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Effects of Conflict on Child Health: Evidence from the 1990–1994 Northern Mali Conflict

by

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Effects of Conflict on Child Health: Evidence from the 1990–1994 Northern Mali Conflict

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Abstract

This study estimates the impact of conflicts in northern Mali on child health using three anthropometric variables: height-for-age, weight-for-age, and weight-for-height Z-scores. The estimation results show that the longer the exposure and the closer the conflict area is to the children and their mothers, the larger the negative impact on child health. In addition, not only the duration but also the timing of exposure is a critical factor affecting child health. More specifically, when children are exposed to conflicts in utero, both long-term and short-term health outcomes are negatively affected. By contrast, after-birth exposure negatively impacts only long-term health.

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1. Introduction

Long-term impact studies have found that early-life health is critically important for socioeconomic outcomes in later life (Currie and Vogl 2013; Strauss and Thomas 1998; Johnson and Schoeni 2011; Smith 2007). In the case of negative effects during pregnancy, even short-term ones, the impact tends to be long lasting and those affected in utero are likely to be less educated (Lee 2014; Leon 2012; Shemyakina 2011), less healthy (Grimard and Laszlo 2014; Akresh et al. 2012b), and less likely to be economically successful (Lee 2014). Not surprisingly, researchers are eager to examine the magnitude of such impacts on child health.

More important are investigations into the impacts of negative shocks on child health in fragile countries that have repeatedly experienced civil wars, where the odds of being affected by negative shocks are higher. In Sub-Saharan Africa, 75% countries have experienced civil wars since World War II (Gleditsch et al. 2002), and the infant mortality rate is the worst in the world (World Development Indicators (WDI) 2014). In these countries, physical as well as human capital such as early-life health is destroyed, which can hinder a nation's future development.

This study examines the effects of the 1990–1994 conflict in northern Mali on child health using data from the Malian Demographic and Health Survey (MDHS95/96 and MDHS2001). Since their independence in 1960, there have been several conflicts in northern Mali, where the armed forces of nomadic tribes, namely the Tuareg, have attempted to form an autonomous state. Mali is considered a critical case given the serious child health conditions in the country, where the infant mortality rate is one of the worst in the world (WDI 2014). In addition, the northern area affected by the war is poorer and child health conditions are worse than those across the rest of the country (CPS/SSDSPF et al. 2014). It remains unclear whether poorer health conditions among children in the northern region can be solely attributed to their low socioeconomic conditions or conflict exposure. Thus, there is an urgent need to evaluate the impact of conflicts on child health using proper identification strategy. Similar to Akresh et al. (2014), we utilize more accurate location information based on GPS data to identify areas most affected by conflict. This allows us to adopt a more effective identification strategy than those used in previous studies.

Recent studies estimating the impact of conflicts on early childhood health focus on birth weight (Camacho 2008; Mansour and Rees 2012). By contrast, this study uses current anthropometric measures instead of recall data. In developing countries, it is often the case that mothers deliver at home and thus, the birth weight is less likely to be measured. The dataset generally comprises birth weight information for children of urban residents and households wealthier than the sample average, which results in selection bias and self-reported bias. Since anthropometric measures such as weight and height can be easily scaled by survey teams, height and weight information is available for all children. Some studies examine the impact of conflict on child health using current anthropometric measures (Akresh et al. 2014; Akresh et al 2012a; Minoiu and Shemyakina 2014; Bundervoet et al. 2009). This study, on the other hand, uses not only height-for-age Z-score (HAZ) but also weight-for-age Z-score (WAZ) and weight-for-height Z-score (WHZ) to measure child health conditions.[1] We use short-term health indicators (WAZ and WHZ) because data were collected immediately after the conflict and thus, may be more appropriate to measure the impact of conflict.[2]

Since we focus on health conditions in early childhood (below 5 years of age), we examine whether the negative effects of conflict differ between in-utero and after-birth (early childhood) conflict exposure. Since the extant literature focuses on in-utero exposure, it is unclear whether after-birth exposure critically impacts child health, even though there are numerous children who have been exposed to conflicts.[3] We find that in-utero exposure

[1] Low HAZ indicates chronic undernourishment (stunting), low WHZ suggests acute undernourishment (wasting), and low WAZ denotes both acute and chronic undernourishment (underweight).
[2] Shemyakina's (2015) study is an exception in which WAZ and WHZ are compared with HAZ.
[3] Akresh et al. (2014) found that in-utero exposure did not worsen children's health in Ethiopia, while

negatively impacts health outcomes, while after-birth exposure only has long-term health effects (HAZ).

The remainder of this paper is structured as follows. Section 2 discusses the background of the northern Mali conflict. Section 3 describes the data and characteristics of children sampled in the study. Section 4 presents the estimation model and results. The robustness of the main results is tested in Section 5. Section 6 examines the mechanism underlying the effects of conflict exposure on child health outcomes. Section 7 concludes.

2. Background on Northern Mali Conflicts

The most recent conflict in northern Mali broke out in January 2012, during which approximately 300,000 people were forced to evacuate their residence to safer places (United Nations High Commissioner for Refugees 2013). This was not the first time that the people of northern Mali were part of a conflict. Some of the previous conflicts broke out during 1962–1964, 1990–1995, and 2007–2009, the causes of which are deep rooted in history. In this study, we examine the effects of the second Tuareg Rebellion on child health outcomes. We focus on the second Tuareg Rebellion because the number of casualties during this conflict was estimated to be the highest (Uppsala Conflict Data Program 2014). In addition, data on the first and fourth conflicts are unavailable and the main battle field during the third Rebellion was Niger, not Mali.

In northern Mali, the main ethnic groups comprise the pastoral Tuareg and Moors (Arabs) and the sedentary Songhay (Benjaminsen 2008). The Tuareg depend on animals grazing in broad areas covering Mali, Algeria, and Niger for their livelihood. However, the establishment of the Malian border at the time of independence restricted their nomadic ways of life (Smith 2009; Kisangani 2012). Moreover, the first president, Modibo Keita, considered nomadism an obstacle in the country's modernization and the new Malian administration

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after-birth exposure negatively impacted children in Ethiopia and Eretria.

discriminated against the Tuareg in northern Mali, deeming them unproductive and futile (Benjaminsen 2008). The anti-nomad policy resulted in the marginalization of nomads, which was one of the reasons underlying the first Tuareg Rebellion (Lecocq 2004).[4] The objective of the rebellion, therefore, was to establish an autonomous state by separating from the southern part of Mali, where the major ethnic group Bambara holds political and economic powers (Krings 1995; Benini 1993; Lecocq 2004).

The loss of cattle due to serious droughts in the late 1980s led many young Tuaregs to emigrate to Algeria and Libya, where many joined the Tuareg's military (Benjaminsen 2008). There was anger among the Tuareg because of the embezzlement of international relief aids for drought-stricken people by government officials. In addition, more than 300 Tuaregs were killed in Niger and more than 100 Tuaregs were executed by the Malian army in 1990 (Krings 1995). Owing to the mounting frustrations, in June 1990, a small group of Tuareg youth attacked a prison in Menaka (300 km from Gao city and near Niger's border), which was followed by the Tuareg's establishment of armed forces, such as the Popular Movement for the Liberation of Azawad (MPLA). This came to be known as the Second Tuareg Rebellion (Benjaminsen 2008; Keita 1998).

The rebellions took the form of mobile commandos targeting paramilitary forces (Sidib 2012). The Malian army attacked not only the Tuareg but also the Moors because it was unable to distinguish between the two groups. Many Tuareg people fled to Mauritania (Benini 1993). At the end of 1990, direct talks were held between the Mali government and rebel leaders, resulting in the Tamanrasset Peace Treaty in January 1991, which promised that 47% of the national budget would be allocated to the north (Benjaminsen 2008). However, soon after the

[4] It is noteworthy that the Tuareg owned slaves and thus, were further marginalized after the latter's liberalization. After independence, traditional pastoral leaders who dominated land management in wetlands along the Niger River lost power under the modernization policy, which resulted in land use conflicts between the pastoralists and farmers (pasture vs. rice field) and the encroachment of enlarged area by the latter led to the marginalization of the pastoralists (Benjaminsen and Ba 2009).

Treaty was signed, the government was toppled over and the rebel group was separated into opponents (moderate and extreme groups) and proponents of the accord (Kisangani 2012). There was conflict among the Tuareg rebel groups, reflecting power dynamics in the Tuareg society (Lecocq and Klute 2013)[5]. The army was beyond the control of the transition government, which increased violence against civilians and compelled people to flee to safer places.

In 1991, most of the violence occurred in Goundam (west of Timbuktu), which became a buffer zone between the government and the rebels (Benini 1993).[6] By the end of 1991, the rebels attacked people in villages around Lake Faguibine, located to the northwest of Goundam, which were then abandoned and whose weekly markets were shut down. As a result, many nomads lost access to food, which worsened the violence and led to the stealing of cattle and grains from other families (Benini 1993). In September 1991, the International Committee of the Red Cross (ICRC) stationed in Goudam to protect civilians and made it possible for weekly markets to be held and for medical staffs to return to their outposts. Although food distribution by ICRC was unreliable due to bad logistics and the dispersed locations of people in need, it helped reduce ethnic tension by decreasing the occurrences of food theft. It is noteworthy that the high mortality rates were mainly ascribed to violence and measles, not famine (Benini 1993).

Attacks were made by both sides, the government army and rebels, as a way of retaliation and continued in a sporadic manner, even after a National Pact was signed in April 1992 (Lecocq and Klute 2013).[7] After more than 100 innocent civilians (Songhai) were killed by one of the Tuareg rebel groups, an auto-defense group was formed by Songhai populations,

[5] Tuareg rebels were split into four factions after the signing of the Tamanrasset Peace Treaty: the Arab-Islamic Front of Azawad (FIAA), the Revolutionary Liberation Army of Azawad (ARLA), the Popular Liberation Front of Azawad (FPLA), and the Popular Movement of Azawad (MPA). The first three groups were established by the dissidents to the Tamanrasset Peace Treaty, which was agreed upon between MPLA and the Malian government. FIAA was formed by the Hassani Arab minority group in northeast Mali. MPA was initially based among Tuareg refugees and exiles in Algeria and Libya. The Tuareg were also divided by royal family line (Boas 2014, Chapter 5).

[6] In May 1991, numerous civilian Tuareg and Moors were massacred in Lere by the Malian army (Randall 2005).

[7] MPA, with support from the Malian army, fought against the FPLA and ARL.

the Patriotic Movement Ghanda Koy (MPGK), which resulted in a war against the Tuareg rebels in 1994 in major northern Mali cities, such as Bourem, Gao, and Ansongo (Lecocq and Klute 2013). In June and July 1994, 500 people were killed and more than 160,000 refugees fled to Algeria and Burkina Faso (Kisangani 2012).

Then, one of the rebel groups (moderate group, namely MPA) defeated other opposition rebel groups (extreme ones) and forced them to sign a peace accord in December 1994 (Kisangani 2012). At the same time, from October 1994, the government took control of the army and peace processes were initiated by civil society (e.g., international NGOs and the Church of Norway) (Benjaminsen 2008). In 1996, a peace ceremony was held in Timbuktu and the second Tuareg rebellion was declared over (Poulton and ag Yousouf 1998).

During this conflict, several thousand people died and 250,000 people displaced and became refugees (Benini 1993). The socioeconomic disruption severely affected not only the rebel groups and the army but also civilians in northern Mali. Those who were displaced had to leave their livestock and farmland behind, which were their main income sources. Food shortages and unsanitary living conditions in refugee camps affected pregnant women and more seriously, infants. Those in conflict areas had less access to healthcare facilities and medical attentions.[8] We postulate that children exposed to conflicts in utero and after birth had worse health outcome.

3. Data

The data used in this study are adopted from the Malian Demographic and Health Survey (MDHS) conducted in 1995–1996 and 2001. The DHS is a nationally representative household

[8] Tuncalp et al. (2015) analyzed data for healthcare facilities collected during the 2012 northern Mali conflict and found that facilities in conflict areas lacked several services such as prenatal care, skilled care during child birth, and post-natal care because of the medical supply chain, destruction of healthcare facilities, and the lack of qualified healthcare workers.

survey that has been conducted more than 200 times in developing countries and most data are publicly available. The MDHS comprises information on women aged 15–49 years, including pregnancies in the last five years, and children aged 0–5 years.[9] We use data for children who were born during 1993–1995 and 1997–1999.[10] Since the conflict lasted from 1990 to 1994, children born between January and September 1995 were exposed to the conflict in utero and those born before January 1995 (in our sample data, between January 1993 and December 1994) were exposed to the conflict both in utero and after birth in this sample.

We construct three war exposure variables: $Months_i^{Utero}$, which is the number of months a child was exposed to the war in utero; $Months_i^{Born}$, denoting the number of months a child was exposed to the war after birth; and $Months_i^{Total}$, indicating the total number of months a child was exposed to the war (in utero or after birth)[11].

The conflict area in this study is the Azawad territory, including the regions of Gao, Timbuktu, Kidal, and the northeastern half of Mopti. Accordingly, we create dummy variable, $WarRegion_j$, which takes the value of one if a household lives in the Azawad territory and zero otherwise. Although people in the Azawad territory were affected during the conflict, the main battle fields were the cities of Gao and Timbukutu (Krings 1995). Thus, we construct a variable ($Distance_i$) indicating the proximity of household i to the main battle fields using GPS location

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9 Figure 1 plots the location of the primary sampling unit (PSU). It shows that the sampled communities in the northern region differ between 1995–1996 and 2001. In 1995–1996, data were not collected outside of cities (e.g., Gao and Timbuktu). Since health facilities and other infrastructure were less available in rural areas, the mean health outcome in the northern region is likely to be worse in 2001 than in 1995–1996, simply because the coverage of the sample areas differ. To test the robustness of the results, we estimate all models by excluding communities located in the rural areas of the northern region from the sample. The results are quantitatively and qualitatively similar to those for the sample that includes these areas. The results using the sub-sample can be made available upon request.

10 Although child-level data are supposed to contain information for those born between 1992 and 2000 (five years prior to data collection), there are few observations for those born between 1992 and 1996. Thus, we decided to not use the data for these years. Since in MDHS1995/96, we use data for children whose birth year falls between 1993 and 1995, for MDHS2001, we use data for 1997–1999 (the same number of years as that for MDHS1995/6).

11 The average number of months exposed to conflict in utero, after birth, and in total are 2.97, 2.88, and 5.85, respectively. There are no differences in time of birth between war and non-war regions.

data.[12]

Panel A of Table 1 shows the child and household characteristics for war and non-war regions. The children in the present sample are not first born (birth order is 4.5) and multiple births are rare (2%). The mothers of children aged less than 5 years old are about 27 years old on average. The mothers are mostly uneducated and often have not even attended school. Almost all the mothers are married (98%). Three-fourth of the sampled children resides in rural areas. Column (4) shows the difference of mean characteristics in the war and non-war region. Significant differences are found in mother's age at birth, years of education, and wealth index. On average, mothers in the war region tend to give birth at a younger age and are less educated and poorer than those in non-war region.

Panel B in the table shows the main outcome variables (HAZ, WAZ, and WHZ)[13] for the war and non-war region as well as for those born during and after the war. We test whether the mean health outcomes of children born during and after the war differ. In all measures, children born after the war, regardless of location, have better health outcomes than those born during the war. The difference between WAZ and WHZ for those born during and after the war is not statistically significant (column 4). This suggests that exposure to the war did not affect child health outcome. Next, we conduct regression analyses to test whether this is the case even after controlling for other factors.

4. Estimation Model and Results

The effects of exposure to war are analyzed using ordinary least squares. The degrees of exposure to war are measured using two parameters: the number of months of war exposure and

[12] Two household-level distance variables (distance to the cities of Gao and Timbuktu) are calculated on the basis of the location measured using GPS data; we use those with shorter distance.
[13] Anthropometric measures were not obtained for about 10% of the children. In addition, there is no difference in geographical distributions of children with and without anthropometric measures in the sample.

the distance between homestead and the main battle fields. The estimation models are as follows:

$$(1)\quad y_{ij} = \alpha + \beta_1\left(WarRegion_j \times Months_i^{Utero}\right) + \beta_2\left(WarRegion_j \times Months_i^{Born}\right) + \gamma_1 X_{ij} + \delta_j + \theta_t + \pi_m + \delta_j \times \theta_t + \varepsilon_{ij},$$

$$(2)\; y_{ij} = \alpha + \beta_3\left(WarRegion_j \times Months_i^{Total}\right) + \gamma_2 X_{ij} + \delta_j + \theta_t + \pi_m + \delta_j \times \theta_t + \varepsilon_{ij}\,,$$

$$(3)\; y_{ij} = \alpha + \beta_4\left(Distance_i * Months_i^{Total}\right) + \gamma_d Distance_i + \gamma_3 X_{ij} + \delta_j + \theta_t + \pi_m + \delta_j \times \theta_t + \varepsilon_{ij}\,,$$

where subscripts $i, j, t, and\ m$ indicate child, region, birth year, and birth month. y_{ij} is the child health outcome (HAZ, WAZ, and WHZ), X_{ij} is a vector of child (birth order, female dummy, multiple birth, and mother's age at his/her birth) and household characteristics (years of education, height of mother, marital status (never married), and wealth index[14]). δ_j, θ_t, $and\ \pi_m$ are region, birth year, and birth month fixed effects. β_1, β_2, β_3, $\beta_4, and\ \gamma$ are parameters to be estimated. ε_{ij} is an error term.

It is expected that children with prolonged exposure to war in utero or after birth are likely to have worse health conditions ($\beta_1 < 0,\ \beta_2 < 0,\ \beta_3 < 0$) and the marginal effects of an additional month of exposure on child health are greater when the child's house is located closer to the main battle field ($\beta_4 < 0$).

The results for the estimation models are provided in Table 2. The coefficients for the months of war exposure in total months are significant in all health measures and ranges from −0.02 SD (HAZ) to −0.03 SD (WAZ).[15] War exposure after birth negatively impacted only HAZ, while that in utero affected WAZ and WHZ, but not HAZ. Thus, the timing of exposure had

[14] DHS data contain a wealth index calculated using principal component analysis on the basis of household assets such as the types of toilet, water, and homestead (Gwatkin et al. 2007; Rutstein and Johnson 2004).
[15] The magnitude of impact is much larger than that found in the case of the Ethiopia–Eritrea conflict (Akresh et al. 2014).

varying effects on child health: in-utero exposure leads to underweight and after-birth exposure results in short stature.

The coefficients of the interaction terms between distance from main battle field and months of war exposure are negative and significant in all health measures, as expected. This indicates that the marginal effects of one month of exposure to war on child health (both height and weight) increase when children live closer to the main battle field.

5. Robustness Checks

5.1. Selective Migration

In the analyses so far, we used the location information of the residence at the time of interviews for identifying whether a household lived in the conflict area during the war as if a household would not change the residence during the conflict. It is possible that some of the respondents interviewed outside of the Azawad territory lived in the Azawad territory when the war broke out but chose to leave during the conflict to safer places. This potential selective migration could lead to over- (under-) estimation of the effects of the conflict if those who migrated were less (more) healthy.

By using the response to the question "For how many years have you been living in this place?" and the ethnicity of the household, we redefine the war-affected population as either (a) long-term residents of the Azawad territory (those interviewed in the Azawad territory and who answered "always lived in this place")[16]; (b) current residents who moved to the territory between the onset of the conflict and 1996, when all the refugees vacated the refugee camps

[16] Our estimates for "living in war region for a long time" include the impact of war on both those who stayed in the war region and those who temporarily migrated to, for example, refugee camps during the conflict and returned to the war region by the time of survey. This is because respondents might answer "always lived in current location" even though they were not in the region for a short time. Our estimated effects of conflict, therefore, are likely to include the effects of such temporary migration due to the war. Randall (2005) described the situation of the refugee camps in Mauritania after the influx of people (both pastoralists and non-pastoralists) during the second Tuareg Rebellion. A majority of the camp residents came to the camp during 1991–1992 and stayed there until 1996.

(those who answered 1–6 years in MDHS95/96 or 6–11 years in MDHS2001 to the above question)[17]; and (c) current residents of non-Azawad territories who belong to northern ethnic groups (Shongai, Tuareg, or Peulh) and moved to non-Azawad territories during the conflict (possible migrants from Azawad territory).[18] Compared with the original definition, group (c) is newly identified as affected population. This redefined war-affected status yields the conservative estimates of the impact of war exposure.

In addition, we examine whether these groups (a)–(c) were equally affected by the war as follows:

$$(4)\ y_{ij} = \alpha + \beta_5\left(G_i^a * Months_i^{Total}\right) + \beta_6\left(G_i^b * Months_i^{Total}\right) + \beta_7\left(G_i^c * Months_i^{Total}\right) + \gamma_4 X_{ij} + \delta_j + \theta_t + \pi_m + \delta_j \times \theta_t + \varepsilon_{ij}\ ,$$

where G_i^a is a dummy variable taking the value of one if a household was interviewed in the Azawad territory and who answered "always lived in this place", G_i^b is a dummy variable taking the value of one if a household was interviewed in the Azawad territory and who moved to the territory between the onset of the conflict and 1996, and G_i^c is a dummy variable taking the value of one if a household was interviewed outside of Azawad territory, belong to northern ethnic groups (Shongai, Tuareg, or Peulh) and moved to non-Azawad territories during the conflict.

The estimation results for the redefined affected population are provided in Table 3. After applying the estimation models (1) and (2), we obtain qualitatively similar results and the coefficients of the interaction terms become smaller, as expected. Even when we use this more conservative definition of affected population, we can conclude that the conflict has a

[17] The conflict lasted from June 1990 to January 1995.

[18] Information on their previous location is either Bamako (large city) or a city, town, countryside, and abroad. We exclude interviews of those who lived in non-Azawad territories but moved from Bamako and abroad during the war. It is likely that several households moved within non-Azawad territories for reasons other than escaping the war, for example, a job search or to attend schools. To more accurately measure the movement from Azawad to non-Azawad territories as a result of conflict, we select those who belong to northern ethnic groups.

devastating impact on child health.

Columns (3), (6), and (9) of Table 3 show the results for estimation model (4). The impacts of war exposure on WAZ and WHZ are almost the same for residents of Azawad, regardless of them migrating during the war (see column 6 and 9). On HAZ, in contrast, only those who did not migrate during the war were significantly affected. It is important to note that children living in non-Azawad territories, who most likely moved from Azawad during the war, could manage to avoid the negative impact on child health partially (about half of those who did not migrate into non-Azawad territories).

5.2. Selective Fertility

The negative impact of war on child health can be attributed to the fact that healthier women in the war region possibly had delayed pregnancies until the end of the war. If children born during the war and in the war region had less healthy mothers than those born after the war and in non-war regions, the estimated effect of the war on child health outcomes may differ by healthy and non-healthy women on the basis of fertility decision (timing of pregnancies).

To test this hypothesis, we examine whether women who gave birth during the war systematically differ from those who gave birth after. We use five variables (w_{kj}) as measures characterizing women: number of births in the last five years, years of education, age, height, and wealth of household.

$$(5)\ w_{kj} = \alpha + \beta_8 (WarRegion_j \times D_{kj}) + \gamma_5 WarRegion_j + \gamma_6 D_{kj} + \varepsilon_{kj}\ ,$$

where D is a dummy variable indicating whether woman k had a delivery during the war. If β_8 significantly differs from zero, children born during the war have mothers who differ from those who did not deliver during the war.

The estimation results are shown in Table 4. In the first three columns (number of births, education, and age), the coefficients of the interaction terms do not differ from zero. This result suggests that the estimated impact of exposure to war in utero on a child's health is not due to selective fertility. From the last two columns, we found that the shorter and richer the women, the more likely they were to have a delivery during the war. Since taller and richer tended to be healthier mothers, who were more likely of having healthier children, the estimated impact of war exposure in Table 3 and 4 are biased towards to zero, thereby considering them as the lower bound. Thus, the estimated impact of the war exposure was not induced by the selective fertility.

5.3. Time Trend

Thus far, we compared children born during and after the war to measure the impact of war exposure on child health outcomes. If there are unobserved time trends correlating with changes in health outcomes even after controlling for region-time dummies, our estimates captured the time trend of the health outcome, not the impact of war exposure on child health. In this section, therefore, we attempt to include children born before the war (1984–1987) using data from MDHS1987.[19]

We do not adopt data from MDHS1987 in the main analyses for the following reasons. First, since GPS data were not collected in MDHS1987, we cannot construct the distance variable. Second, the survey domain in MDHS1987 (four zones: north, central, south, and Bamako) is more aggregated than the later waves (eight regions), which does not allow us to classify the Azawad territory (war region) as applied in main model. Third, the wealth index was not provided in MDHS1987.

Given these data limitations, we adjust the estimation models in following ways. First,

[19] Similar to the other waves, there is detailed information of children born in five years prior to the data collection for MDHS1987. However, the number of observations for those born in 1982 and 1983 are few; thus, we use data for children born during 1984–1987.

instead of using region fixed effects, we control for zone fixed effects. Second, the wealth index is dropped from a set of explanatory variables and third, estimation model 3 (where the distance from homestead to the main battle fields is used) is not analyzed. Table 5 shows the estimation results. The coefficients of the interaction terms are almost the same as those for the main results shown in Table 2. Thus, we can conclude that the estimated negative effect of war exposure on child health in main results is not spurious.

6. Mechanism

With this study, we found that in-utero war exposure negatively impacts child health. In this section, we investigate the mechanism underlying this effect. A likely reason is that the war disrupted access to healthcare services, such as prenatal care and proper attention during delivery. We examine whether access to healthcare services is lower in the war region during the war by estimating the same models presented in Section 4.

As a measure of access to healthcare services, we use four variables: a dummy variable indicating whether the mother of the child received prenatal care (doctor or nurse) during the pregnancy, the number of times a mother visited the clinic for antenatal care, a dummy variable for whether a mother delivered a child at the hospital or in a clinic (using delivery at home as a reference group), and a dummy variable denoting whether a child was delivered with assistance such as from a doctor, nurse, and auxiliary midwife.

The estimation results are shown in Table 6. The coefficients of the interaction terms are not significant in all models. This means that the disruption of access to healthcare services is not a cause for worsening child health outcomes resulting from in-utero war exposure. This is possibly because people in northern Mali did not depend on modern healthcare facilities at the time, even in the absence of a war.[20]

7. Conclusion

In this study, we estimated the impact of the northern Mali conflict on child health using more accurate measures of affected areas. We found that children exposed to the conflict had worse health outcomes than those who were not exposed. In addition, the impact was greater when the child was subject to prolonged exposure and lived closer to the main battle field. The impact determined in this study is much larger than that found in existing studies, which suggests that the conflict in poor countries results in greater consequences. From the robustness checks, we found that the estimated impact was not due to selective migration, selective fertility, and time trend.

We also found that the negative impact mainly emanated from in-utero conflict exposure when WAZ and WHZ are used as health outcome measures. Although the measure we used is not birth weight, our results confirmed that in-utero exposure to shocks such as war negatively affect children's weight, which is in line with the findings of existing studies that use birth weight as a health measure. As for HAZ, however, conflict exposure after birth was the one that affect child health significantly. Thus, avoiding exposure to conflict after birth is equally important to improve children's health conditions.

We also attempted to identify a mechanism how conflict affected child health. Given that health supplies were less available in affected areas, we examined whether those exposed to conflicts in utero were less likely to take prenatal care and deliver in a hospital. The results indicated, however, that this was not the case. Owing to data limitations, testing other likely mechanisms is left for future research.

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[20] Rausmussen (2005) states that Tuareg women in rural areas avoided going to town hospitals because they believed that they tended to be mistreated. Nevertheless, today, they visit clinics for injections and pills but still prefer to give birth at home rather than in clinics.

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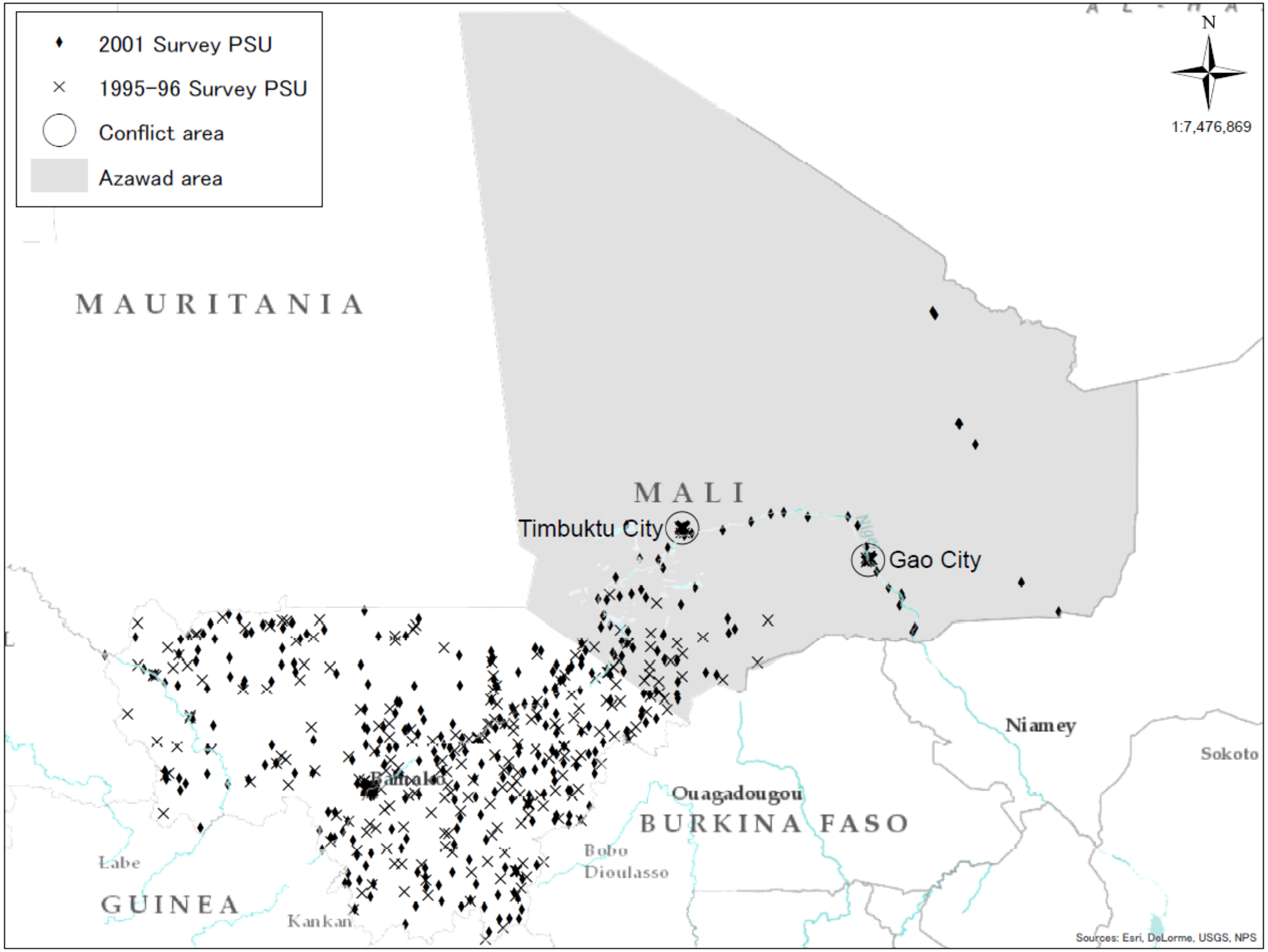
Figure 1: Mali regional map and sampled communities



Source: Authors plotted the GIS information of sampled communities (primary sampling unit, PSU) by using ArcGIS software.

Table 1: Descriptive Table

Variable	(1) Full Sample N = 9567		(2) Non-war region N = 8048		(3) War region N = 1519		(4) Difference (3)-(2)		
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean		Std. Err.
Panel A									
Child characteristics									
Birth Order	4.487	2.792	4.477	2.708	4.578	3.414	0.101		0.109
Sex; 0=male, 1=female	0.501	0.500	0.506	0.484	0.459	0.623	-0.047	***	0.018
Twin; 0=single, 1=multiple	0.024	0.152	0.023	0.149	0.018	0.165	-0.007		0.007
Mother's age at child's birth (months)	327.679	84.426	326.456	81.717	338.496	104.323	12.040	***	3.251
Household characteristics									
Mother's highest educational in single years	0.825	2.244	0.842	2.204	0.675	2.383	-0.167	*	0.100
Never married =1, married=0	0.018	0.133	0.018	0.128	0.019	0.173	0.002		0.006
Wealth Index	0.023	1.007	0.055	1.001	-0.262	0.809	-0.318	***	0.050
Type of residence (1=urban, 0=rural)	0.255	0.436	0.259	0.424	0.220	0.518	-0.040		0.036
Panel B									
Months of war experience									
In Utero	2.972	3.996	3.010	3.879	2.639	4.836	-0.370		0.362
After birth	2.876	5.883	2.916	5.714	2.523	7.088	-0.392		0.391
Total	5.848	9.233	5.925	8.967	5.163	11.127	-0.763		0.735
Height for Age (HAZ)									
All periods	-1.584	1.719	-1.574	1.649	-1.676	2.301			
Born during the war (a)	-1.906	1.542	-1.895	1.474	-2.025	2.171			
Born after the war (b)	-1.474	1.762	-1.461	1.694	-1.578	2.307			
Diff. in mean HAZ born during/after the war (b) – (a)	0.432***	(0.059)	0.433***	(0.063)	0.446**	(0.179)	-0.013		0.188
Weight for Age (WAZ)									
All periods	-1.655	1.333	-1.633	1.282	-1.848	1.737			
born during the war (a)	-2.071	1.255	-2.044	1.200	-2.355	1.729			
born after the war (b)	-1.512	1.329	-1.489	1.281	-1.705	1.692			
Diff in mean WAZ born during/after the war (b) – (a)	0.559***	(0.048)	0.555***	(0.051)	0.650***	(0.106)	-0.095		0.117
Weight for Height (WHZ)									
All periods	-0.894	1.199	-0.871	1.160	-1.094	1.472			
born during the war (a)	-1.208	1.186	-1.179	1.138	-1.509	1.561			
born after the war (b)	-0.787	1.184	-0.764	1.150	-0.978	1.413			
Diff. in mean WHZ born during/after the war (b) – (a)	0.421***	(0.040)	0.415***	(0.043)	0.531***	(0.088)	-0.117		0.098

Note: Standard errors in parentheses. ***, **, * mean significant level at 1%, 5%, 10%.

Table 2: Effect of Exposure to Conflict on Child Health (Main Result)

	HAZ			WAZ			WHZ		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
WarRegion × Months of war experience in Utero	0.007			-0.091***			-0.101***		
	(0.027)			(0.022)			(0.019)		
WarRegion × Months of war experience after birth	-0.039*			0.013			0.029*		
	(0.022)			(0.019)			(0.016)		
WarRegion × Total Months of war experience		-0.019**			-0.032***			-0.027***	
		(0.008)			(0.009)			(0.008)	
Distance to Main battle field (1000km)			-6.793***			-5.594***			-2.235**
× Total Months of war experience			(1.571)			(1.254)			(1.129)
Birth Order	-0.069***	-0.070***	-0.070***	-0.047***	-0.046***	-0.047***	-0.012	-0.011	-0.011
	(0.013)	(0.013)	(0.013)	(0.009)	(0.009)	(0.009)	(0.008)	(0.008)	(0.008)
Sex; 0=male, 1=female	0.130***	0.129***	0.122***	0.071***	0.072***	0.066**	0.054*	0.055*	0.052*
	(0.037)	(0.037)	(0.037)	(0.027)	(0.027)	(0.028)	(0.028)	(0.028)	(0.028)
Twin; 0=single, 1=multiple	-0.476***	-0.477***	-0.481***	-0.496***	-0.493***	-0.497***	-0.205*	-0.201	-0.205*
	(0.130)	(0.130)	(0.129)	(0.108)	(0.107)	(0.105)	(0.124)	(0.124)	(0.123)
Mother's age at child's birth (months)	0.002***	0.002***	0.002***	0.001***	0.001***	0.001***	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Mother's highest educational in single years	0.032***	0.032***	0.032***	0.035***	0.035***	0.035***	0.024***	0.024***	0.024***
	(0.010)	(0.010)	(0.010)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Mother's height (cm)	0.014***	0.014***	0.014***	0.012***	0.012***	0.012***	0.005***	0.005***	0.005***
	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)
Never married =1, married=0	-0.238*	-0.236*	-0.238*	-0.228**	-0.232**	-0.236**	-0.125	-0.131	-0.135
	(0.129)	(0.129)	(0.130)	(0.109)	(0.109)	(0.108)	(0.092)	(0.093)	(0.093)
Wealth Index	0.118***	0.118***	0.115***	0.130***	0.132***	0.126***	0.084***	0.085***	0.079***
	(0.029)	(0.029)	(0.029)	(0.026)	(0.026)	(0.026)	(0.021)	(0.021)	(0.021)
Distance to Main battle field (1000km)			69.794**			84.034***			67.016***
			(30.381)			(25.623)			(23.482)
Constant	-4.203***	-4.197***	-4.802***	-3.776***	-3.791***	-4.499***	-1.789***	-1.808***	-2.351***
	(0.483)	(0.483)	(0.528)	(0.371)	(0.372)	(0.427)	(0.262)	(0.263)	(0.324)
N	9567	9567	9567	9567	9567	9567	9567	9567	9567
R-squared	0.197	0.197	0.199	0.150	0.149	0.150	0.097	0.095	0.094

Note: Robust standard errors in parentheses. ****, ** and * mean significant level at 1%, 5% and 10%, respectively. All equations include region fixed effect, birth year fixed effect, birth month fixed effect, and interaction terms between region and birth year.

Table 3: Robustness Checks (Migration)

	HAZ			WAZ			WHZ		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
WarRegion (new def.)× Months of war experience in Utero	0.018			-0.069***			-0.085***		
	(0.020)			(0.016)			(0.015)		
WarRegion (new def.)× Months of war experience after birth	-0.033**			0.015			0.031***		
	(0.016)			(0.013)			(0.011)		
WarRegion (new def.)× Total Months of war experience		-0.011*			-0.021***			-0.019***	
		(0.006)			(0.006)			(0.005)	
Living in WarRegion for long time			-0.015*			-0.026**			-0.022**
× Total Months of war experience (a)			(0.009)			(0.009)			(0.007)
Moved to Non-War region during the war			-0.004			-0.013**			-0.013*
× Total Months of war experience (c)			(0.009)			(0.003)			(0.007)
Moved in War Region during the war			-0.012			-0.027**			-0.026**
× Total Months of war experience (b)			(0.010)			(0.012)			(0.012)
N	9567	9567	9567	9567	9567	9567	9567	9567	9567
R-squared	0.197	0.197	0.197	0.149	0.148	0.148	0.097	0.093	0.094

Note: Robust standard errors in parentheses. ***, ** and * mean significant level at 1%, 5% and 10%, respectively.
Other explanatory variables used but not shown are same as Table 2. All equations include region fixed effect, birth year fixed effect, birth month fixed effect, and interaction terms between region and birth year.
New definition of WarRegion=1: "(a) when households always live in Azawad territory", "(b) households interviewed in Azawad territory and moved in Azawad territory during the war", or "(c) those who "(A2) those who were interviewed in non-Azawad territory and answered 1-6 years for MDHS95/96 or for 6-11 years for MDHS2001", and were interviewed in non-Azawad territory and answered 1-6 years for MDHS95/96 or for 6-11 years for MDHS2001".

Table 4: Robustness Checks (Selective Fertility)

	# of births in last five years	highest educational years	Age	Height (cm)	Wealth index
	(1)	(2)	(3)	(4)	(5)
WarRegion * Has delivery during the war	-0.008	-0.081	0.392	-1.278**	-0.170***
	(0.057)	(0.138)	(0.577)	(0.578)	(0.050)
WarRegion	-0.003	-0.101*	-0.147	0.068	0.065**
	(0.018)	(0.060)	(0.269)	(0.195)	(0.028)
Has delivery during the war	-0.049*	-0.194**	-0.922***	1.322***	-0.290***
	(0.029)	(0.082)	(0.309)	(0.315)	(0.028)
Constant	1.725***	0.881***	161.318***	28.833***	0.041**
	(0.010)	(0.038)	(0.138)	(0.122)	(0.017)
N	8714	8714	8714	8714	8714
R-squared	0.001	0.001	0.001	0.002	0.011

Note: Analyses were done by using mother-level data. Robust standard errors in parentheses. ***, ** and * mean significant level at 1%, 5% and 10%, respectively.

Table 5: Robustness Checks (Before, During, and After the Conflict Data)

	HAZ		WAZ		WHZ	
	(1)	(2)	(3)	(4)	(5)	(6)
WarRegion × Months of war experience	-0.115***		-0.215***		-0.141***	
in Utero	(0.034)		(0.029)		(0.029)	
WarRegion × Months of war experience	-0.097***		-0.030		0.011	
after birth	(0.033)		(0.026)		(0.022)	
WarRegion × Total Months of war experience		-0.105***		-0.111***		-0.056***
		(0.024)		(0.020)		(0.018)
N	10654	10654	10654	10654	10654	10654
R-squared	0.176	0.176	0.138	0.135	0.087	0.085

Note: Robust standard errors in parentheses. ***, ** and * mean significant level at 1%, 5% and 10%, respectively. Other explanatory variables used but not shown are same as Table 2 (except wealth index and mother's height). All equations include region fixed effect, birth year fixed effect, birth month fixed effect, and interaction terms between region and birth year. WarRegion=1 when always live in Azawad region" or "those who were interviewed in non-Azawad region and answered 1-6 years for MDHS95/96 or for 6-11 years for MDHS2001".

Table 6: Mechanism (Access to Prenatal Care and Assistance at Delivery)

	Prenatal care (Yes=1, No=0)		Number of antenatal care taken		Delivery at hospital (Yes=1, No=0)		Delivery with assistance (Yes=1, No=0)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
War region × Months of war experience in utero	-0.004		-0.013		-0.005		-0.000	
	(0.002)		(0.016)		(0.003)		(0.003)	
Distance from war region × Months of war experience in utero		0.132		0.306		0.324		-0.541
		(0.536)		(4.028)		(0.846)		(0.542)
Birth Order	-0.008***	-0.008***	-0.108***	-0.109***	-0.007**	-0.007**	-0.001	-0.002
	(0.003)	(0.003)	(0.022)	(0.022)	(0.003)	(0.003)	(0.003)	(0.003)
Sex; 0=male, 1=female	-0.010	-0.010	0.053	0.055	-0.009	-0.009	-0.008	-0.008
	(0.009)	(0.009)	(0.061)	(0.061)	(0.011)	(0.010)	(0.008)	(0.008)
Twin; 0=single, 1=multiple	-0.016	-0.018	0.740***	0.729***	0.060	0.058	0.078***	0.076***
	(0.030)	(0.030)	(0.260)	(0.257)	(0.043)	(0.044)	(0.029)	(0.029)
Mother's age at child's birth (months)	0.000***	0.000***	0.002**	0.002**	0.000	0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Mother's highest educational in single years	0.015***	0.015***	0.208***	0.210***	0.014***	0.014***	0.013***	0.013***
	(0.003)	(0.003)	(0.018)	(0.018)	(0.003)	(0.003)	(0.003)	(0.003)
Mother's height (cm)	0.000	0.000	0.003	0.003	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.003)	(0.003)	(0.001)	(0.001)	(0.000)	(0.000)
Never married =1, married=0	0.011	0.010	-0.615**	-0.618**	0.045	0.044	0.056*	0.056*
	(0.034)	(0.034)	(0.246)	(0.244)	(0.036)	(0.036)	(0.031)	(0.031)
Wealth Index	0.060***	0.058***	0.538***	0.505***	0.073***	0.069***	0.091***	0.087***
	(0.010)	(0.010)	(0.073)	(0.073)	(0.010)	(0.010)	(0.012)	(0.012)
Distance from main battle fields		19.255***		223.301***		26.080		24.217**
		(7.086)		(74.419)		(15.910)		(10.098)
Constant	0.341***	0.193**	1.600***	-0.115	0.339***	0.139	0.379***	0.194*
	(0.076)	(0.091)	(0.604)	(0.769)	(0.094)	(0.149)	(0.073)	(0.100)
N	9567	9567	7235	7235	9567	9567	9567	9567
R-squared	0.285	0.286	0.316	0.319	0.308	0.310	0.481	0.483

Note: Robust standard errors in parentheses. ***, ** and * mean significant level at 1%, 5% and 10%, respectively. All equations include region fixed effect, birth year fixed effect, birth month fixed effect, and interaction terms between region and birth year.