Terror and Birth Weight: Evidence from Boko Haram Attacks*

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Abstract

This paper examines the impact of 2009-2013 Boko Haram attacks in Nigeria on birth weight of infants. Using spatial and time variation of attacks during trimesters of pregnancy I find that in utero exposure to additional terror-related fatality on average reduces birth weight and increases the probability of having low birth weight. This effect is larger when exposure is close to date of delivery. Results are robust to alternative terror exposure measurements, group heterogeneity and socioeconomic status of the mother.

JEL Codes: I12,J13

Keywords: birth weight, pregnancy, terror, Boko Haram

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1 Introduction

Low birth weight is widely held to be an indicator for poor infant health[1]. Several studies have highlighted the cost and possible impact of low birth weight on child health and future status. Infants with low birth weight experience severe health and developmental difficulties with societal costs (Almond *et al.*, 2005). Babies with low birth have poorer outcomes in terms of mortality rates, educational attainment and earnings (Black *et al.*, 2007; Oreopoulos *et al.*, 2008; Royer, 2009). Low birth weight is also a predictor of future outcomes amongst mothers born into the same family. Women whose mother had low birth weight have a higher chance of having low birth weight, live in a poorer area and have less education at the time of child birth (Currie and Moretti, 2007). Possible mechanisms that lead to low birth weight are shocks suffered during gestation (Barker, 1990, 1995), air pollution (Currie and Neidell, 2005; Pope *et al.*, 2010)[2], terrorist attacks (Camacho, 2008; Smits *et al.*, 2006), malnutrition (Almond *et al.*, 2011)[3]. However, the casual relationship of these associations has been a subject of debate. The casual influence of low birth weight on health outcomes may depend on certain health problems or socioeconomic factors which increase infant mortality and other adverse outcomes that are prevalent amongst low birth weight infants. Besides effects of shocks on the incidence of low birth weight also depend on mother characteristics such as education and marital status[4].

In this paper, I present new evidence on the effect of shock on birth weights in Nigeria using fatalities from terror attacks as an instrument of shock. Terror attacks by Jama'atu Ahlis Sunna Lidda'awati Wal-Jihad, also known as Boko Haram (which translates to Western education is forbidden) has claimed the lives of 5800 Nigerians between

[1] Low birth weight as defined by the World Health Organization (WHO) is the weight at birth of less than 2,500 grams (5.5 pounds). See World Health Organization (2011).

[2] Pope *et al.* (2010) found that exposure of pregnant women to indoor air pollution from solid fuel use increased the risk of low birth weight and stillbirth.

[3] Almond *et al.* (2011) found that preganancies exposed to Food Stamp Program yield deliveries with increased birth weight with a larger effect on low birth weights.

[4] Dehejia and Lleras-Muney (2004) present evidence showing that babies conceived during periods of unemployment have reduced incidence of low and very low birthweight attributed to improvements in health behavior and mother selection during periods of recession.

July 2009 and October 2014[5]. Attacks have occured mostly in the northern region of the country resulting in a declaration of state of emergency in certain northern states. This paper analyzes the impact of Boko Haram terror attacks on the birth weight of chidren. I use data from the 2013 Nigerian Demographic and Health Survey (NDHS), conducted by the National Population Commission approximately four years after the start of terror attacks by Boko Haram. The NDHS was administered to approximately 26000 households located in the northern region and contains questions on birth weight, fertility, infant mortality, prenatal care and place of delivery. I exploit variation in a large number of Boko Haram terror attacks in Nigeria from 2009 to 2013 using data on fatalities based on event dates and attack locations from the Armed Conflict Location and Event Dataset (ACLED) (Raleigh *et al.*, 2010), and examine whether the terror attack raises the probability of having low birth weight. I find that in utero exposure to terror attacks increases the risk of a child being born below 2500 grams especially if attacks occur close to child birth.

The remainder of the paper is organized as follows. In Section 2, I describe mechanisms by which environmental exposures affect birth weight and briefly summarize the existing literature on the topic. In Section 3, I give a historical account of Boko Haram and discuss the estimation strategy. After describing the data and providing an initial descriptive analysis in Section 4, I present the statistical results and a range of empirical tests in Section 5. Section 6 concludes.

2 Environmental Exposures and Birth Weight

In broad terms, prenatal enviromental exposures affect birth weight through four channels: maternal health, economic shocks and pollution (Almond and Currie, 2011) and conflict (Currie, 2013). Maternal health shocks affects fetal health through malnutrition, famine and disease. In addition to the maternal health channel, shocks from economic downturns (such as recession) may affect birth weight through altering the socioeconomic

[5]Estimate from Raleigh *et al.* (2010).

status of the mother at the time of birth and reduce adult survival. Moreover, air pollution exposes the fetal health to toxins which reduces birth weight and gestation while exposure to civil violence reduces birth weight through maternal stress. I describe each of these mechanisms below.

The maternal health channel operates through the well-documented effect of nutrition on fetal health. Results show that cohorts affected during later stages of pregnancy experienced reductions in birth weight. For instance, Roseboom *et al.* (2011a) examined the effect of malnutrition on infants born during the 1944-45 wartime famine in Holland. They found that mid or late gestation exposure to famine resulted in low birth weights, head circumference and length amongst affected cohorts[6]. Almond and Mazumder (2011) show the effect of maternal fasting on the child in utero. Their study show that pre-natal exposure to maternal fasting during Ramadan is associated with lower birth weight and has a 22-23% likelihood of leading to disability of the infant in adulthood[7]. Intrauterine exposure to famine also has long term effects in terms of schooling and socioeconomic outcomes. Relative to unexposed cohorts, cohorts exposed to the Chinese famine (1959-1961) in utero attain 0.58 fewer years of schooling (Meng and Qian, 2009); are 3-6% less likely to work and 12-13% more likely to be disabled (Almond *et al.*, 2007). Exposure of maternal health to disease environment also have latent effect on children in utero. Using 1989-2009 Vital Statistics natality microdata, Almond *et al.* (2012) found that disease exposure to early childhood increases diabetes incidences and associated with poor socioeconomic outcomes and maternal behavior.

Economic shocks around the time of birth are likely determinants of birth weight since it creates maternal stress which affects the child in utero. However, findings are less consistent than the maternal health channel. Dehejia and Lleras-Muney (2004) provide evidence that children conceived during periods of recession have reduced incidence

[6]In a recent study, Hult *et al.* (2010) found that cohorts exposed to undernutrition and in infancy in the Biafra famine during the Nigerian civil war (1967-1970) have increased prevelance of hypertension on order of 9.5 to 24 percent and type 2 diabetes from 8 to 13 percent when they reach the age of 40 Early childhood exposure to the famine led to increased prevalence of adult blood pressure within the range of 9.5 to 16 percent. This has high implication in that nutritional effects on cohorts exposed are more pronounced at an earlier age when compared to cohorts exposed during the Dutch famine. See Roseboom *et al.* (2011b).

[7]A further study by Almond *et al.* (2014) indicate that this affects subsequent academic outcomes of the child at the age of 7. They find that test scores are 0.05-0.08 standard deviations lower for students exposed to Ramadan in first trimester of pregnancy.

of low birth weight[8]. In contrast, Van den Berg *et al.* (2006) show that a child born during a recession live a few years less than a chid born during a boom period. Their study indicate that maternal stress from economic conditions presupposes the infant to a high mortality rate later in life.

Prenatal exposure to pollution increases the risk of negative health outcomes for the infant in utero. A natural experiment study by Currie *et al.* (2009) show that infants exposed in utero to high levels of carbon monoxide (CO) had low birth weight and gestation length relative to siblings and with an increase in death risk of 2.5%[9]. In addition, Coneus and Spiess (2012) find that an average increase in CO exposure in the last trimester reduces birth weight by 289g for infants and increases the likelihood of bronchitis and respiratory diseases for toddlers.

Exposure to conflict is another potential mechanism that affects infant health. Recent studies show that child in utero is affected through psychological stress experienced by the mother. Using 2000-2005 al-Aqsa Intifada in Palestine, Mansour and Rees (2012) find that additional conflict fatality in the first and last trimester increases the probability of low birth weight by 0.003 and 0.002 percentage points respectively. Besides, Camacho (2008) show that prenatal exposure to landmine explosions reduces birth weight by 8.7 grams relative to sibbling not exposed to explosions. This paper focuses on the impact of terror attacks on birth weight. As I show below, intensity in terror attacks affect all trimesters with a persistent effect on the last trimester. This effect is of interest for several reasons: First, recent attacks have greater impact than previous attacks which show that early shocks tend to dissipate while late shocks are more latent. Second, the socioeconomic status of the mother has no mitigating effect if attack occurs too close to birth. Third, individual or group heterogeneity has minimal effect if attacks occur in final trimester.

[8]Banerjee *et al.* (2010) find that income shocks decreases height in the long-run but does not affect health outcomes or life expectancy.

[9]See Currie (2011, 2013) for recent summary of this literature.

3 Historical Background and Estimation

3.1 A Brief History of Boko Haram Terror Activity

Boko Haram (BH) was founded in 2002 with the aim to create a strict Islamic state in the north of Nigeria that would address societal ills such as corruption and bad governance. However, it was not until mid-2009 that it turned to large-scale terrorist activity. Table 1 shows the number of killings and kidnapping from 2009 to 2014. Boko Haram's terrorist activity has been high, with an average of 981 victims per year within this period. The last three years has witnessed a total of 5105 victims with a great percentage in 2014 in addition to the abuction of secondary school girls from Chibok. To finance its operations, Boko Haram has used abductions for ransom; robberies and extortions mainly through looting villages and towns in the north.

Figure 1 depicts the spatial distribution fatalities from the terror attacks for the period of 2009-2013[10]. Boko Haram's terrorist attack has been concentrated in the northern region with more fatalities in the north east region. Table 2 show deaths and deaths per million inhabitants per year caused by Boko Haram for the period of 2009-2014. Almost 100 percent of deaths caused by Boko Haram in Nigeria during this period occured in the north of the country. The comparison is even more striking once expressed in per capita terms to show terror exposure intensity. Boko Haram's violent activity in the north has been 660 times as large as in the rest of Nigeria and its activity in the north east almost 54.79 times as large as in the whole country.

[10]See Appendix for attack incidents per quarter within the same period.

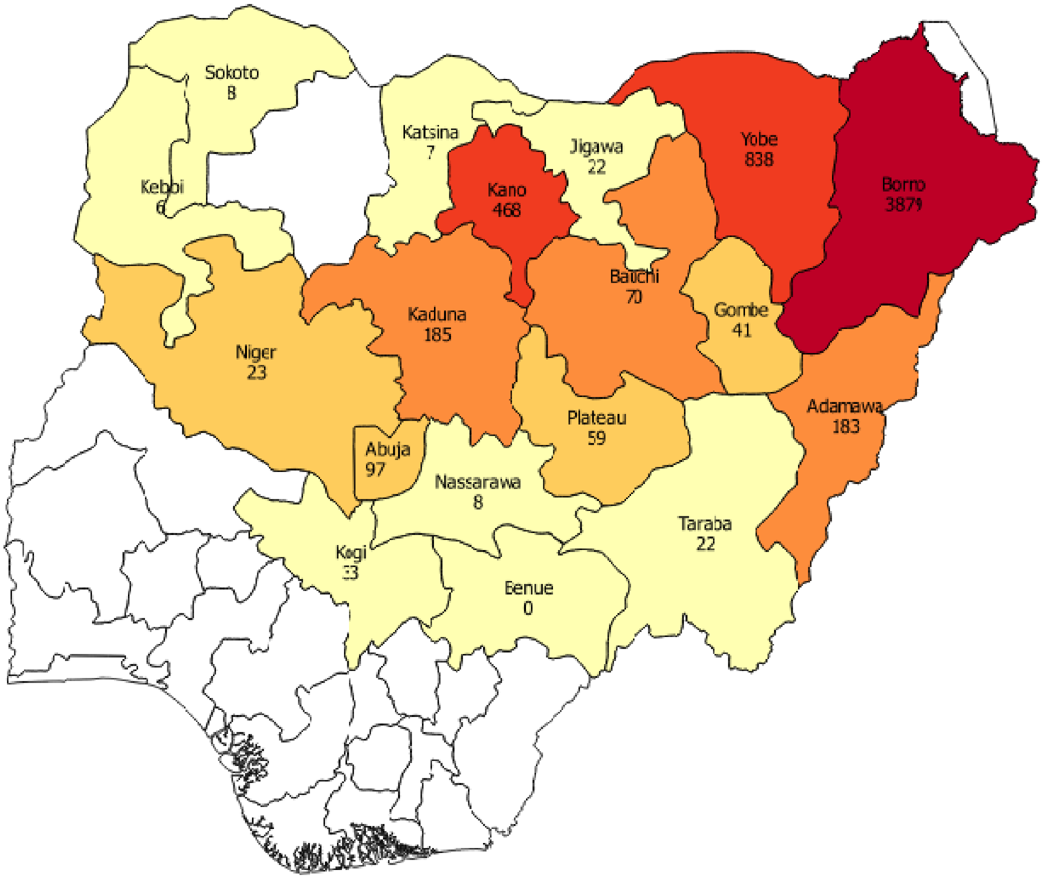

Figure 1: DISTRIBUTION OF TERROR FATALITIES ACROSS STATES, 2009-2013
Data source: ACLED, Raleigh *et al.* (2010).

3.2 Estimation

I follow Mansour and Rees (2012) and regress measures of the child's birth weight on measures of terror intensity corresponding to the trimesters of birth. Thus, the model is essentially

$$
\begin{aligned}
BW_{ist} = \alpha &+ \beta_1(9 - 6\ Months\ Before\ Birth)_{st} \\
&+ \beta_2(5 - 3\ Months\ Before\ Birth)_{st} \\
&+ \beta_3(2 - 0\ Months\ Before\ Birth)_{st} \\
&+ \beta_4\tau_t + \beta_5\delta_s + \beta_6\lambda_t + \beta_7 X_{ist} \\
&+ \varepsilon_{ist}
\end{aligned} \tag{1}
$$

In this equation, i indexes individuals, s indexes states, and t indexes month of birth (t=1...53). BW is birth weight, X is a vector of individual observable characteristics, τ_t is a fixed year effect (2009 - 2013), δ_s is a fixed state effect and λ_t is month fixed effect (12 months). The fixed effect control for time-series changes in birth weight of individuals born within a family (β_4), the time-invariant characteristics of terror attack states (β_5) and the time-invariant characteristics of individuals born each month (β_6). Terror intensity through early pregnancy is captured by measuring fatalities that occur *9-6 Months Before Birth* (β_1), *5-3 Months Before Birth* (β_2) and *2-0 Months Before Birth* (β_3)[11]. ε_{ist} is a random error term. The set of demographic covariates used includes i's indicator for twin, gender, firstborn, mother's age when i was born, mother's age at marriage, mother's education, father's education and father's occupation and family wealth[12].

Following the literature on the effects of conflict on birth weight (Mansour and Rees (2012); Camacho (2008)), I also estimate equation (1) by restricting sample to siblings to control for family characteristics that affect fertility decisions in response to terror attack

[11] The next section explains in detail how these are derived.

[12] Additional covariates are place of residence (rural or urban), religion, ethnicity, state level tax returns and unemployment rates in addition to fatalities from conflicts other than attacks from Boko Haram. Data on tax returns and unemployment rates by state are from National Bureau of Statistics of Nigeria. See National Bureau of Statistics of Nigeria (2011, 2013).

exposure[13]. Hence I estimate

$$
\begin{aligned}
BW_{imst} = \alpha &+ \beta_1 (9-6 \; Months\, Before\, Birth)_{st} \\
&+ \beta_2 (5-3 \; Months\, Before\, Birth)_{st} \\
&+ \beta_3 (2-0 \; Months\, Before\, Birth)_{st} \\
&+ \beta_4 \tau_t + \beta_5 \omega_m + \beta_6 \lambda_t + \beta_7 X_{imst} \\
&+ \varepsilon_{imst}
\end{aligned}
\tag{2}
$$

where i indexes individuals, m indexes mother, s indexes states and t indexes month of birth. X consists of i's indicators for twin, gender, whether firstborn and mother's age when i was born. ω_m is mother fixed effect. Birth weight are observed for 1998 sibblings. Mean values for the sibling sample are reported in the third column of Table 3. Children in this sample are likely to have marginally higher birth weight than in the full sample. However, mean value of mother characteristics are practically the same across samples.

As an additional test, I modify equation (1) to capture state linear trends by interacting month and year indicators to estimate

$$
\begin{aligned}
BW_{ist} = \alpha &+ \beta_1 (9-6 \; Months\, Before\, Birth)_{st} \\
&+ \beta_2 (5-3 \; Months\, Before\, Birth)_{st} \\
&+ \beta_3 (2-0 \; Months\, Before\, Birth)_{st} \\
&+ \beta_4 \kappa_t + \beta_5 \delta_s + \beta_6 X_{ist} \\
&+ \varepsilon_{ist}
\end{aligned}
\tag{3}
$$

I implement (3) with and without mother fixed effects to capture variation at the household level within each state.

[13]This is to remove potentially cofounding factors from unobserved characteristics, for instance, adjustment to mother's behavior given exposure to terror attacks.

4 Data and Sample

I use the 2013 Nigeria Demographic and Health Survey (NDHS) data. The NDHS contains data on 38,522 households interviewed between February and June 2013. Information at the household level relates to birth registration, maternal education and age, marital status, paternal demographic characteristics, maternal behavior during pregnancy (e.g. number of prenatal visits) and infant health at birth. The household data is merged with data on fatalities by Boko Haram collected by ACLED on a monthly basis at the state level. Following Mansour and Rees (2012), I construct three terror intensity variables by matching the number of Nigerians killed by Boko Haram to children in the NDHS based on their date of birth and state of residence. Hence terror intensity in the first trimester is calculated as the total number of fatalities that occured in the state of residence *9-6 Months Before Birth*; *5-3 Months Before Birth* for the second trimester and *2-0 Months Before Birth* for the last trimester[14].

I impose four main sample restrictions. First, the sample consists only of children born in the north of Nigeria[15]. Second, for these infants, I limit the sample to those born from January 2009 to July 2013[16]. Third, I focus on intensity of terror attack fatalities. Hence, I only consider infant in utero exposed to at least an attack with one fatality within the three trimesters. Fourth, I adjust for relative birth size and heaping at 2500 grams[17]. As emphasized by Blanc and Wardlaw (2005) a considerable amount of heaping

[14]These calculations are based on the assumption that with a median gestational age of 38 weeks, an infant born between March 1 and 15 is likely to have been conceived in the last week of June. Hence, for infants born between March 1 and 15, fatalities *9-6 Months Before Birth* would be the total number of fatalities within the state of residence that occured in June, July, August and September of the previous year. However, for infants born between March 16 and 31, fatalities *9-6 Months Before Birth* would be those that occured within their state of residence in July, August and September. Furthermore, fatalities *5-3 Months Before Birth*, for infants born in March, would be those that occured in their state of residence in October, November and December while fatalities *2-0 Months Before Birth* would be those that occured during the months of January, February and March.

[15]99 percent of the terror attacks are in the northern region and vary by month and year. See Table 2.

[16]The upsurge in terror attacks started in July 2009 and the final birth entry in the survey is on July 2013.

[17]Heaping is a pattern of misreporting in which distrubtion of a number as reported by respondents, such as age or birth weight, shows large frequencies of particular values which usually ends in 0 or 5. See United Nations Children's Fund and World Health Organization (2004); Blanc and Wardlaw (2005).

occurs on reported birth weights of exactly 2500 grams. Hence, weights that are less than 2500 grams are reported at exactly 2500 grams. In addition, analyzing only infants weighed at birth would bias the sample downwards especially if there is a smaller percentage of infants weighed at birth. Given the survey data limitation in reporting birth weights for the majority of infants[18], I utilize the mother's subjective assessment of the infant'size at birth by year and state of residence to establish likely weight estimates[19]. I further experiment with two categories of low birth weight ($\leq$ 2500g and $<$ 2500g), thus, controlling for the downward bias of low birth weight on heaping and when infants not weighed at birth are excluded from sample[20].

Table 3 provides summary statistics of the sample. Throughout the analysis I examine full and sibling samples separately. The mean birth weight for the full sample is 3109 grams with eight percent of infants weighing less than 2500 grams and an additional 2 percent weighing exactly 2500 grams. T-tests for difference in mean values of the components show that women exposed to terror fatalities are more likely to have higher prevalence of low birth weight; marry at a younger age and deliver outside the hospital. However, households experience similar levels of birth weights and pregnancy complications.

[18] 93 percent of the initial sample had missing birth weights.

[19] Results are still robust when estimated weights are excluded. See Appendix Table 7.

[20] I assume that within the same state, the relationship between birth weight and the mother'assessment of infant size does not does not depend on whether the infant was weighed.

5 Results

I present the results in five subsections. First, I consider the impact and magnitude of terror fatalities on birth weight. I find an increasingly negative effect of terror intensity on birth weight in all trimesters. Second, I examine whether socioeconomic status of the mother, using mother's education and age at marriage, has a mitigating effect on terror attack exposure. Third, I examine the impact of fatalities on the use of medical services. I find an effect in the outcomes in later stages of pregnancy. Fourth, I present impact estimates of terror fatalities per capita on low birth weight. Fifth, I discuss robustness.

5.1 Terror fatalities and birth weight

The effect of terror on birth weight could manifest itself in terms of prevalence of preterm birth (i.e. before 38 weeks of gestation), restricted foetal (intrauterine) growth, reduced birth weight and increased probability of having low birth weight. I do not observe preterm birth or restricted foetal growth, as NDHS does not contain this data. However, I observe birth weight and an indicator for low birth weight.

To examine the effect of terror attacks on birth weight, I begin with a regression of the relationship between fatalities and birth weight shown in the first two columns of Table 4. Estimates using the 20 states in the northern region show that fatalities during the first trimester is associated with birth weight reduction of 0.20 grams and additional fatalities in the second and third trimester results in a decrease in birth weight by 0.37 grams and 0.49 grams respectively.

To examine whether these effects are consistent with sampling variability, I estimate using the sibling sample taking into consideration mother fixed effects (equation 2)[21]. The estimates are uniformly negative with significant effects for the second and third trimesters: additional fatality in these trimesters are associated with a birth weight reduction of 0.93 and 1.09 grams.

[21] I control for family wealth in each sample.

I further disaggregate these effects into indicators on the probability of having low birth weight. As mentioned above, the indicators are of two forms. The first indicator includes weight measures at 2500 grams with estimates for the full and sibling sample in column 3 and 4 of Table 4. Full sample estimates show a positive and significant relationship between fatalities and the probability of having a low birth weight during birth trimesters. Fatalities that occur in the first trimester is associated with a 0.0001 increase in the probability of having low birth weight; additional fatality in the next trimester with a probability increase of 0.0004 and fatality in the subsequent trimester with a 0.0005 increase in this probability. Sibling sample estimates show an increase in magnitude for fatality effects in the second and last trimesters of 0.0007 and 0.0010 respectively.

The second indicator, shown in column 5 and 6, excludes weight measures of 2500 grams. Overall estimates indicate a significant effect of fatalities on low birth weight probability across samples with an exception to the first trimester in the sibling sample. An 0.0005 increase in the probability of having an infant with less than 2500 grams is associated with fatalities that occur in the later stages of pregnancy. The magnitude increases to 0.0006 and 0.0009 for the last two trimesters when sample are restricted to siblings.

In summary, I find evidence that terror fatalities affect the probability of a mother having a child that weighs less than 2500 grams. Though the findings is not surprising in light of other conflict channel studies (Mansour and Rees (2012); Camacho (2008)), the conclusion has several implications. First, persistent exposure to terror attacks increases the likelihood of having a low birth weight. Second, the magnitude increases within the sibling sample which suggests mother's education or age at marriage has minimal effect on fertility decisions if attack occur close to birth. Besides comparison with other studies estimates show similar effects in the later stages of pregnancy. For example, Wainstock *et al.* (2013) find that women exposed to rocket attacks in Israel during the second trimester of pregnancy had 15 percent chance of delivering low birth weight infants than women unexposed. In addition, Mansour and Rees (2012) find the probability of having low birth weight to be 0.0019 for women exposed to conflict fatalities in the last trimester during the al-Aqsa Intifada in Palestine.

5.2 Education and Age at Marriage

Having determined that terror fatalities alter the probability of having low birth weight, I proceed to examine the impact of these fatalities given the mother's educational attainment and age at marriage. I begin by spliting the sample by educational attainment in columns 1 through 4 in Table 5. I highlight two aspects of the estimates. First, the education of the mother only has a mitigating effect if attack occur in the first trimester but this effect diminishes with attacks in the last trimester. Second, attacks close to term has a slightly higher likelihood of resulting in low birth weight for more educated women (0.0011) than less educated (0.0008).

Estimates based on age at marriage samples are given in columns 5 through 8. The estimate show that women who marry at a young age (less 18 years) are somehow shielded from the effects of terror if attacks occur in the first and second trimester than women who do not marry at a young age (at 18 years or greater). However, effects are similar across marriage samples when attacks occur close to birth.

The effect of mother's socioeconomic status as a mitigating factor when exposed to terror is consistent with two stories. One story is the hypothesis that, better-educated women are shielded from effects of terror through fertility decisions. However, as noted above, this is conditional that attacks occur early in pregnancy[22]. Attacks close to term give little time for fertility decisions to take effect. A second story is that, younger mothers have a stronger constitution to withstand the effects of terror when exposed early in pregnancy than older mothers.

An important issue in the interpretation of these estimates is that the effect may be due to mother's age at birth. I address this issue by estimating the impact of terror by mother's age at first birth hence differentiating between possible effects of teen motherhood. The results remain consistent with previous estimates in that impacts of terror exposure are stronger for women at older maternal age[23]. Previous studies on the effect of socioeconomic status on birth outcomes show similar results. For instance, Currie and Hyson (1999) find that high socioeconomic status does not mitigate low birth weight in

[22] Attacks at this stage predisposes the mother to migrate to a safe haven to give birth.
[23] See Appendix Table 8.

terms of use of health facilities and educational attainment [24] . Gueorguieva *et al.* (2001) show that risk associated with being a teen mother is not related to age per se but to the confounding influences of associated with environmental factors. In addition, Kramer and Lancaster (2010) find that negative consequences associated with teen motherhood is due, not to chronological age, but to relative developmental maturity and the availability of non-maternal support.

5.3 Use of medical services

Proceeding next to the analysis of the effect of terror exposure on the availability of medical services, I examine the effect of medical care restriction given the increase in terror intensity (Table 6) using two measures of medical care: prenatal care visits and delivery in hospital or clinic. Columns 1 and 2 show the impact of terror exposure on prenatal visits. Estimates show a significant negative relationship between terror intensity and prenatal visits. Additional fatality in later stages of pregnancy reduces the likelihood of prenatal visits in the second (-0.0088) and third trimester (-0.0066). The effects are similar for delivery in hospital or clinic (columns 3 and 4).

I further consider whether prenatal care access through prenatal visits serves as a channel of mediation on the effect of fatalities and low birth weight probability (Table 7). Estimates show a negligible effect in later stages of pregnancy across samples[25].

[24] They find that low birth weight women of high socioeconomic status are less likely to report poor health than other low birth weight women. In addition, high socioeconomic status boys suffer more than low socioeconomic status boys in educational attainment terms.

[25] The result is consistent with the hypothesis that women who experience violence during birth trimesters are likely to delay entry to or experience challenges to effective prenatal care or hospital delivery. See Nunes *et al.* (2010); Dietz *et al.* (1997) for effects of violence on prenatal care. There is also a negative relationship between fatalities and probability of reporting any complication. Moreover, fatalities are negatively related to anemia in later stages of pregnancy. See Appendix Table 3.

5.4 Fatalities by state population

To understand the magnitude of fatalites on birth weight at state level, I turn to estimates based on fatalities scaled by state population. Using 2006 state population estimates (in hundreds of thousands) I show state size effect of terror exposure. The estimates are reported in Table 8.

Terror intensity estimates show a positive relationship across all trimesters with significant effects in the second and third trimester. Full sample estimate for the second (third) trimester is 0.0203 (0.0214) with a standard error of 0.0077 (0.0083). Estimates in sibling sample show second (third) trimester effects as 0.0290 (0.0390) with standard error of 0.0143 (0.1438)[26]. A possible caveat to this estimate is that I do not observe migration rates as a result of terror intensity[27], notwithstanding, estimate is large in economic magnitude.

5.5 Fatalities and child mortality

Terror fatalites affects infant health to the extent that terror exposure affects a mother's behavior which affects the health of the child. Hence, I explore child mortality as a possible effect of terror attacks. Estimates (Appendix Table 4) are in two samples: if the child died within a month and if the child died within two months. Estimated impact of terror on infant mortality are generally statistically insignificant, small and of mixed sign[28]. Besides, results are consistent with previous studies. For instance, in comparing infant mortality by high and low terrorism departments in Peru, Paxson and Schady (2005) found that, while not ruling out an indirect effect of terrorism on infant mortality, terrorism cannot account for infant mortality changes shown through disruptions in

[26] Given that the last population census was 2006, there is possiblity that estimates reflect pre-terror events. Hence, I consider terror intensity effects using state population estimates for 2011(see National Bureau of Statistics of Nigeria (2012) for estimates). Results (Appendix Table 9) show similar estimates with stronger effects.

[27] NDHS does not contain this data.

[28] A positive and significant relationship only occurs at later stages of pregnancy in the sibbling sample.

healthcare access. Mansour and Rees (2012) find similar effects with conflict intensity. However, Bruckner *et al.* (2010) find that the aftermath of the September 2001 terror attack increased the odds of a male fetal death above its expected value.

5.6 Robustness

Several assumptions have been made in the identification of the effects of terror fatalities on birth weight. First, homogeneity across exposed mothers. Second, terror exposure in the first trimester is conditional that the infant is born in the first or second half of the month[29]. Third, terror exposure is similar across weight at birth recall (either from health card or mother's recall). Fourth, effect depends on birth weight cutoff at 2500 grams and does not consider impacts prior and after birth trimesters nor attacks in neighboring states. I elaborate on these points in addition to state linear trends (equation 3) below.

The effect of terror intensity on birth weight is likely to be heterogeneous for reasons such as religion and ethnicity[30]. Appendix Table 1 gives estimated effects of these characteristics. I find little evidence of any persistent effect of terror intensity in the early stages of pregnancy in the maternal characteristics I measure: whether Muslim, Christian, Hausa or other ethnic groups. However, there are significant effects, irrespective of characteristics, in the last trimester with a higher magnitude in the sibling sample for mothers that are either Christian or from other ethnic groups. Similarly, I find little evidence of terror intensity effect for the alternative measure of first trimester exposure (Table 9)[31]. In contrast, exposure effects are sizeable and significant in the second and third trimester.

Turning to estimates for weight at birth recall, I find a positive relationship in the later stage of pregnancy when samples are restricted to infants with health cards (columns 5 through 8 of Table 6) or restricted to mother's recall (Table 10). This suggests that

[29] See section 4.

[30] Northern Nigeria has a high Muslim and Hausa(Fulani) population.

[31] I use fatalities that occur 9-6 months before birth regardless of which half of the month the child was born.

terror exposure is not influenced by child weight recollection. Estimates on different birth weight cutoffs of 1500 and 3000 grams (Appendix Table 2) show no evidence of infant weighing less than 1500 grams when exposed to terror attacks. However, there is a slight probability of weighing less than 3000 grams in the sibling sample if exposed in the first trimester.

Finally, I show estimates for state linear trend (Table 11), terror exposure prior to conception and after birth (Appendix Table 5) and neighboring state effect (Appendix Table 6). Results on state linear trend show a sizeable and significant effect of terror exposure on the probability of having low birth weight in the first and last trimester. The estimates are consistent with sample variability. There is little evidence that terror exposure prior to month of conception or after month of birth has impact on infant weight. Similary, I find no evidence of terror exposure results to low birth weights if attack occur in neighboring states.

6 Conclusion

I examine the effect of 2009-2013 terror attacks of Boko Haram in Nigeria on the birth weight of infants using natality data from demographic and health survey in addition to information on the exact date and location of attack collected during this period. Specifically, I examine the effect of terror fatalities on birth weight and on the probability of having low birth weight. I find that additional fatality during trimesters of pregnancy reduces birth weight and increases the probability of the infant weighing less than 2500 grams. This impact is stronger and persistent if attacks occur in the last trimester and is not mitigated by the socioeconomic status of the mother. Possible mechanisms are reduction in prenatal visits and delivery in hospital which increases maternal stress. I find little evidence of heterogenous effects of terror exposure nor does effect depend on mother's age at birth.

While not ruling out the hypothesis that shocks from terror affect birth weight, estimates should be interpreted with caution for three reasons. First, non-availability of data on plausible mechanisms such as household migration, preterm birth and restricted foetal growth reduces causal implications. Second, estimates are specific to the subpopulation of birth weight of children whose mother are affected by terror attacks. Thus, it may be difficult to generalize to other subpopulations. Third, effects are short term, hence do not represent possible future outcomes. However, results are consistent with those of medical literature and is substantive in examining the impact of terror on child health.

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TABLE 1-CHRONOLOGY OF BOKO HARAM'S TERROR ACTIVITY

Year	Killings	Kidnapping	Event
2009	700	0	Clashes with police and military in Maiduguri
2010	10	0	Nigerian President Umaru Musa Yar'Adua dies
2011	71	0	Bombing of United Nations (UN); national police headquarters in Abuja and Christmas day bombings in Niger, Plateau and Yobe
2012	294	0	Closure of the Nigerian border in the north
2013	1789	0	Bus bombing in Kano; School shooting in Yobe
2014*	3022	276	Kidnapping of school girls from Chibok in Borno

Notes: * These are fatalities from January - October 18, 2014.

Source: Armed Conflict Location and Event Data Project (ACLED), Raleigh *et al.* (2010).

TABLE 2-BOKO HARAM'S TERROR ACTIVITY, 2009-2014

Deaths:	
North Central	281
North East	5201
Nort West	330
Rest of Nigeria	4
Percentage in the North	99.93
Deaths per million inhabitants per year:	
North Central	2.76
North East	54.79
North West	1.84
Rest of Nigeria	0.09
Ratio Northern region/Rest of Nigeria	660

Notes: Author's computation from ACLED, Raleigh *et al.* (2010).

Table 3-SUMMARY STATISTICS

	Observations (1)	Full sample (2)	Sibling sample (3)	Terror fatalities (4)	No terror fatalities (5)	Difference in means (5-4)
Birth outcomes						
birth weight in grams	4222	3109	3117	3160.95	3067.44	-93.51***
birth weight $< 2{,}500$ grams	4222	0.10	0.10	0.12	0.07	0.05***
birth weight $\leq 2{,}500$ grams	4222	0.08	0.07	0.09	0.07	0.02**
died within one month of birth	4222	0.03	0.04	-	-	-
died within two months of birth	4222	0.00	0.00	-	-	-
female	4222	0.49	0.49	-	-	-
twin	4222	0.03	0.06	-	-	-
first born	4222	0.81	0.97	-	-	-
Mother's characteristics						
mother's age at birth	4222	26.64	27.30	26.58	26.88	0.30
mother's education	4222	3.06	2.96	3.31	3.38	0.07
mother's age at marriage	4222	15.82	15.78	15.61	16.09	0.48***
husband's education	4176	5.02	5.27	5.28	5.23	-0.05
Medical care use						
number of prenatal visits	4222	2.91	2.75	3.15	3.13	-0.02
delivered in hospital or clinic	4222	0.17	0.17	0.16	0.19	0.03**
birth attended by doctor	4196	0.06	0.04	0.05	0.06	0.01
Pregnancy complications						
any complication	4222	0.36	0.34	0.37	0.35	-0.02
anemia	4222	0.61	0.60	0.59	0.68	-0.09***

Notes: Terror and non terror fatalities are based on the intensity of attack resulting to fatal deaths.

Terror fatalities is 1 if attacks always result to fatal deaths and 0 otherwise.

***Statistically significant at 1 percent level

**Statistically significant at 5 percent level

*Statistically significant at 10 percent level

TABLE 4-THE EFFECT OF FATALITIES ON BIRTH WEIGHT

	Birth weight in grams		low birth weight $\leq 2{,}500$g		low birth weight $< 2{,}500$g	
	(1)	(2)	(3)	(4)	(5)	(6)
9-6 Months Before Birth	-0.2022***	-0.2151	0.0001*	0.0001	0.0001**	0.00004
	(0.0632)	(0.1487)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
5-3 Months Before Birth	-0.3690**	-0.9297**	0.0004**	0.0007**	0.0005***	0.0006*
	(0.1734)	(0.3655)	(0.0001)	(0.0003)	(0.0002)	(0.0004)
2-0 Months Before Birth	-0.4839**	-1.0930**	0.0005**	0.0010***	0.0005***	0.0009**
	(0.1703)	(0.4173)	(0.0002)	(0.0003)	(0.0002)	(0.0003)
mother fixed effects	no	yes	no	yes	no	yes
Observations	4176	1998	4176	1998	4176	1998

Note: Standard errors clustered by state are in parentheses. Critical values are from a t-distribution with 16 (20 - 4) degrees of freedom. All regressions are based on weighted data for the period January 2009 through July 2013 and include controls for year and month of birth, mother's age at birth and marriage, infant's gender and birth order, fatalities from other conflicts and tax returns at state level.

***Statistically significant at 1 percent level

**Statistically significant at 5 percent level

*Statistically significant at 10 percent level

TABLE 5-THE EFFECT OF FATALITIES ON BIRTH WEIGHT BY MOTHER'S EDUCATION AND AGE AT MARRIAGE

	Mother's education < 12 years		Mother's education ≥ 12 years		Age at marriage < 18 years		Age at Marriage ≥ 18 years	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Model 1: low birth weight($\leq$ 2500g) :								
9-6 Months Before Birth	0.0001*	0.0001*	0.0001*	-0.0004***	0.0001	-0.0001	0.0001**	-0.0002
	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
5-3 Months Before Birth	0.0004**	0.0006**	0.0003*	0.0009	0.0004**	0.0004	0.0003**	0.0013**
	(0.0002)	(0.0003)	(0.0001)	(0.0006)	(0.0002)	(0.0003)	(0.0001)	(0.0004)
2-0 Months Before Birth	0.0005**	0.0008**	0.0006**	0.0011***	0.0005**	0.0009**	0.0005**	0.0012**
	(0.0002)	(0.0003)	(0.0001)	(0.0003)	(0.0002)	(0.0004)	(0.0001)	(0.0004)
mother fixed effects	no	yes	no	yes	no	yes	no	yes
N	4060	1949	3433	1668	3946	1901	3547	1716
Model 2: low birth weight($<$ 2500g) :								
9-6 Months Before Birth	0.0001**	0.0001**	0.0001*	-0.0005***	0.0001**	-0.0001*	0.0002**	-0.0002
	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
5-3 Months Before Birth	0.0005***	0.0005*	0.0003**	0.0006	0.0005***	0.0003	0.0003**	0.0011**
	(0.0002)	(0.0003)	(0.0001)	(0.0005)	(0.0002)	(0.0003)	(0.0001)	(0.0004)
2-0 Months Before Birth	0.0005***	0.0008***	0.0005**	0.0011***	0.0005**	0.0008**	0.0004**	0.0011***
	(0.0002)	(0.0002)	(0.0002)	(0.0003)	(0.0002)	(0.0004)	(0.0001)	(0.0004)
mother fixed effects	no	yes	no	yes	no	yes	no	yes
Observations	4060	1949	3433	1668	3946	1901	3547	1716

Note: Standard errors clustered by state are in parentheses. Critical values are from a t-distribution with 16 (20 - 4) degrees of freedom.
All regressions are based on weighted data for the period January 2009 through July 2013 and include controls for year and month of birth, mother's age at birth and marriage, infant's gender and birth order, fatalities from other conflicts and tax returns at state level.

***Statistically significant at 1 percent level

**Statistically significant at 5 percent level

*Statistically significant at 10 percent level

TABLE 6- THE EFFECT OF FATALITIES ON MEDICAL USE AND SERVICES

	Number of prenatal visits		Hospital or clinic delivery		Health card birth weight $\leq$2500g		Health card birth weight $<$ 2500g	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
9-6 Months Before Birth	-0.0001	0.0006	0.0000	-0.0001*	0.0000	-0.0004**	0.0001	-0.0004**
	(0.0004)	(0.0014)	(0.0000)	(0.0001)	(0.0000)	(0.0002)	(0.0001)	(0.0002)
5-3 Months Before Birth	-0.0004	-0.0088***	-0.0000	-0.0008***	0.0001	0.0009	0.0001	0.0007
	(0.0012)	(0.0014)	(0.0001)	(0.0002)	(0.0002)	(0.0007)	(0.0002)	(0.0006)
2-0 Months Before Birth	0.0008	-0.0066***	-0.0001	-0.0011***	0.0004*	0.0010***	0.0004*	0.0011**
	(0.0007)	(0.0013)	(0.0001)	(0.0001)	(0.0002)	(0.0003)	(0.0002)	(0.0003)
mother fixed effects	no	yes	no	yes	no	yes	no	yes
Observations	4176	1998	4176	1998	3369	1646	3369	1646

Note: Standard errors clustered by state are in parentheses. Critical values are from a t-distribution with 16 (20 - 4) degrees of freedom. All regressions are based on weighted data for the period January 2009 through July 2013 and include controls for year and month of birth, mother's age at birth and marriage, infant's gender and birth order, fatalities from other conflicts and tax returns at state level.

***Statistically significant at 1 percent level

**Statistically significant at 5 percent level

*Statistically significant at 10 percent level

TABLE 7-THE EFFECT OF FATALITIES ON LOW BIRTH WEIGHT:CONTROLLING FOR PRENATAL CARE AND ANEMIA

	low birth weight $\leq$ 2,500g		low birth weight $<$ 2,500g	
	(1)	(2)	(3)	(4)
9-6 Months Before Birth	0.0001	0.0001	0.0001**	0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
5-3 Months Before Birth	0.0004**	0.0006	0.0005***	0.0005
	(0.0002)	(0.0004)	(0.0002)	(0.0004)
2-0 Months Before Birth	0.0005**	0.0008**	0.0005***	0.0007*
	(0.0002)	(0.0003)	(0.0002)	(0.0004)
prenatal visits	yes	yes	yes	yes
anemia	yes	yes	yes	yes
mother fixed effects	no	yes	no	yes
Observations	4176	1998	4176	1998

Note: Standard errors clustered by state are in parentheses. Critical values are from at-distribution with 16 (20 - 4) degrees of freedom. All regressions are based on weighted data for the period January 2009 through July 2013 and include controls for year and month of birth, mother's age at birth and marriage, infant's gender and birth order, fatalities from other conflicts and tax returns at state level.

***Statistically significant at 1 percent level

**Statistically significant at 5 percent level

*Statistically significant at 10 percent level

TABLE 8-THE EFFECT OF FATALITIES SCALED BY STATE POPULATION (IN HUNDREDS OF 1000s) ON LOW BIRTH WEIGHT

	low birth weight $\leq$ 2,500g		low birth weight $<$ 2,500g	
	(1)	(2)	(3)	(4)
9-6 Months Before Birth	0.0030	-0.0002	0.0040**	-0.0009
	(0.0018)	(0.0034)	(0.0016)	(0.0031)
5-3 Months Before Birth	0.0203**	0.0290*	0.0200**	0.0266*
	(0.0077)	(0.0143)	(0.0076)	(0.1456)
2-0 Months Before Birth	0.0214**	0.0390**	0.0215**	0.0379**
	(0.0083)	(0.1438)	(0.0082)	(0.1412)
mother fixed effects	no	yes	no	yes
Observations	4176	1998	4176	1998

Note: Standard errors clustered by state are in parentheses.
Critical values are from at-distribution with 16 (20 - 4) degrees of freedom.
All regressions are based on weighted data for the period January 2009 through July 2013 and include controls for year and month of birth, mother's age at birth and marriage, infant's gender and birth order, fatalities from other conflicts and tax returns at state level.
***Statistically significant at 1 percent level
**Statistically significant at 5 percent level
*Statistically significant at 10 percent level

TABLE 9-THE EFFECT OF FATALITIES ON LOW BIRTH WEIGHT: ALTERNATIVE MEASURES OF FIRST-TRIMESTER EXPOSURE

	low birth weight $\leq$2500g		low birth weight $<$ 2500g		low birth weight $\leq$2500g		low birth weight $<$ 2500g	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
9-6 Months Before Birth[@]	0.0001	-0.0002***	0.0001	-0.0003***	-	-	-	-
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	-	-	-	-
8-6 Months Before Birth	-	-	-	-	0.0001	0.0000	0.0001*	-0.0000
	-	-	-	-	(0.0001)	(0.0001)	(0.0001)	(0.0001)
5-3 Months Before Birth	0.0004**	0.0007**	0.0005***	0.0007*	0.0004**	0.0008**	0.0005***	0.0008*
	(0.0002)	(0.0003)	(0.0002)	(0.0004)	(0.0002)	(0.0004)	(0.0002)	(0.0004)
2-0 Months Before Birth	0.0005**	0.0098***	0.0005***	0.0009**	0.0005**	0.0010**	0.0005***	0.0010**
	(0.0002)	(0.0003)	(0.0002)	(0.0003)	(0.0002)	(0.0004)	(0.0002)	(0.0004)
mother fixed effects	no	yes	no	yes	no	yes	no	yes
Observations	4176	1998	4176	1998	4176	1998	4176	1998

Note: Standard errors clustered by state are in parentheses. Critical values are from a t-distribution with 16 (20 - 4) degrees of freedom. All regressions are based on weighted data for the period January 2009 through July 2013 and include controls for year and month of birth, mother's age at birth and marriage, infant's gender and birth order, fatalities from other conflicts and tax returns at state level.

[@] This represents fatalities that occur 9-6 months before birth regardless of which half of the month the child was born.

***Statistically significant at 1 percent level

**Statistically significant at 5 percent level

*Statistically significant at 10 percent level

TABLE 10-THE EFFECT OF FATALITIES ON LOW BIRTH WEIGHT: SAMPLE RESTRICTED TO WEIGHT AT BIRTH RECALL

	Mother's recall birth weight $\leq$ 2,500g		Mother's recall birth weight $<$ 2,500g		Birth weight missing	
	(1)	(2)	(3)	(4)	(5)	(6)
9-6 Months Before Birth	0.0001	-0.0004*	0.0001*	-0.0004*	0.0000	-0.0002*
	(0.0001)	(0.0002)	(0.0001)	(0.0002)	(0.0000)	(0.0001)
5-3 Months Before Birth	0.0001	0.0003	0.0002	-0.0004	0.0001	0.0001
	(0.0002)	(0.0014)	(0.0002)	(0.0010)	(0.0001)	(0.0001)
2-0 Months Before Birth	0.0006***	0.0013*	0.0005*	0.0017***	0.0001	0.0000
	(0.0002)	(0.0006)	(0.0003)	(0.0005)	(0.0001)	(0.0001)
mother fixed effects	no	yes	no	yes	no	yes
Observations	3349	1632	3349	1632	4092	1958

Note: Standard errors clustered by state are in parentheses. Critical values are from a t-distribution with 16 (20 - 4) degrees of freedom. All regressions are based on weighted data for the period January 2009 through July 2013 and include controls for year and month of birth, mother's age at birth and marriage, infant's gender and birth order, fatalities from other conflicts and tax returns at state level.

***Statistically significant at 1 percent level

**Statistically significant at 5 percent level

*Statistically significant at 10 percent level

TABLE 11-THE EFFECT OF FATALIIES ON LOW BIRTH WEIGHT: CONTROLLING FOR STATE-SPECIFIC LINEAR TREND

	low birth weight $\leq$ 2,500g		low birth weight < 2,500g	
	(1)	(2)	(3)	(4)
9-6 Months Before Birth	0.0009*	0.0021***	0.0009*	0.0023***
	(0.0005)	(0.0006)	(0.0005)	(0.0005)
5-3 Months Before Birth	0.0008**	0.0012	0.0008***	0.0004
	(0.0003)	(0.0010)	(0.0003)	(0.0010)
2-0 Months Before Birth	0.0013***	0.0030***	0.0012***	0.0034***
	(0.0003)	(0.0004)	(0.0005)	(0.0004)
linear time trends	yes	yes	yes	yes
mother fixed effects	no	yes	no	yes
Observations	4176	1998	4176	1998

Note: Standard errors clustered by state are in parentheses. Critical values are from at-distribution with 16 (20 - 4) degrees of freedom.
All regressions are based on weighted data for the period January 2009 through July 2013 and include 53 month-of-birth indicators.
Other additional controls are mother's age at birth and marriage, mother's education, infant's gender and birth order, state fixed effects, fatalities from other conflicts and tax returns at state level.
***Statistically significant at 1 percent level
**Statistically significant at 5 percent level
*Statistically significant at 10 percent level

Appendix to

Terror and Birth Weight: Evidence from Boko Haram Attacks

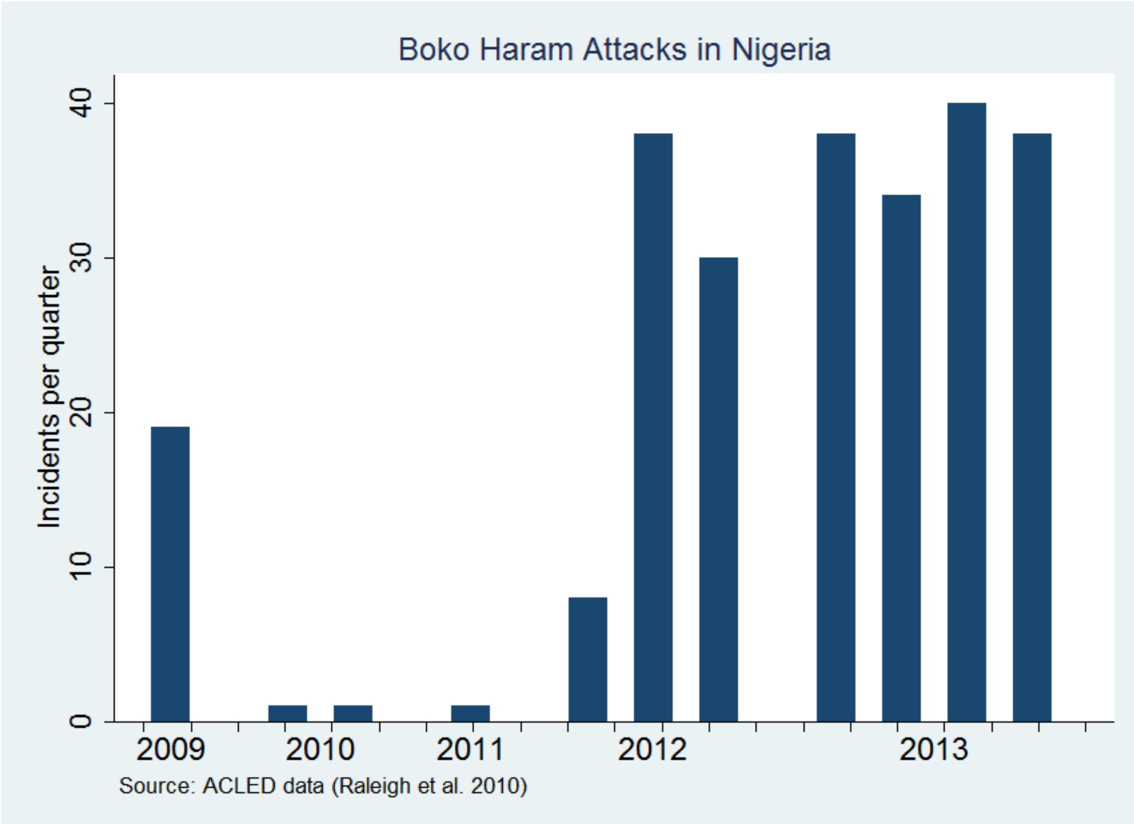

Figure 2: TERROR ATTACK INCIDENTS PER QUARTER, 2009-2013

APPENDIX TABLE 1-HETEROGENOUS EFFECTS: RELIGION AND ETHNICITY

	Muslim		Christian		Hausa		Non-Hausa	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Model 1: low birth weight($\leq$ 2500g) :								
9-6 Months Before Birth	0.0001	0.0000	0.0001	-0.0004	0.0001*	-0.0002**	0.0001**	-0.0000
	(0.0001)	(0.0001)	(0.0001)	(0.0003)	(0.0001)	(0.0001)	(0.0001)	(0.0000)
5-3 Months Before Birth	0.0004**	0.0004**	0.0000	0.0004	0.0003**	-0.0000	0.0004**	0.0012***
	(0.0002)	(0.0002)	(0.0002)	(0.0014)	(0.0002)	(0.0002)	(0.0002)	(0.0004)
2-0 Months Before Birth	0.0005**	0.0008**	0.0004*	0.0020*	0.0005***	0.0005**	0.0005**	0.0015***
	(0.0002)	(0.0003)	(0.0002)	(0.0010)	(0.0002)	(0.0002)	(0.0002)	(0.0004)
mother fixed effects	no	yes	no	yes	no	yes	no	yes
Observations	3983	1907	3501	1707	3793	1817	3700	1800
Model 2: low birth weight($<$ 2500g) :								
9-6 Months Before Birth	0.0001**	0.0000	0.0001*	-0.0004	0.0001**	-0.0002**	0.0001**	-0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0001)	(0.0001)	(0.0001)	(0.0000)
5-3 Months Before Birth	0.0005**	0.0004	0.0001	-0.0003	0.0004**	-0.0005	0.0004**	0.0011**
	(0.0002)	(0.0002)	(0.0002)	(0.0010)	(0.0002)	(0.0002)	(0.0002)	(0.0004)
2-0 Months Before Birth	0.0005**	0.0007***	0.0005	0.0024***	0.0005***	0.0004**	0.0005**	0.0014***
	(0.0002)	(0.0003)	(0.0003)	(0.0008)	(0.0002)	(0.0002)	(0.0002)	(0.0004)
mother fixed effects	no	yes	no	yes	no	yes	no	yes
Observations	3983	1907	3501	1707	3793	1817	3700	1800

Note: Standard errors clustered by state are in parentheses. Critical values are from a t-distribution with 16 (20 - 4) degrees of freedom.

All regressions are based on weighted data for the period January 2009 through July 2013 and include controls for year and month of birth, mother's age at birth and marriage, infant's gender and birth order, fatalities from other conflicts and tax returns at state level.

***Statistically significant at 1 percent level

**Statistically significant at 5 percent level

*Statistically significant at 10 percent level

APPENDIX TABLE 2-THE EFFCT OF FATALTIES ON BIRTH WEIGHT: USING DIFFERENT CUTOFFS FOR BIRTH WEIGHT

	low birth weight < 1500g		low birth weight ≤ 1500g		low birth weight < 3000g		low birth weight ≤ 3000g	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
9-6 Months Before Birth	-0.0004	0.0000	-0.0004	0.0000	-0.0001	-0.0001	0.0000	0.0006***
	(0.0007)	(0.0000)	(0.0007)	(0.0000)	(0.0001)	(0.0002)	(0.0001)	(0.0001)
5-3 Months Before Birth	-0.0002	0.0000	-0.0002	0.0000	-0.0004	-0.0000	-0.0004	-0.0002
	(0.0002)	(0.0000)	(0.0002)	(0.0000)	(0.0004)	(0.0004)	(0.0004)	(0.0002)
2-0 Months Before Birth	-0.0002	0.0000	-0.0002	0.0000	-0.0002	0.0003	-0.0002	-0.0002
	(0.0002)	(0.0000)	(0.0002)	(0.0000)	(0.0003)	(0.0005)	(0.0003)	(0.0002)
mother fixed effects	no	yes	no	yes	no	yes	no	yes
Observations	4176	1998	4176	1998	4176	1998	4176	1998

Note: Standard errors clustered by state are in parentheses. Critical values are from a t-distribution with 16 (20 - 4) degrees of freedom. All regressions are based on weighted data for the period January 2009 through July 2013 and include controls for year and month of birth, mother's age at birth and marriage, infant's gender and birth order, fatalities from other conflicts and tax returns at state level.

***Statistically significant at 1 percent level

**Statistically significant at 5 percent level

*Statistically significant at 10 percent level

APPENDIX TABLE 3-THE EFFECT OF FATALITES ON PREGNANCY COMPLICATIONS

	Any complication		Anemia	
	(1)	(2)	(3)	(4)
9-6 Months Before Birth	0.0006	0.0002	-0.0002	0.0002**
	(0.0006)	(0.0001)	(0.0002)	(0.0001)
5-3 Months Before Birth	-0.0017**	-0.0009**	-0.0006***	-0.0011***
	(0.0007)	(0.0002)	(0.0002)	(0.0002)
2-0 Months Before Birth	-0.0007	-0.0014**	-0.0004*	-0.0016***
	(0.0007)	(0.0003)	(0.0002)	(0.0002)
prenatal visits	yes	yes	yes	yes
mother fixed effects	no	yes	no	yes
Observations	2588	1998	3923	1998

Note: Standard errors clustered by state are in parentheses. Critical values are from at-distribution with 16 (20 - 4) degrees of freedom. All regressions are based on weighted data for the period January 2009 through July 2013. Other additional controls are mother's age at birth and marriage, mother's education, infant's gender and birth order, state fixed effects, fatalities from other conflicts and tax returns at state level.

***Statistically significant at 1 percent level

**Statistically significant at 5 percent level

*Statistically significant at 10 percent level

APPENDIX TABLE 4-THE EFFECT OF FATALITIES ON INFANT MORTALITY

	child died within one month				child died within two months			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
9-6 Months Before Birth	0.0001**	0.0001**	-0.0001	-0.0001	0.0005	-0.0004	-0.0001	-0.0001
	(0.0000)	(0.0000)	(0.0002)	(0.0002)	(0.0000)	(0.0000)	(0.0001)	(0.0001)
5-3 Months Before Birth	-0.0000	-0.0006	0.0005	0.0007*	0.0005	-0.0004	-0.0001	-0.0001
	(0.0000)	(0.0000)	(0.0004)	(0.0004)	(0.0009)	(0.0008)	(0.0002)	(0.0002)
2-0 Months Before Birth	0.0001	0.0001*	0.0004	0.0006**	0.0004	-0.0002	-0.0002	-0.0002
	(0.0000)	(0.0000)	(0.0003)	(0.0003)	(0.0008)	(0.0008)	(0.0002)	(0.0002)
low birth weight ($\leq$ 2500g)	no	yes	no	yes	no	yes	no	yes
mother fixed effects	no	no	yes	yes	no	no	yes	yes
Observations	4176	4176	1998	1998	4176	4176	1998	1998

Note: Standard errors clustered by state are in parentheses. Critical values are from a t-distribution with 16 (20 - 4) degrees of freedom. All regressions are based on weighted data for the period January 2009 through July 2013 and include controls for year and month of birth, mother's age at birth and marriage, infant's gender and birth order, fatalities from other conflicts and tax returns at state level.

***Statistically significant at 1 percent level

**Statistically significant at 5 percent level

*Statistically significant at 10 percent level

APPENDIX TABLE 5-THE EFFECT OF FATALITIES ON LOW BIRTH WEIGHT: ADDING FATALITIES THAT OCCURED PRIOR TO MONTH OF CONCEPTION AND AFTER MONTH OF BIRTH

	birth weight ≤ 2,500g		birth weight < 2,500g		birth weight ≤ 2,500g		birth weight < 2,500g	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
15-12 Months Before Birth	0.0001	0.0001	0.0000	0.0002*	-	-	-	-
	(0.0001)	(0.0002)	(0.0001)	(0.0001)	-	-	-	-
12-9 Months Before Birth	0.0002	-0.0005***	0.0002	-0.0004***	-	-	-	-
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	-	-	-	-
9-6 Months Before Birth	0.0002**	-0.0001	0.0002**	-0.0001	0.0001**	0.0000	0.0001**	-0.0003
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
5-3 Months Before Birth	0.0005***	0.0009**	0.0005***	0.0008*	0.0004**	0.0006	0.0004**	0.0005
	(0.0002)	(0.0004)	(0.0002)	(0.0004)	(0.0002)	(0.0004)	(0.0002)	(0.0004)
2-0 Months Before Birth	0.0005**	0.0011**	0.0006***	0.0011**	0.0004**	0.0009**	0.0005**	0.0008**
	(0.0002)	(0.0004)	(0.0002)	(0.0004)	(0.0002)	(0.0003)	(0.0002)	(0.0003)
1-3 Months After Birth	-	-	-	-	0.0002	0.0013**	0.0002	0.0013**
	-	-	-	-	(0.0004)	(0.0005)	(0.0004)	(0.0005)
4-6 Months After Birth	-	-	-	-	0.0001	-0.0004**	0.0001	-0.0004**
	-	-	-	-	(0.0003)	(0.0002)	(0.0003)	(0.0002)
mother fixed effects	no	yes	no	yes	no	yes	no	yes
Observations	4176	1998	4176	1998	4176	1998	4176	1998

Notes: Standard errors clustered by state are in parentheses. Critical values are from a t-distribution with 16 (20 - 4) degrees of freedom. All regressions are based on weighted data for the period January 2009 through July 2013. List of controls are the same as in Table 2. 15-12 Months Before Birth is equal to the sum of fatalities that occured 15 through 13 months before birth, if the infant was born in the first half of the month,and fatalities that occured 14 through 12 months before birth, if the infant was born in the second half of the month. 12-9 Months Before Birth is equal to the sum of fatalities that occurred 12 through 10 months before birth, if the infant was born in the first half of the month, and fatalities that occured 11 through 9 months before birth, if the infant was born in the second half of the month. 1-3 Months after Birth is equal to the sum of fatalities that occurred in the first three months after birth while 4-6 Months After Birth corresponds to fatalities that occurred in the subsequent three months after birth.

***Statistically significant at 1 percent level

**Statistically significant at 5 percent level

*Statistically significant at 10 percent level

APPENDIX TABLE 6-THE EFFECT OF FATALITIES ON LOW BIRTH WEIGHT: ADDING FATALITIES FROM NEIGHBORING STATES

	birth weight $\leq$ 2,500g		birth weight $<$ 2,500g	
	(1)	(2)	(3)	(4)
9-6 Months Before Birth	0.0001	0.0005	0.0001	0.0000
	(0.0000)	(0.0001)	(0.0000)	(0.0001)
5-3 Months Before Birth	0.0010***	0.0010***	0.0010***	0.0009***
	(0.0003)	(0.0003)	(0.0003)	(0.0004)
2-0 Months Before Birth	0.0011***	0.0013***	0.0011***	0.0012***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
9-6 Months Before Birth	0.0002	-0.0009	0.0004	-0.0007
Neighboring States	(0.0004)	(0.0012)	(0.0003)	(0.0011)
5-3 Months Before Birth	-0.0009***	0.0008	-0.0007***	0.0009
Neighboring States	(0.0002)	(0.0016)	(0.0002)	(0.0016)
2-0 Months Before Births	-0.0008***	-0.0015***	-0.0008***	-0.0013**
Neighboring States	(0.0002)	(0.0007)	(0.0002)	(0.0006)
mother fixed effects	no	yes	no	yes
Observations	4176	1998	4176	1998

Note: Standard errors clustered by state are in parentheses. Critical values are from at-distribution with 16 (20 - 4) degrees of freedom. All regressions are based on weighted data for the period January 2009 through July 2013 and include controls for year and month of birth, mother's age at birth and marriage, infant's gender and birth order, fatalities from other conflicts and tax returns at state level.
***Statistically significant at 1 percent level
**Statistically significant at 5 percent level
*Statistically significant at 10 percent level

APPENDIX TABLE 7-THE EFFECT OF FATALITIES ON BIRTH WEIGHT: SAMPLE RESTRICTED TO REPORTED BIRTH WEIGHT

	Birth weight in grams		low birth weight $\leq$ 2,500g		low birth weight $<$ 2,500g	
	(1)	(2)	(3)	(4)	(5)	(6)
9-6 Months Before Birth	-0.0518	0.4327	0.0001	-0.0004*	0.0001	-0.0004*
	(0.1206)	(0.2492)	(0.0001)	(0.0002)	(0.0001)	(0.0002)
5-3 Months Before Birth	0.1020	-1.9506**	0.0001	0.0009	0.0001	0.0006
	(0.1976)	(0.7990)	(0.0002)	(0.0007)	(0.0002)	(0.0005)
2-0 Months Before Birth	-0.4637	-3.1728***	0.0005***	0.0011***	0.0004*	0.0011***
	(0.4600)	(0.2621)	(0.0002)	(0.0003)	(0.0002)	(0.0003)
mother fixed effects	no	yes	no	yes	no	yes
Observations	3401	1659	3401	1659	3401	1659

Note: Standard errors clustered by state are in parentheses. Critical values are from a t-distribution with 16 (20 - 4) degrees of freedom. All regressions are based on weighted data for the period January 2009 through July 2013 and include controls for year and month of birth, mother's age at birth and marriage, infant's gender and birth order, fatalities from other conflicts and tax returns at state level.

***Statistically significant at 1 percent level

**Statistically significant at 5 percent level

*Statistically significant at 10 percent level

APPENDIX TABLE 8-THE EFFECT OF FATALITES ON BIRTH WEIGHT: BY MOTHER'S AGE AT FIRST BIRTH

	Birth weight $\leq$ 2500g		Birth weight $<$ 2500g	
	(1)	(2)	(3)	(4)
Model 1: Age at first birth ($<$ 19 years):				
9-6 Months Before Birth	0.0001	-0.0001	0.0001*	-0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
5-3 Months Before Birth	0.0004**	0.0003	0.0005***	0.0003
	(0.0002)	(0.0004)	(0.0002)	(0.0004)
2-0 Months Before Birth	0.0005**	0.0008	0.0005***	0.0007
	(0.0002)	(0.0005)	(0.0002)	(0.0005)
mother fixed effects	no	yes	no	yes
Observations	3803	1839	3803	1839
Model 2: Age at first birth ($\geq$ 19 years):				
9-6 Months Before Birth	0.0001**	-0.0001**	0.0002**	-0.0001***
	(0.0001)	(0.0001)	(0.0001)	(0.0000)
5-3 Months Before Birth	0.0003**	0.0009***	0.0004**	0.0008***
	(0.0002)	(0.0003)	(0.0001)	(0.0003)
2-0 Months Before Birth	0.0004***	0.0010***	0.0004***	0.0010***
	(0.0001)	(0.0003)	(0.0001)	(0.0003)
mother fixed effects	no	yes	no	yes
Observations	3690	1778	3690	1778

Note: Standard errors clustered by state are in parentheses. Critical values are from at-distribution with 16 (20 - 4) degrees of freedom. All regressions are based on weighted data for the period January 2009 through July 2013. Other additional controls are mother's age at birth and marriage, mother's education, infant's gender and birth order, state fixed effects, fatalities from other conflicts and tax returns at state level.
***Statistically significant at 1 percent level
**Statistically significant at 5 percent level
*Statistically significant at 10 percent level

APPENDIX TABLE 9-THE EFFECT OF FATALITIES SCALED BY 2011 STATE POPULATION ESTIMATES (IN HUNDREDS OF 1000s) ON LOW BIRTH WEIGHT

	low birth weight $\leq$ 2,500g		low birth weight $<$ 2,500g	
	(1)	(2)	(3)	(4)
9-6 Months Before Birth	0.0035	-0.0000	0.0046**	-0.0009
	(0.0021)	(0.0040)	(0.0018)	(0.0037)
5-3 Months Before Birth	0.0243**	0.0339*	0.0241**	0.0310*
	(0.0092)	(0.0170)	(0.0092)	(0.0174)
2-0 Months Before Birth	0.0256**	0.0456**	0.0259**	0.0442**
	(0.0100)	(0.0170)	(0.0098)	(0.0167)
mother fixed effects	no	yes	no	yes
Observations	4176	1998	4176	1998

Note: Standard errors clustered by state are in parentheses.
Critical values are from at-distribution with 16 (20 - 4) degrees of freedom.
All regressions are based on weighted data for the period January 2009 through July 2013 and include controls for year and month of birth, mother's age at birth and marriage, infant's gender and birth order, fatalities from other conflicts and tax returns at state level.
***Statistically significant at 1 percent level
**Statistically significant at 5 percent level
*Statistically significant at 10 percent level