficient Visits, Formal Sources of Care, Blood Pressure, Urine Test, Blood Test, and Iron Supplement are indicators taking the value of one if the woman had at least four prenatal visits, received prenatal care from formal sources, had her blood pressure measured, had her urine and blood tests, and took iron supplement during pregnancy, respectively, and zero otherwise. We then take the average of these variables and multiplied with 100 to generate the Prenatal Care composite index proxying for women's utilization of prenatal care.

As for delivery care, we examine: (i) whether the delivery was assisted by a professional such as doctor, nurse/midwife, obstetrician/gynecologist, or other trained professionals (Skilled Attendant), (ii) whether the woman delivered her baby in an official health facility such as a public hospital, a public health center, other public facilities, a private hospital/clinic, or other private facilities (Institutional Delivery), (iii) whether the woman had Cesarean delivery (Cesarean Delivery), and (iv) whether the woman received vitamin supplement after delivery (Vitamin after Delivery). To put it differently, the variables Skilled Attendant, Institutional Delivery, Cesarean Delivery, and Vitamin after Delivery are dummy variables taking the value of one if the woman had her delivery assisted by a trained professional, the woman gave birth in an official health facility, the woman had C-section delivery, and the woman received vitamin supplement after birth, respectively, and zero otherwise. To reflect women's utilization of delivery care, we average across the four above-mentioned variables and multiplied with 100 to construct the Delivery Care Index.

Descriptive statistics of outcome variables are reported in Panel B of [Table 1](#). The Prenatal Care Index takes the mean of 43.37. Approximately 47.6, 74.9, 46.4, 37.8, 39.9, and 42.4% of women report meeting WHO recommended level of prenatal visits, receiving care from formal sources, having blood pressure measured, having urine and blood tests, as well as receiving iron supplement during pregnancy, respectively. The average value of the Delivery Care Index is 36.17. The proportions of women who report having their birth delivery assisted by a trained professional, having institutional delivery, having Cesarean delivery, and receiving vitamin supplement after delivery are 61.7, 40.3, 8.3, and 28.9%, respectively.

4. Empirical methodology

To evaluate the impacts of exposure to armed conflict during pregnancy on prenatal and delivery care utilization, we use the following regression model,

$$Y_{ist} = \beta_0 + \beta_1 Exposed_{ist} + X'_{ist}\Phi + \lambda_s + \delta_t + \epsilon_{ist} \quad (1)$$

The subscripts i , s , and t denote woman, residential district, and conception month-year, respectively. The outcome variable Y_{ist} represents the Prenatal Care and Delivery Care indices as well as the underlying items as presented in Panel B of Table 1. Our main explanatory variable $Exposed_{ist}$ is a dummy variable that equals one if the woman experienced armed conflicts in her residential district during pregnancy, and zero otherwise. The covariate X'_{ist} includes woman's age at conception, woman's age at conception squared, woman's education, whether the woman lives in the urban area, woman's marital status, the gender of the baby, plural birth indicator, birth order of the baby, and country-specific linear trend. The terms λ_s and δ_t represent residential district and conception month-year fixed effects, respectively. Finally, ϵ_{ist} denote the error term. Standard errors throughout the paper are clustered at the district and child's birth year.²

Our empirical model given in Equation (1) is the difference-in-differences (DiD). The coefficient of interest is β_1 which captures the impacts of exposure to armed conflicts during pregnancy on women's utilization of prenatal and delivery care. Our DiD model compares the prenatal and delivery care utilization of women subject to armed conflicts during pregnancy with the outcomes of women unexposed to armed conflicts when they are pregnant within the same district, relative to the analogous differences for women living in another district. In other words, in this setup, the treatment group consists of women who experienced armed conflicts in their districts during pregnancy. The control group comprises those totally unexposed to armed conflicts, those exposed prior to conception, and those exposed after birth delivery. The identifying assumption is that within-district unobservables should not simultaneously affect the timing of armed conflicts and women's utilization of prenatal as well as delivery care.

To provide evidence for the comparability between women in the control group and women in the treatment group, we conduct a balance test in the spirit of Buckles and Hungerman (2013). Particularly, we regress some women's characteristics (age at birth, education, residential place, fertility, etc.) on the $Exposed_{ist}$ indicator, conditioning on the country-specific linear trend and the fixed effects for district and birth month-year. The results shown in Table A2 suggest that women's characteristics are not correlated with whether they are subject to armed conflict during pregnancy, i.e., women from the control group are comparable to women from the treatment group.

5. Results

5.1. Overall composite indices

The estimated impacts of armed conflicts on the composite indices of Prenatal Care and Delivery Care are displayed in Table 2. The outcome variable is the Prenatal Care index for Columns 1 through 3. Columns 4 through 5 present the results for the Delivery Care index as the dependent variable.

²Since there could be spatial and temporal correlation in standard errors, we adopt two-way clustering at the district and child's birth year levels (Conley, 1999, 2008; Hsiang, 2010).

Table 2. Prenatal and Delivery Care Indices.

	Prenatal Care Index			Delivery Care Index		
	(1)	(2)	(3)	(4)	(5)	(6)
Exposed	-4.350** (1.858)	-3.816*** (0.894)	-2.928*** (0.804)	-3.471*** (0.833)	-3.055*** (0.667)	-2.468*** (0.548)
Observations	656,277	656,277	656,021	650,812	650,812	650,556
Other Controls	.	.	✓	.	.	✓
Conception Mth-Yr FE	.	✓	✓	.	✓	✓
District FE	✓	✓	✓	✓	✓	✓

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. FE stands for fixed effects. Other Controls include woman's age at conception, woman's age at conception squared, woman's education, whether the woman lives in the urban area, woman's marital status, the gender of the baby, plural birth indicator, birth order of the baby, and country-specific linear trend.

Table 2 suggests that exposure to armed conflicts during pregnancy reduces women's utilization of prenatal care and delivery care. According to the most parsimonious specifications, exposure to armed conflicts is linked with the declines in the composite indices of Prenatal Care and Delivery Care by 4.35 and 3.47 points, respectively (Columns 1 and 4). With the inclusion of conception month-year fixed effects, the point estimates decline by 12.3 and 12.0% (Columns 2 and 5) while the estimates remain statistically significant. Finally, the most extensive specifications in Columns 3 and 6 suggest that exposed women tend to have worse prenatal and delivery care, evidenced by the reductions by 2.93 and 2.47 points in the Prenatal Care and Delivery Care indices, respectively. These estimates represent the 6.76 and 6.83% decreases relative to the sample averages, respectively.

5.2. Underlying items

To further explore which aspects of care are driving the deterioration in women's prenatal and delivery care utilization induced by conflicts, we examine the items underlying the Prenatal Care and Delivery Care indices. The estimating results are reported in Tables 3 and 4, respectively. All estimates come from our most extensive specification (similar to Columns 3 and 6 of Table 2).

Starting with the items underlying the Prenatal Care index in Table 3, we find that armed conflicts exacerbate women's prenatal care utilization in all aspects. Specifically, evident from Column 1, women exposed to armed conflicts during pregnancy are 3.6 percentage points less likely to meet WHO recommended level of prenatal visits

Table 3. Prenatal Care by Items.

	Sufficient	Formal	Blood	Urine	Blood	Iron
	Visits	Sources of Care	Pressure	Test	Test	Supplement
	(1)	(2)	(3)	(4)	(5)	(6)
Exposed	-0.036*** (0.009)	-0.034*** (0.010)	-0.034*** (0.009)	-0.036*** (0.008)	-0.026*** (0.008)	-0.033*** (0.009)
Observations	496,134	498,822	656,021	656,021	656,021	656,021

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. All regressions control for conception month-year fixed effects, district fixed effects, woman's age at conception, woman's age at conception squared, woman's education, whether the woman lives in the urban area, woman's marital status, the gender of the baby, plural birth indicator, birth order of the baby, and country-specific linear trend.

Table 4. Delivery Care by Items.

	Skilled Attendant	Institutional Delivery	Cesarean Delivery	Vitamin after Delivery
	(1)	(2)	(3)	(4)
Exposed	−0.038*** (0.003)	−0.037*** (0.003)	−0.006*** (0.002)	−0.026*** (0.005)
Observations	635,493	643,231	646,305	204,338

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. All regressions control for conception month-year fixed effects, district fixed effects, woman's age at conception, woman's age at conception squared, woman's education, whether the woman lives in the urban area, woman's marital status, the gender of the baby, plural birth indicator, birth order of the baby, and country-specific linear trend.

(i.e., receiving prenatal care at least four times). As shown in Column 2, experiencing armed conflicts during pregnancy makes women 3.4 percentage points less likely to obtain prenatal care from formal sources (defined as services provided by doctor, nurse/midwife, obstetrician/gynecologist, or other trained professionals). Next, we further find that being subject to armed conflicts during pregnancy reduces the likelihood of women having their blood pressure measured, having urine tests, having blood tests, and taking iron supplements by 3.4, 3.6, 2.6, and 3.3 percentage points, respectively (Columns 3 through 6). The estimates in Table 3 represent the decreases by 7.56, 4.54, 7.76, 9.52, 6.52, and 7.78 % in the probabilities of having at least four prenatal visits, acquiring prenatal care from formal sources, having blood pressure measured, having urine tests, having blood tests, and receiving iron supplements compared to the sample averages, respectively.

We proceed with the items underlying the Delivery Care index in Table 4. As shown in Columns 1 and 2, we find that women who are exposed to armed conflicts during pregnancy are 3.8 percentage points less likely to have their delivery assisted by a skilled attendant (e.g., doctor, nurse/midwife, obstetrician/gynecologist, or other trained professionals) and are 3.7 percentage points less likely to deliver their babies in an official health facility. Moving on to Columns 3 and 4, we find that exposed women are 0.6, and 2.6 percentage points less likely to have Cesarean delivery, and receive vitamin supplements after delivery, respectively. The estimates in Table 4 correspond to the decreases by 6.16, 9.18, 7.23, and 8.99% in the probabilities of having delivery assistance by a skilled attendant, institutional delivery, C-section delivery, and vitamin supplement after delivery relative to the sample averages, respectively.

5.3. Heterogeneity

We proceed to investigate if the effects of armed conflict differ by baby's gender, woman's education, and woman's wealth. First, we re-estimate our most extensive specification for women who were pregnant with male babies and women who were pregnant with female babies separately. It is possible that son preference might make better resources devoted to male babies (Aurino, 2017; Baker & Milligan, 2016; Le & Nguyen, 2022), therefore, the impacts among mothers of male babies may potentially be smaller. However, according to Panels A and B of Table 5, armed conflicts reduce the utilization of prenatal care and delivery care of mothers of both male and female babies and the impacts do not largely differ between these two groups.

Table 5. Heterogeneous Impacts of Armed Conflicts.

	Prenatal Care Index	Delivery Care Index
	(1)	(2)
Panel A: Boys		
Exposed	−3.508*** (0.759)	−2.556*** (0.523)
Observations	334,224	331,468
Panel B: Girls		
Exposed	−3.215*** (0.895)	−2.396*** (0.595)
Observations	321,711	318,997
Panel C: Low Educated Women		
Exposed	−3.748*** (0.847)	−2.586*** (0.545)
Observations	360,721	358,334
Panel D: High Education Women		
Exposed	−1.389* (0.734)	−1.775*** (0.539)
Observations	289,961	286,877
Panel E: Poor Women		
Exposed	−2.604** (0.960)	−2.135*** (0.572)
Observations	263,502	261,215
Panel F: Nonpoor Women		
Exposed	−3.540*** (0.727)	−2.156*** (0.411)
Observations	404,668	402,320

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. All regressions control for conception month-year fixed effects, district fixed effects, woman's age at conception, woman's age at conception squared, woman's education, whether the woman lives in the urban area, woman's marital status, the gender of the baby, plural birth indicator, birth order of the baby, and country-specific linear trend.

As prior studies show that maternal education could have favorable impacts of education on health behavior and child health (Alderman & Headley, 2017; Grepin & Bharadwaj, 2015), we want to explore whether low educated women and high education women are differentially affected. Low educated women do not complete primary education while high education women complete at least primary schooling. We re-run our most extensive model for the two groups separately. As evident from Panels C and D of Table 5, the utilization of prenatal care and delivery care declines more substantially among low educated women than high education women.

Finally, we examine whether there are heterogeneous impacts of armed conflict by maternal wealth because socio-economic background might influence the repercussions of adverse shocks (Currie, 2009). We estimate the most extensive regression model separately for poor and non-poor mothers. Poor mothers refer to women from households whose wealth index is in the bottom two quintiles of the within-country wealth distribution. Non-poor mothers come from households whose wealth index is in the third, fourth, and top quintiles of the within-country wealth distribution. As shown in Panels E and F, there is not enough evidence for the stark differences in the impacts of armed conflict among poor and non-poor mothers.

5.4. Robustness

So far we have found evidence that armed conflicts worsen women's utilization of prenatal care and delivery care. In this section, we conduct multiple robustness checks to further support the integrity of our findings. In the first set of exercises, we use alternative measures of conflicts instead of the *Exposed* indicator as described in Section 3.3. In the second set of exercises, we adopt different model specifications. The estimating results are reported in Tables 6 and 7, respectively.

We proceed to utilize alternative measures of conflict in Table 6. Outcomes are Prenatal Care Index in Panel A and Delivery Care Index in Panel B. We first replace the *Exposed* indicator with the log number of conflicts that occurred in the woman's district during her pregnancy.³ As the number of conflicts increases by 10%, women's Prenatal Care and Delivery Care indices fall by approximately 0.23 and 0.17 points, respectively (Column 1). Second, instead of using the log number of conflicts, we employ the standardized measure of the number of conflicts by standardizing the number of conflicts in the woman's district during pregnancy across the sample to have zero mean and unit variance. We find that a one standard deviation increase in the number of conflicts decreases the Prenatal Care and Delivery Care indices by 0.48 and 0.36 points (Column 2). Third, we use the log number of fatalities due to armed conflict in the woman's district during her pregnancy as our main explanatory variable.⁴ We find that a 10% increase in the number of fatalities is

Table 6. Robustness 1: Other Measures.

	(1)	(2)	(3)	(4)
Panel A: Y = Prenatal Care Index				
Log Number of Conflict	-2.332*** (0.125)			
Standardized Number of Conflict		-0.476*** (0.048)		
Log Number of Fatalities			-0.396*** (0.048)	
Standardized Number of Fatalities				-0.119*** (0.024)
Observations	656,021	656,021	656,021	656,021
Panel B: Y = Delivery Care Index				
Log Number of Conflict	-1.667*** (0.099)			
Standardized Number of Conflict		-0.362*** (0.037)		
Log Number of Fatalities			-0.352*** (0.037)	
Standardized Number of Fatalities				-0.055** (0.021)
Observations	650,556	650,556	650,556	650,556

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. All regressions control for conception month-year fixed effects, district fixed effects, woman's age at conception, woman's age at conception squared, woman's education, whether the woman lives in the urban area, woman's marital status, the gender of the baby, plural birth indicator, birth order of the baby, and country-specific linear trend.

³We use the log of one plus the number of conflicts to avoid the omission of districts without any conflict during women's pregnancy interval. We use UCDP-GED's definition of conflict where conflict is defined as an event of violence involving the use of weapons by an "organized actor" against another "organized actor" or against civilians and causing at least one direct death (Stina, 2019; Sundberg & Melander, 2013). One event is counted as one conflict.

⁴We use the log one plus the number of fatalities, just as the log measure of the number of conflicts, to avoid the omission of districts without any conflict during women's pregnancy interval.

Table 7. Robustness 2: Other Specifications.

	Prenatal Care Index			Delivery Care Index		
	No Child Gender	No Teenage Mother	Nearby Districts	No Child Gender	No Teenage Mother	Nearby Districts
	(1)	(2)	(3)	(4)	(5)	(6)
Exposed	-3.354*** (0.211)	-3.243*** (0.223)	-4.482*** (0.224)	-2.470*** (0.162)	-2.485*** (0.171)	-3.017*** (0.171)
Exposed (Neighbor)			-2.836*** (0.166)			-1.212*** (0.127)
Observations	656,021	589,400	656,021	650,556	584,401	650,556

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. All regressions control for conception month-year fixed effects, district fixed effects, woman's age at conception, woman's age at conception squared, woman's education, whether the woman lives in the urban area, woman's marital status, plural birth indicator, birth order of the baby, and country-specific linear trend. Regressions in Columns 2, 3, 5, and 6 also control for the gender of the baby. Regressions in Columns 3 and 6 further accounts for conflict exposure in neighboring districts. Exposed (Neighbor) is an indicator taking the value of one if there is armed conflict in any district neighboring the woman's residential district during her pregnancy, and zero otherwise

associated with the 0.40 and 0.35 point increases in the Prenatal Care Index and Delivery Care Index, respectively (Column 3). Finally, instead of the log measure, we use the standardized measure of the number of fatalities due to armed conflict. A one standard deviation increase in the number of fatalities leads to the reductions in the Prenatal Care Index and Delivery Care Index by 0.12 and 0.06 standard deviations, respectively (Column 4). All point estimates are statistically distinguishable from zero, suggesting that our main findings on the relationship between armed conflicts and women's utilization of prenatal care and delivery care do not depend on how we construct the conflict measure.

Next, we adopt different model specifications in Table 7. First, we remove the baby's gender from the model since distressing events such as armed conflicts could affect the number of male births (Catalano, Bruckner, Marks, & Eskenazi, 2006; Sanders & Stoecker, 2015). As evident from Columns 1 and 4, we still find statistically and economically significant impacts of armed conflict exposure on women's utilization of prenatal care and delivery care. Second, we exclude teenage mothers from our regressions because teenage pregnancy might influence mother and baby outcomes (Chen et al., 2007; Gibbs, Wendt, Peters, & Hogue, 2012). We also want to rule out the possibility that our results are driven by teenage mothers. As shown in Columns 2 and 5, with the exclusion of teenage mothers, our estimates remain significant in both statistical and economic terms. Finally, because pregnant women could be affected by not only conflict in their own districts but also by conflict in neighboring districts, we control for conflict in nearby districts in our model. Exposed (Neighbor) is an indicator that equals one if armed conflict occurs in any district neighboring the woman's residential district during her pregnancy, and zero otherwise. Evident from Columns 3 and 6, the main impacts (coefficients on the Exposed indicator) are larger when nearby districts' conflict is accounted for. It is possible that these estimates might represent the average of the spillover effects from neighboring districts' conflicts and the effects of conflicts in women's own districts. Taken together, our main findings are not sensitive to different model specifications.

5.5. Discussion

This study has provided evidence on the impacts of armed conflict exposure during pregnancy on women's utilization of prenatal and delivery care. In particular, exposure to armed conflicts during pregnancy reduces the composite indices of Prenatal Care and Delivery Care by 2.93 and 2.47 points, representing the 6.76 and 6.83% decreases relative to the sample averages, respectively. Our findings are robust to different measures of the main explanatory variable as well as model specifications.

Exploring the items underlying the Prenatal Care index, we show that women experiencing armed conflicts during pregnancy are 3.6, 3.4, 3.4, 3.6, 2.6, and 3.3 percentage points less likely to have a sufficient number of prenatal visits, to access prenatal care from formal sources, to have their blood pressure measured, to have urine tests, to have blood tests, and to have iron supplements during pregnancy, respectively. Taking the proportions of women adopting each aspect of prenatal care as the benchmarks, our estimates correspond to the reductions by 7.56, 4.54, 7.76, 9.52, 6.52, and 7.78% in the probabilities of having the WHO recommended level of four prenatal visits, acquiring prenatal care from formal sources, having blood pressure measured, having urine tests, having blood tests, and receiving iron supplements during pregnancy, respectively. The negative impacts of armed conflicts on these components of prenatal care might have serious implications. Specifically, reaching the WHO recommended level of four prenatal visits is important to prevent pregnancy-related complications (World Health Organization (WHO), 2006). Besides, receiving care from accredited health professionals (formal sources) allows women to acquire reliable advice to protect themselves and the fetuses as well as reduces the risk of misinformation and uncertainty. Furthermore, blood pressure checks can prevent infant mortality, prematurity, and low birth weight (Centers for Disease Control (CDC), 2016; Lincetto, Mothebesoane-Anoh, Gomez, & Munjanja, 2006). Urine tests and blood tests are intended to assess the development of the fetus, check the well-being of the mother, as well as screen for particular conditions. Iron supplement intake during pregnancy can avoid maternal anemia, puerperal sepsis, low birth weight, and preterm birth (World Health Organization (WHO), 2016). By decreasing the probabilities of women having at least four prenatal visits, obtaining prenatal care from formal sources, having blood pressure measured, having urine and blood tests, and taking iron supplements during pregnancy, armed conflicts might put pregnant women's and their babies' health at risk.

Exploring the items underlying the Delivery Care index, we detect that exposure to armed conflicts during pregnancy decreases the probabilities of women having their delivery assisted by a skilled attendant, delivering their babies in an official health facility, having Cesarean delivery, and receiving vitamin supplements after delivery by 3.8, 3.7, 0.6, and 2.6 percentage points, respectively. These estimates correspond to the reductions by 6.16, 9.18, 7.23, and 8.99% compared to the sample averages, respectively. The adverse impacts armed conflicts impose on these four components of delivery care entail important implications. Because accredited health professionals (skilled attendants) are formally trained to manage childbirth and complications in women as well as newborns, their presence at delivery is crucial in curtailing maternal and infant deaths (World Health Organization (WHO), 2004). Besides, given the adequate quality of care of obstetric and newborn services an official health facility can offer, institutional delivery

can reduce the risk of intrapartum complications and neonatal mortality (Khanam et al., 2018; McKinnon, Harper, Kaufman, & Bergevin, 2015). Moreover, C-section delivery is a safe method of delivery for the mother and the baby, especially in urgent situations as it can reduce permanent brachial plexus injuries for the babies, alleviate anal incontinence for the mothers, and lower the risk of neonatal mortality (Culligan et al., 2005; Houweling, Arroyave, Burdorf, & Avendano, 2017). Furthermore, taking vitamin supplements after delivery can help improve women's nutritional status and the quality of breast milk (Siddiqua et al., 2016; Wagner, Hulse, Fanning, Ebeling, & Hollis, 2006). Therefore, by decreasing the probabilities of skilled attendant presence at delivery, institutional delivery, C-section delivery, and post-delivery vitamin supplement intake, armed conflicts can be damaging to the mother's and the newborn's wellbeing.

There are several potential channels through which armed conflicts could worsen women's utilization of prenatal and delivery care. First, armed conflicts can reduce the availability of maternal and reproductive health care services by destroying health facilities (Li & Wen, 2005; Urdal & Che, 2013), making it harder to provide adequate prenatal and delivery care for women. Second, armed conflicts could create a shortage of medical staff because they might have fled health facilities to avoid danger (Rubenstein & Bittle, 2010). The scarcity of medical personnel in health facilities will increase waiting time, thus raising the opportunity cost of utilizing care from formal sources. Consequently, women may be discouraged from obtaining sufficient prenatal and delivery care. Third, armed conflicts can threaten the security in the neighborhood, making it less safe to travel to health facilities. Therefore, women tend to reduce the number of prenatal visits and become less likely to acquire prenatal care from formal sources as well as have institutional delivery. Finally, armed conflicts could depress household income (Bruck & Schindler, 2009; Justino, 2012), decreasing demand for health care services. As a result, women may experience deterioration in prenatal and delivery care utilization.

Our findings are consistent with studies showing the adverse impacts of armed conflicts on women's utilization of maternal and reproductive health care. Specifically, in the context of Rwanda, armed conflict leads to the reduction in the number of babies born in official health facilities (Chandrasekhar et al., 2011). Ostby et al. (2018) also detect the decreases in the number of African women obtaining institutional delivery due to violent conflicts. From a broader perspective, our study complements the literature on the hidden cost of conflicts. For example, armed conflicts can raise maternal and child mortality (Kotsadam & Ostby, 2019; Wagner et al., 2018) as well as depreciate health outcomes of children (Akresh, Lucchetti, & Thirumurthy, 2012; Minoiu & Shemyakina, 2014). Armed conflicts are also reported to worsen long-term health, shorten educational attainment, and lower lifetime earnings (Bundervoet et al., 2009; Leon, 2012; Shemyakina, 2011).

This study underlines the less tangible but non-negligible cost of armed conflicts. Going beyond the immediate cost of life and permanent injuries, by worsening women's utilization of prenatal and delivery care, armed conflicts could seriously dampen maternal health and threaten the health outcomes of children (Conway & Kutinova, 2006; Gajate-Garrido, 2013; Le & Nguyen, 2021; Wehby et al., 2009). To this end, not only do armed conflicts obstruct SDG-16 (peace, justice, and strong institutions), but armed conflicts also hinder the achievement of SDG-3 (good health and well being). Given that

the deterioration of maternal and child health means productivity loss for the present (women) and the future (children), the atrocious cost to aggregate labor productivity of armed conflicts could be greater than it is calculated in previous works. Thus, our study suggests effective interventions to improve maternal health during and after conflicts should be implemented. It is crucial to ensure access to health care services for pregnant women during conflicts. Post-conflict reconstruction programs that aim to support women and children affected by armed conflicts could help alleviate the adverse consequences on human capital.

6. Concluding remarks

This study estimates the less salient yet non-negligible cost of armed conflicts to women's prenatal and delivery care utilization in 35 developing countries over nearly 30 years. Information on women's utilization of maternal care is retrieved from the DHS-GPS. The DHS-GPS further provides the geographic location of women's residential places which allows us to merge with the conflict data. Information on armed conflicts worldwide is obtained from the UCDP-GED. To estimate the impacts of interest, we rely on the difference-in-differences model that hinges upon the differences in prenatal and delivery care utilization of women subject to armed conflicts during pregnancy from the outcomes of women unexposed to armed conflicts during pregnancy within the same district, relative to the analogous differences for women residing in other districts.

Findings from this study can be summarized as follows. Exposure to armed conflicts during pregnancy reduces women's utilization of prenatal care and delivery care evident by the declines in the composite indices of Prenatal Care and Delivery Care by 7.76 and 6.83% compared to the sample averages, respectively. We further explore the underlying items behind each index. Regarding the Prenatal Care index, we show that the likelihood of meeting WHO recommended level of prenatal visits, accessing prenatal care from formal sources, having their blood pressure measured, having urine tests, having blood tests, and taking iron supplements during pregnancy decreases by 7.56, 4.54, 7.33, 9.52, 6.52, and 7.78%, relative to the sample averages, respectively. Exploring the items underlying the Delivery Care index, we find that armed conflict exposed women are less likely to have their delivery assisted by a skilled attendant, deliver their babies in an official health facility, have Cesarean delivery, and receive vitamin supplements after delivery by 6.16, 9.18, 7.23, and 8.99% compared to the sample averages, respectively.

By worsening women's utilization of prenatal and delivery care, armed conflicts could aggravate maternal and child health as insufficient care raises the risk of pregnancy-related morbidity for the mothers and the probability of unfavorable birth outcomes (Conway & Kutinova, 2006; Gajate-Garrido, 2013; Wehby et al., 2009). The deterioration of maternal and child health implies productivity loss for the present (women) and the future (children). To put it differently, going beyond the immediate civilian deaths and injuries, armed conflicts impose non-negligible costs to human development, thus impeding our progress toward sustainable development. Our study emphasizes the importance of interventions to maintain access to adequate health care services for pregnant women during conflicts. Post-conflict reconstruction initiatives should place priority on women and children victims to mitigate the cost to human development.

Our study has three limitations. First, our model might suffer from mortality bias. Specifically, armed conflicts could lead to maternal death and miscarriage. Nevertheless, our estimation sample only consists of surviving mothers and children because the data make it impossible to account for pregnant women who lost their lives and had miscarriages due to armed conflict. If such women (and their children) were to survive, being critically affected by armed conflict might prevent them from accessing prenatal and delivery care, which can further emphasize the consequence of armed conflict. In other words, our estimates might be smaller than the true effects of conflict. Second, our model cannot account for potential fertility bias. Particularly, armed conflict could have decreased fertility (Kraehnert, Bruck, Di Maio, & Nisticò, 2019; Thiede, Hancock, Kodouda, & Piazza, 2020). Women who would have been pregnant during conflict might have had inadequate access to prenatal care and delivery care, which will bias our estimates towards zero. Finally, selective migration can be another weakness of our study. In particular, pregnant women could possibly migrate to new areas because armed conflict may destroy basic infrastructures such as health facilities. If such women chose to stay, they would probably have little access to health care. The inclusion of such women would further deepen the estimated impacts of armed conflict on prenatal care and delivery care utilization. As we cannot account for such women (due to the data), our estimates might suffer from attenuation bias.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Appendix A

Table A1. List of Countries.

#	Country Code	Country Name	Observations	Percentage	Cumulative Percentage
1	AO	Angola	13,023	1.98	1.98
2	BD	Bangladesh	14,009	2.13	4.12
3	BU	Burundi	10,709	1.63	5.75
4	CD	Congo Dem. Rep.	6,810	1.04	6.79
5	CF	Central African Rep.	2,190	0.33	7.12
6	CI	Cote d'Ivoire	2,937	0.45	7.57
7	CM	Cameroon	5,535	0.84	8.41
8	CO	Colombia	13,596	2.07	10.48
9	EG	Egypt	53,518	8.15	18.64
10	ET	Ethiopia	26,072	3.97	22.61
11	GH	Ghana	9,178	1.40	24.01
12	GN	Guinea	11,502	1.75	25.76
13	GY	Guyana	2,032	0.31	26.07
14	HT	Haiti	14,034	2.14	28.21
15	IA	India	188,862	28.7	56.99
16	JO	Jordan	22,973	3.50	60.49
17	KE	Kenya	15,553	2.37	62.86
18	KH	Cambodia	13,825	2.11	64.96
19	MA	Morocco	5,023	0.77	65.73
20	MD	Madagascar	13,031	1.99	67.71
21	ML	Mali	34,213	5.21	72.93
22	NG	Nigeria	31,418	4.79	77.71
23	NI	Niger	8,871	1.35	79.07
24	NM	Namibia	6,323	0.96	80.03
25	NP	Nepal	13,374	2.04	82.07
26	PE	Peru	30,718	4.68	86.75
27	RW	Rwanda	6,074	0.93	87.67
28	SN	Senegal	12,582	1.92	89.59
29	TG	Togo	3,335	0.51	90.10
30	TJ	Tajikistan	5,532	0.84	90.94
31	TZ	Tanzania	15,051	2.29	93.23
32	UG	Uganda	18,253	2.78	96.02
33	ZA	South Africa	2,736	0.42	96.43
34	ZM	Zambia	12,921	1.97	98.40
35	ZW	Zimbabwe	10,494	1.60	100.0

This table provides the list of 35 countries in our sample.

Table A2. Balancing Test.

	Mother's Age At Birth	Mother's Education	Husband's Education	Mother's Wealth	Number of Children	Living in Urban Areas
	(1)	(2)	(3)	(4)	(5)	(6)
Exposed	0.004 (0.049)	−0.035 (0.041)	−0.053 (0.053)	−0.009 (0.013)	0.020 (0.018)	−0.001 (0.004)
Observations	656,277	656,021	452,062	515,079	656,277	656,277

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. All regressions control for district fixed effects, birth month-year fixed effects, country-specific linear trend.