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ABSTRACT

Simultaneous exposure to natural calamities and conflict shocks is a phenomenon that has been largely understudied. The interplay between natural disasters and conflict shocks can have adverse effects extending beyond the current family members to children in utero. The current paper tries to fill this gap by investigating the impact of floods on pregnancy and birth outcomes across conflict-affected and unaffected districts in Pakistan. Using mother fixed effects strategy in a triple difference framework, the results suggest that in-utero exposure to flood in conflict-affected areas increases the probability of small birth size by 8.1 percentage points. Moreover, exposure to violence in non-flooded districts reduces the likelihood of small birth size by 5.6 percentage points but increase the probability of miscarriage by 3.7 percentage points, thereby suggesting selection into birth. Significant heterogeneities are found across place of residence, income groups, and education levels.

Keywords: Natural Calamity, Violence, Birth Outcomes, Child Health, Pakistan

1. INTRODUCTION

Several studies have examined the impact of natural calamities and conflict shocks, albeit separately, on households in developing countries. This literature has found evidence of the detrimental effects of these shocks on various individual and household level outcomes. Nonetheless, the effects of natural disasters in conflict-affected areas are largely understudied. This is important because the phenomenon of the interaction between conflicts and natural catastrophes has been on the rise since the last decade or so. For instance, 80 percent of the people affected by natural disasters between 2006 and 2008 were living in violence-affected countries [Kellett and Sparks (2012)].

The interplay between natural disasters and conflict shocks can have more severe consequences compared to when these shocks occur independently. This can happen for several reasons. First, on a macro level, a country facing conflict would have already been constrained in resources due to increased military and other security-related spending. Subsequently, the government would lack sufficient resources for rescue, relief, and rehabilitation in case a natural calamity hits the country in these circumstances. Second, conflict depletes the health system, destroys basic infrastructure (including hospitals and health centres), frightens the skilled medical staff away, and weakens the state capacity to establish new or even rebuild the damaged health infrastructure and improve the quality of health services [McPake, *et al*. (2015)]. Third, the prevalence of conflict situations make it harder for the government and non-governmental organisations (NGOs) to reach out to affected areas in the post-disaster period due to fear of victimisation [Harris, *et al*. (2013)]. Hence, the households living in conflict-affected areas are more susceptible to adverse climatic shocks.

On the individual and household level, people living in violent environments are usually constrained in their mobility, access to basic health services, earning opportunities, and access to relief aid in a post-disaster situation [Buchanan-Smith and Christoplos (2004); Eriksen and Lind (2009); Jaspars and O'Callaghan (2010); UNDP (2011)]. This, together with the prevalence of violence, can leave the households physically and psychologically more vulnerable and can limit their ability to cope with the unforeseen shocks, both *ex ante* and *ex post*. The subsequent adverse effects could extend beyond the current family members to the children in utero. The Fetal Origin Hypothesis (FOH) and the empirical literature on early-life shocks and later-life outcomes suggest that these effects can have long term welfare consequences [Barker (1992); Strauss and Thomas (2008); Almond and Currie (2011)].

Surprisingly though, there is a dearth of studies investigating the combined effect of two adverse shocks on children's health outcomes. Although Akresh, *et al*. (2011) examines the impact of two shocks—civil war and crop failure - on children's health in the same country (Rwanda), the timing and provinces of these shocks were different. The only study, to my knowledge, that inspects the simultaneous impact of drought and political violence is Tranchant, *et al*. (2014). The study examines the effects of drought on malnutrition in conflict-affected communities in Andhra Pradesh, India, and finds that the child nutrition is adversely affected by draught only in conflict-affected communities. Both these studies, nonetheless, scrutinise the adverse effects on children's post birth outcomes; on their height-for-age Z-scores (HAZ). There is, however, lack of studies exploring the impact on pregnancy outcomes and endowments at birth in these settings.

The current paper tries to fill this gap by investigating the impact of floods on pregnancy and birth outcomes across conflict-affected and unaffected districts in Pakistan. Specifically, the impacts on birth weight, birth size, still births and miscarriages have been examined. Being a frontline ally in the War on Terror, Pakistan launched a military operation in 2004 in the tribal region bordering Afghanistan that subsequently resulted in the formation of an insurgent organisation called Tehreek-e-Taliban Pakistan (TTP).[1] This led to a spatial-temporal increase in terrorist incidents, including suicide attacks, across different cities in the country. More than 60,000 Pakistanis have lost their lives in this War on Terror, and the country incurred a cost of $107 billion in the previous one and half decade [Pakistan (2014-15)]. On the other hand, Pakistan confronted two major floods in the years 2010 and 2011 that affected districts from all four provinces. These also included districts from conflict-affected areas.

Evidence suggests that the overall response to these floods by the government and civil society had been praiseworthy [Fair, *et al*. (2014)]. This is probably because of the coordinated efforts by the National Disaster Management Authority (NDMA), a disaster management organisation set up by the federal government in the aftermath of the devastating earthquake on October 8, 2005. Out of 5,577,039 children and 1,729,925 pregnant and lactating women who were screened, more than 500,000 children and 270,000 women were found either undernourished or at the risk of malnutrition and were treated by admitting to the Supplementary Feeding Program (SFP) [UNDP (2012)]. However, there are also indications that the security situation in parts of Khyber Pakhtunkhwa, Balochistan and FATA was one of the main hurdles in reaching out to affected households in these areas [UNDP (2012)]. Consequently, the presence of conflict in some districts had a negative effect on access to aid in these zones. For example, Ghorpade (2015) finds that conflict reduced households' access to two large governmental aid programs—the Citizens Damage Compensation Program (CDCP) and Benazir Income Support Program (BISP)—in the post 2010 flood period. This could have been from both supply and demand sides. On one hand, immunisation camps, NGOs, and aid workers were attacked in several conflict-affected districts in Pakistan. Attacks against doctors, lady health workers (who provide door to door health services) and journalist had increased significantly [South Asia Terrorism Portal (2015)]. On the other hand, people in these areas were issued threats against taking any financial aid and health service (such as immunisation of children) from the government and NGOs. These barriers in access to post-flood aid might have had detrimental effects on pregnant women and, subsequently, the foetuses.

The empirical results in this paper confirm that this is indeed the case. Using mother fixed effects strategy in a triple difference framework, the results suggest that in-utero exposure to flood in conflict-affected areas increases the probability of small birth

[1]All other insurgent groups came under the umbrella of Tehreek-e-Taliban Pakistan (TTP). These included Punjabi Taliban as well as insurgents from other ethnic groups.

size by 8.1 percentage points. Moreover, exposure to violence in non-flooded districts reduces the likelihood of small birth size by 5.6 percentage point but increase the probability of miscarriage by 3.7 percentage points, thereby suggesting selection into birth by the healthy foetuses. No effects were found on still births, and neonatal and infant mortalities and the results were robust to changes in definition of flood and conflict exposures. The effect heterogeneity concludes that the negative influences of these shocks are observed only in rural areas, by lower socio-economic status (SES) families, and by less or uneducated mothers. An extensive analysis of various potential mechanisms proposes that maternal depression during pregnancy caused by exposure to these shocks might have been the plausible channel. No evidence was found for endogenous fertility and migration. Additional analyses indicate that older mothers, educated parents, urban households, and rich families are more likely to weight a child at birth; in other words, visit a formal health facility for delivery.

The study makes several contributions to the literature: first, it adds to the broader literature on prenatal shocks and child health outcomes using different settings of violence and natural disasters. As such, it also brings together three distinct brands of literature: child health; conflict shocks; and adverse climatic events. Second, this study contributes to the scarce literature that examines the simultaneous impact of two prenatal shocks in general, and violence and natural disaster in particular, on birth endowments. Third, to my knowledge, this is first study that examines the impact of flood and terrorism on pregnancy and birth outcomes in the context of Pakistan. This is important because the country has been a victim of violence and climate shocks for the past one and half decade and research on their long-run consequences and the potential mechanisms could be valuable for policy decisions regarding preventive and curative measures.

Rest of the study is organised as follows: Section 2 reviews the violence and flood situation in Pakistan. Section 3 discusses in detail about data and construction of variables of interest. Identification strategy is presented in Section 4. Results and discussion are provided in Section 5. Section 6 concludes the study.

2. TERRORISM AND FLOODS: SPATIAL-TEMPORAL VARIATIONS

2.1. Terrorist Attacks in Pakistan

Pakistan has experienced several episodes of conflicts, of different nature and varying degrees of intensity, throughout its history. The communal riots accompanying massive migration immediately after partition in 1947, the political, ethnic, and sectarian violence in various parts of the country, and the gang violence in Karachi are some of the major conflicts being witnessed over the last few decades [Nasr (2002); Alavi (1988); Cohen (2004); Grare (2013)]. These conflicts were, nonetheless, at different times and in different parts of the country and the government was somehow able curtail the spread and intensity of violence resulted from these events.

The most intensive and devastating outbreak of violence, however, has been observed in the last decade due to the emergence of Islamic militancy. In the aftermath of 9/11 attacks, the US and coalition forces invaded Afghanistan in pursuit of Osama Bin Laden, the al-Qaeda leader who claimed responsibility for the attacks. This US-led War on Terror was successful in toppling the Taliban's regime in the country. Mullah Omar, the Taliban's supreme commander, ordered the Taliban to retreat and disperse. However, after couple of years they came out from their hideouts and started guerrilla warfare against the coalition forces. The geographic continuity and the complicated terrains along the Pakistan-Afghanistan boarder allowed the militants to find safe sanctuaries in these rugged areas. Using this tribal belt as a base, the militant launched attacks against the coalition forces in Afghanistan [Yusuf (2014)]. This led Pakistan to conduct a military operation in 2004 in Waziristan Agency.[2] This operation, coupled with the drone strikes conducted by the US, led to the creation of what is now called Pakistani Taliban in the year 2006. Tahreek-e-Taliban Pakistan (TTP), one of the most influential and lethal groups among the Pakistani Taliban, declared a war against the Pakistani government. Initially, the army personnel were targeted which compelled the armed forces to use heavy weapons. In retaliation to the subsequent collateral damage, this war started to spread not only geographically but also in terms of targets. The violence initially spread to other Agencies in the FATA region and, subsequently, to rest of the country. This also invigorated other forms of violence, especially the ethnic fractionalisation in the Balochistan province and sectarian violence (mostly against Shia sect) in several districts of the country. Besides the attacks against law enforcement agencies, worship places (mosques, churches), schools, and markets were also targeted; as such, the use of violence has been indiscriminate and resulted in the loss of precious human lives and physical capital. The insurgency and counter-insurgency related violence has caused more than 60,000 fatalities in Pakistan during the period 2003-2016 [South Asia Terrorism Portal (2015)]. Moreover, the War on Terror has compelled the country to incur a cost of $107 billion in the previous one and half decade [Pakistan (2014-15)].

The surge in terrorism has been one of the major problems facing the country in the last few years. Maps A.1 to A.4 show the spread of terrorist attacks across districts over time. In the years 2007 and 2008, the terrorist attacks were mainly concentrated in the Tribal regions and parts of the Khyber Pakhtunkhwa province. In 2009, the Quetta district in Balochistan province and the city of Karachi in Sindh province were also among the highly affected areas. By 2012, terrorists were able to successfully attack major cities across the entire country. While the number of overall terrorist incidents increased over time, in some districts the number of attacks also decreased. Because of the uncertain nature of a terrorist attack with respect to time, place, and its impact, these violent events may be considered exogenous to the population living in these districts. The overall situation of conflict between 2007 and 2012 is shown in Map A.5. In order to split the districts in conflict-affected and unaffected regions, I added all the attacks during the relevant period of 2007-2012 and used the 75th percentile (or 19 terrorist attacks) as the threshold. All districts that have experienced more than 19 attacks were assigned to the treated group (conflict-affected districts). All other districts were included in the control group. This situation is exhibited in Map A.6.[3]

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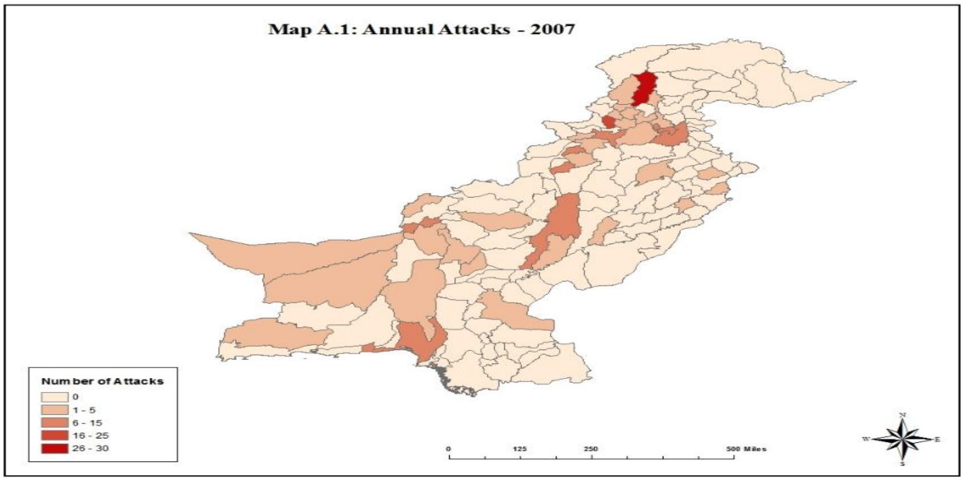
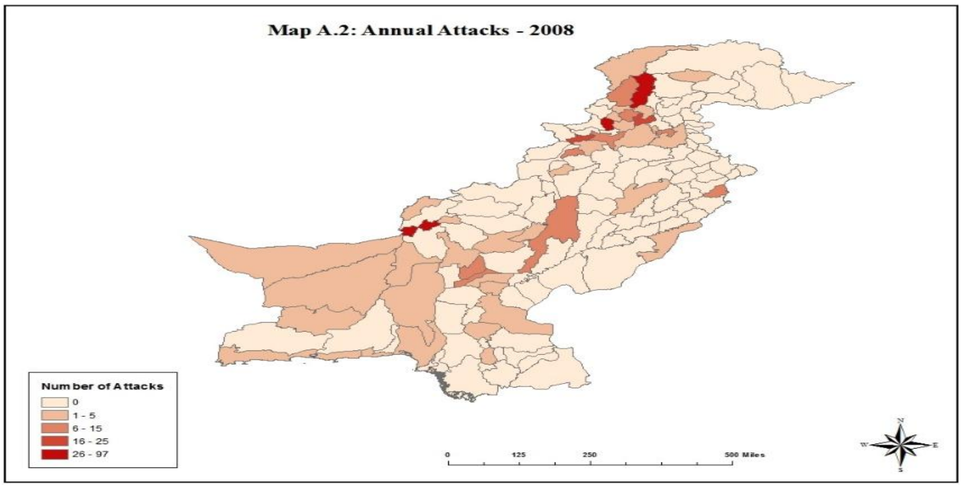
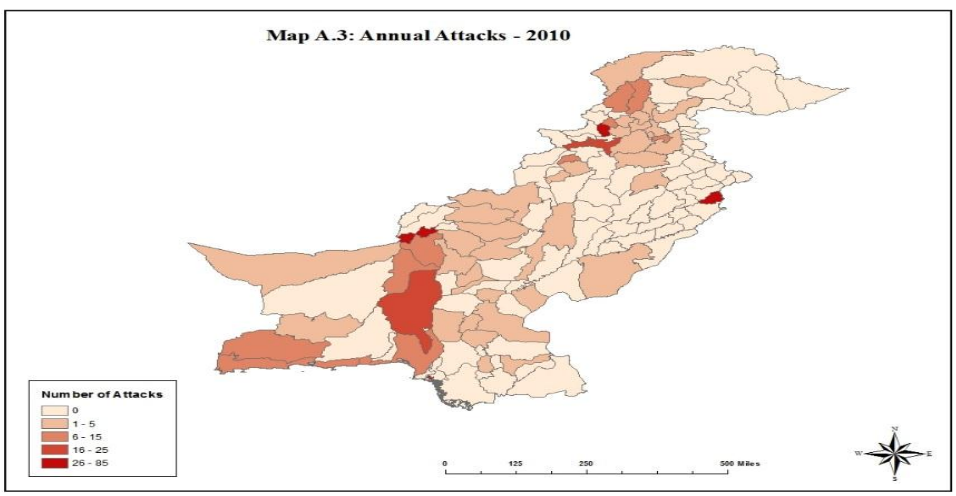
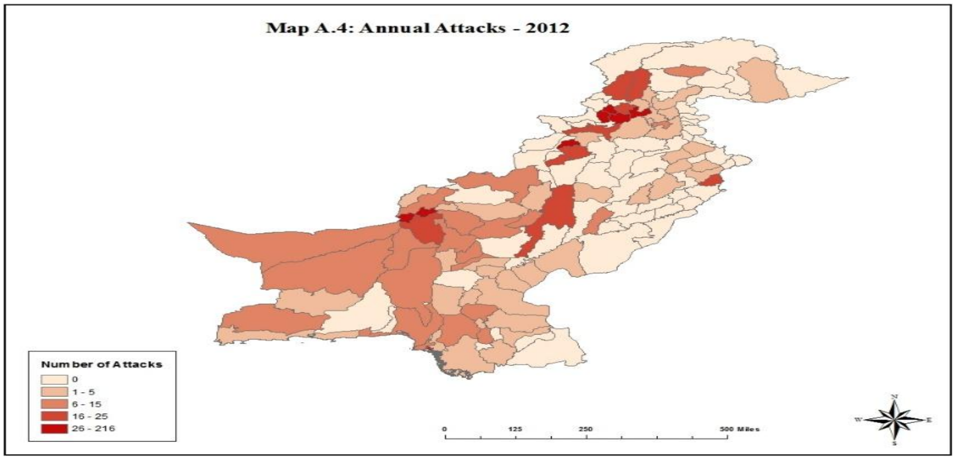
[2]The word Agency is used in geographical sense and is equivalent to a district in the settled areas. There are seven Agencies in the Federally Administered Tribal Region (FATA) in Pakistan; Khyber, Bajaur, Mohmand, Kurram, Orakzai, South Waziristan, North Waziristan.

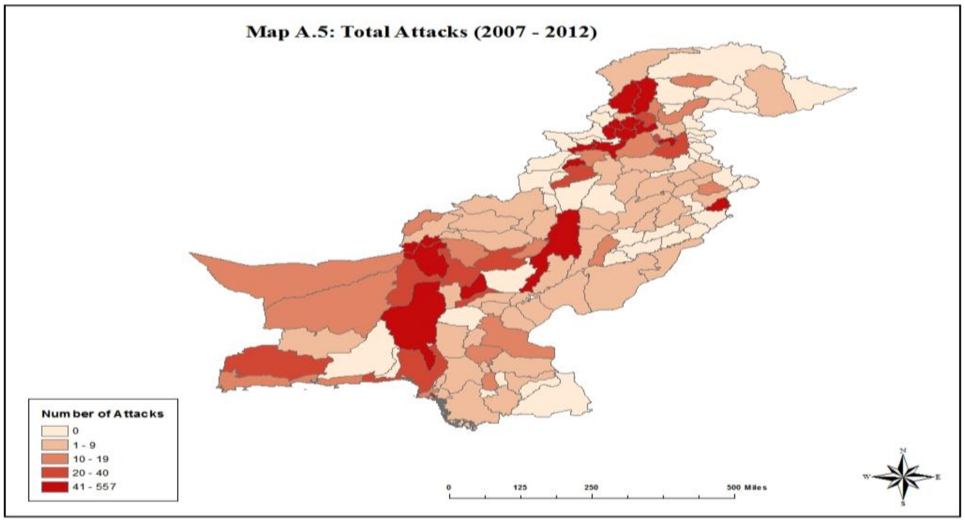
[3]The most number of attacks in an "unaffected district" is 19 for a period of 6 years, or 3 incidents per year, which are well below the country's average of 4.63 per district per year for the period 2007-2012, and are very unlikely to have significant effects in the context of Pakistan.

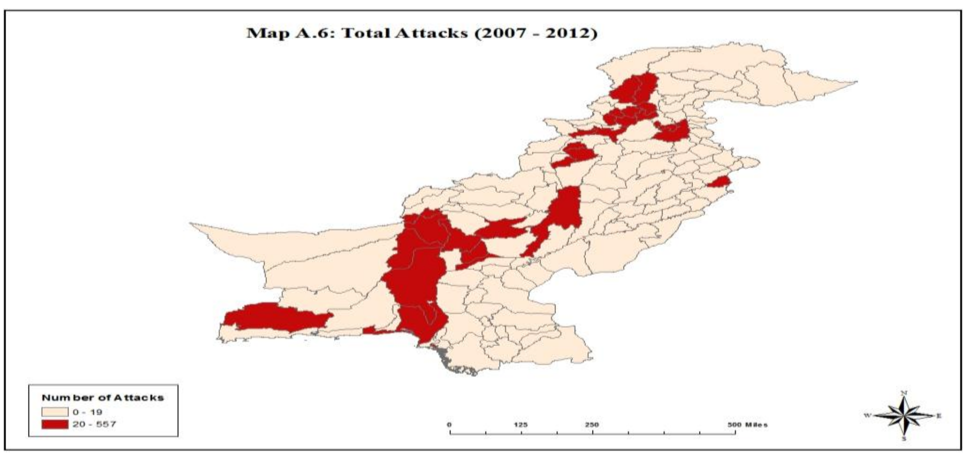

Map A.1: Annual Attacks - 2007
Number of Attacks
0
1 - 5
6 - 15
16 - 25
26 - 30
0
125
250
500 Miles


Map A.2: Annual Attacks - 2008
Number of Attacks
0
1 - 5
6 - 15
16 - 25
26 - 97
0
125
250
500 Miles


Map A.3: Annual Attacks - 2010
Number of Attacks
0
1 - 5
6 - 15
16 - 25
26 - 85
0
125
250
500 Miles



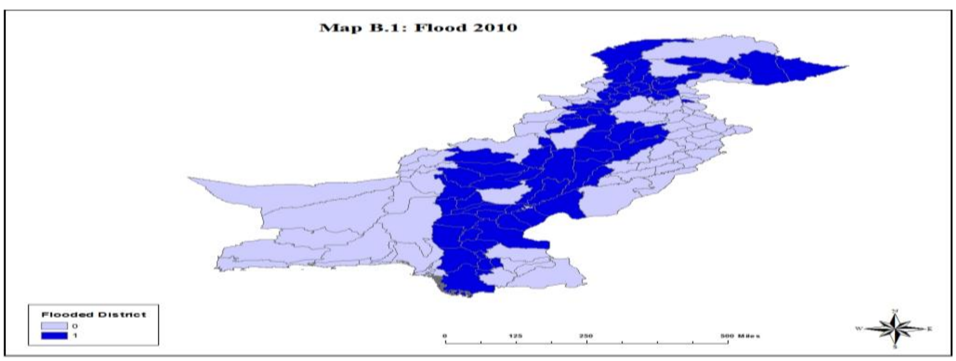


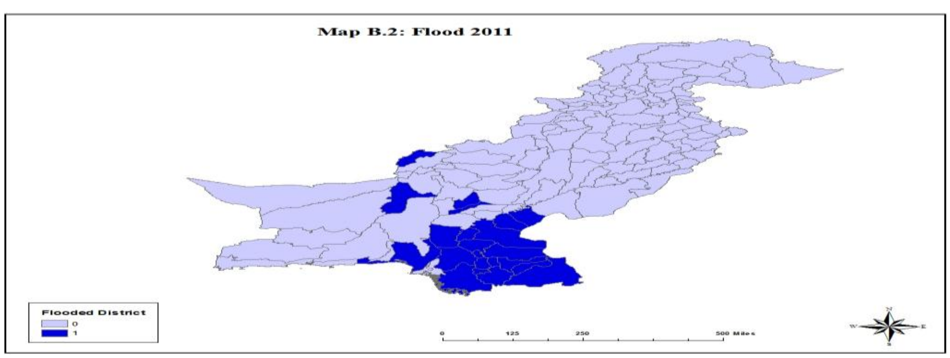


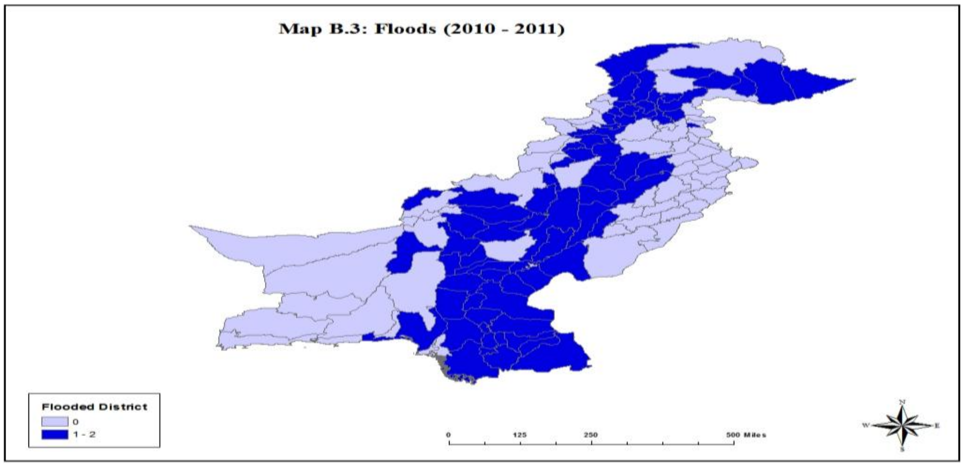
Source: Author's Calculation using GTD Database.

2.2. Floods in Pakistan

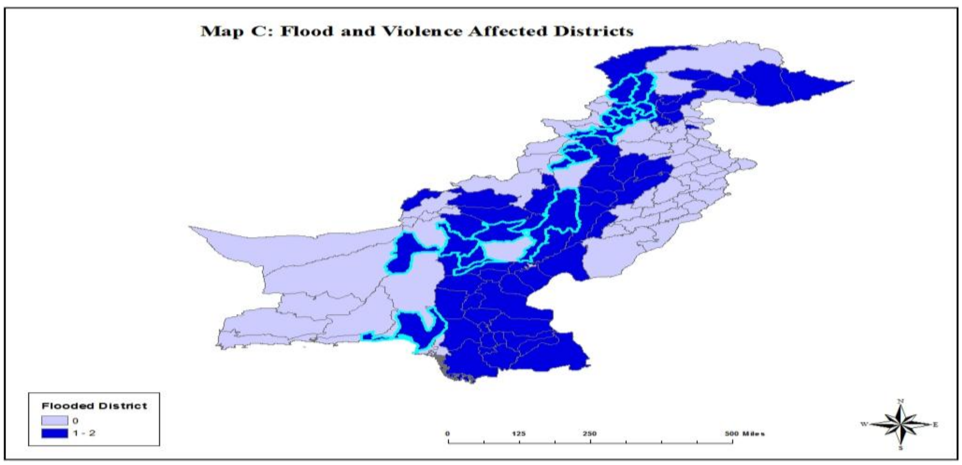
Although Pakistan had witnessed several floods over the course of its history, it experienced the most severe one in 2010. This resulted from an unprecedented increase in the average rainfall (four times of the average rainfall) in monsoon season from June to August. More than 20 million people were affected with a death toll of approximately 1900, and more than 10 million people being temporarily displaced, and around 20 percent of land area under flood water. Compared to small scale floods in some other years such as the one in year 2007, where the intensity was limited to few districts in one particular province, the flood in 2010 affected districts from all the four provinces. Map B.1 shows the coverage of the 2010 flood. In 2011, another major flood, though less in severity than the one in 2010, hit several districts of Sindh and Balochistan provinces. With more than 5 million being affected including 0.66 million being displaced and a death toll of approximately 505, this flood severely affected the efforts to rehabilitate the affectees from the 2010 flood [Centre for Research on the Epidemiology of Disasters CRED (2013)]. Map B.2 shows the flood situation in 2011 whereas Map B.3 represents the combined affected districts from floods 2010 and 2011. Together, these two floods had adverse consequences on the country’s economy. Besides the fatalities, millions of people were displaced, their homes and other properties were either completely or partially damaged, and standing crops were destroyed. For those who survived, these floods were not only a source of stress but might also have created food shortages and health problems. The consequence might have been even more severe for those living in conflict-affected zones for the reasons discussed earlier.







Source: Author's Calculation using Data from UNDP and IDD.



Source: Author's Calculation using Data from GTD, UNDP and IDD Results.

3. DATA AND VARIABLES

The data on pregnancy and birth outcomes along with other children, women, and household characteristics have been used from the Pakistan Demographic and Health Survey [PDHS (2012-13)]. The current study uses PDHS 2012-13 which covers all the outcomes since 2007, the year when violence started to surge and spread across the country. The PDHS is a nationally representative survey that covers almost all of the districts from the four provinces, the Gilgit Baltishtan region, and the capital territory, Islamabad. In addition to the information about all pregnancies of ever married women age 15-49 years who were eligible for interview, it also provides anthropometric records of all children age 0-5 years. Overall, 13,944 households and 13,558 eligible women were interviewed throughout the country.

The main outcome variables include birth weight, birth size, miscarriage, and still birth. The birth weight is measured as weight at birth in grams. Using this measure, I also construct another indicator of fetal health; the likelihood of low birth weight which is measured as a binary variable that takes the value 1 if the birth weight is less than 2500 grams and 0 otherwise. For birth size, I used the information being asked from mothers about size of the child at birth. Mothers were asked whether they think size of the child was "very small", "smaller than average", "average", "larger than average", or "very large". I construct an indicator for small birth size using a dichotomous variable that takes the value 1 if the child was very "small" or "smaller than average" at birth and 0 otherwise. The measure for miscarriage takes the value 1 if the mother reported that the child was lost before the birth and 0 if the child was born alive. Similarly, the still birth variable is 1 if the child was born dead and 0 if the child was born alive.[4] In addition to these outcome variables, I also check the impact on neonatal and infant mortalities. The variable neonatal (infant) death takes the value 1 the child died in the first month (first year) of life after birth.

The control variables used in the analysis, depending on specification, include gender, and birth order of the child; mother's age, education, employment, place of residence, and number of pregnancies; husband's education and employment; and household size and household wealth (measured using the wealth index). For analysis of potential channels, information on prenatal care and weight-for-age Z-score of children was also utilized. Controls at the district level include distance of a district from Afghan border (Durand Line), distance from the nearest river, and mean elevation of the district.

Terrorism is quantified by using the number of terrorist attacks in a given district in a year. The data for this variable is obtained from the Global Terrorism Database (GTD) of the National Consortium for the Study of Terrorism and Responses to Terrorism (START). The Global Terrorism Database (GTD) describes terrorism as, "a terrorist attack which fulfils the following three criterions: (i) The incident must be intentional; (ii) The incident must entail some level of violence or threat of violence and (iii) The perpetrators of the incidents must be sub-national actors. In addition, at least two of the following three criterion must be present for an incident to be included in the GTD: (i) The act must be aimed at attaining a political, economic, religious or social goal; (ii) There must be evidence of an intention to coerce, intimidate or convey some other message to a larger audience (or audiences) than the immediate victims, and (iii) The action must be outside the context of legitimate warfare activities." As mentioned, one of the main objectives of the terrorists is to inflict fear in the minds of a larger audience beyond the immediate victims through the use of violence. This is crucial for our sample of analysis—the pregnant mothers—as these attacks could become stressful events for them even if they are not the direct victims. This, in turn, could affect the fetuses through the biological channel as will be discussed later. The data on terrorist attacks are available for each month for each district. As mentioned in the previous section and also shown in Map A.6, the districts are divided into two groups; conflict-affected district are the ones that have experienced more than 19 terrorist attacks between 2007 and 2012, whereas districts that have observed less than 19 attacks are included in control group and are considered the non-violent districts. The treated group (violent district) takes the value 1 and 0 otherwise.

[4]The indicators for miscarriage and still birth were constructed against the live birth and, hence, these were analysed separately.

The data on flooding is obtained from various sources such Pakistan National Disaster Management Authority, several flood-related reports of United Nations Development Programme [UNDP (2012)], and the International Disasters Database. A binary indicator is constructed for the flood variable where it is assigned the value 1 if the district is affected by either of the floods in 2010 or 2011.[5] However, the districts were flooded only in some particular months and not the entire year. For example, the duration of the 2010 flood was from July to September and that of 2011 from August to September. Hence, children who were born in the affected districts but in earlier months were not exposed to flood. Subsequently, the variable for flood exposure is constructed as follows: a fetus (mother) would be exposed to the 2010 flood if she was in utero (pregnant) in the months of July, August, and September in 2010 in the flood affected districts. This means that all births (pregnancies) from July, 2010 to March, 2011 in the affected districts experienced the flood shock. Similarly, the 2011 flood victims would be exposed if they were in utero (pregnant) in the months of August and September in the same year in flood affected districts. Hence, all the births (pregnancies) from August, 2011 to April, 2012 were exposed.

4. EMPIRICAL STRATEGY

The discussion in previous section reveals that there are three sources of variation to identify the effect of floods: (i) the spatial variation in flood exposure; (ii) the temporal variation in flood exposure; and (iii) the spatial variation in conflict exposure (i.e. exposure to flood in conflict-affected districts). The spatial variation in flood exposure compares fetuses that were in utero in flood-affected districts to those who were in the non-affected districts. Out of 121 districts for which the data is available, a total of 78 districts were affected from the two floods in 2010 and 2011.[6] As discussed earlier, the temporal variation is captured by whether the child (fetus) was in utero at the time of flood. Lastly, the conflict exposure is accounted for by whether the child (fetus) was in utero in a conflict-affected district.

A straightforward approach to identify the effect of flood exposure in conflict-affected areas is to compare children who were in utero at the time of floods, in the flood-affected and unaffected districts, and across conflict-affected and unaffected districts – the well-known difference-in-difference approach. There are, however, two concerns regarding to this strategy. First, the districts that are closer to Afghan border, especially the ones that are in Khyber Pakhtunkhwa and Balochistan provinces, are more likely to experience terrorist attacks. Second, the assumption that floods hit the districts randomly may not hold since the probability of flooding is higher in districts that are spatially contiguous to the rivers.

With regard to the first issue, I argue that although districts closer to Pak-Afghan border have higher probability of being attacked, people are uncertain about the time, exact location, and magnitude of a terrorist attack. Moreover, the intended targets keep changing and are, therefore, unpredictable. As mentioned earlier, military personnel,

[5]In case a district is affected in both years, it is also given the value 1.

[6]70 and 23 districts were affected from the flood in 2010 and 2011 respectively. There were 8 districts that experienced floods in both years.

government officials, mosques and churches, schools and universities, and markets have all been targeted. Hence, the use of violence had been indiscriminate. Moreover, in specifications where I do not control for district or mother fixed effects (discussed later), I control for the distance of the district from the Durand Line (Pak-Afghan border).

As far as the second issue is concerned, one possibility is to control for distance of the district from the nearest river. This may not, however, completely solve the problem since distance to river is not the only determinant of the extent and intensity of floods. A better approach is to leverage the timing of exposure to flood within and across flood-affected districts by utilising a triple difference strategy. Specifically, this strategy would allow the comparison of children (fetuses) who were conceived at the time of flood with those who were not, across flood-affected and unaffected districts. The third difference then comes from the fact that whether the child (fetus) belongs to a violent or non-violent district. This methodology follows the one used in Gunnsteinsson, *et al*. (2014).[7]

Using this triple difference strategy, I estimate three different specifications. The first specification controls for child, mother, household, and district level characteristics. Nonetheless, there can be considerable differences across districts' characteristics (for example, backwardness, poverty etc.) that may be correlated with both outcome variables and conflict.[8] Hence, in the second specification, I control for district fixed effects.[9] Yet again, district is a large geographical unit and there could be significant variations in households' characteristics even within a particular district. Moreover, unobserved maternal heterogeneity may also be correlated with exposure to shocks. Subsequently, I control for mother fixed effects in the third specification which is also our preferred specification since it significantly strengthen the identification strategy.

Hence, the causal effect of exposure to flood and violence on pregnancy and birth outcomes is examined by employing mother fixed effects in a triple difference framework:

$$BO_{ijdt} = \alpha + \lambda_j + \beta X_{ijd} + \varphi_1 in\ utero_i + \varphi_2 in\ utero_i * violent\ dist_d + \varphi_3 in\ utero_i * flood\ dist_d + \varphi_4 in\ utero_i * flood\ dist_d * violent\ dist_d \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

Here BO_{ijdt} is the outcome for child *i* of mother *j* living in district *d* at time *t*. λ_j are the mother fixed effects which absorbs the main effects of flooded district, violent districts and their interactions;[10] $X_{ijd}$is vector of child characteristics;[11] $in\ utero_i$ shows whether the child was in utero at the time of flood; $flood\ dist_d$ and $violent\ dist_d$ are indicators for flood and conflict-affected districts respectively. The coefficient φ_4 identifies the impact of flood exposure in the conflict-affected districts on a birth or pregnancy outcome.

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[7]The spatial allocation of sectors to treatment and placebo groups was random in Gunnsteinsson, *et al*. (2014). In the current paper, however, I argue that the spatial allocation of conflict may be random conditional on distance to the Durand Line.

[8]Here time-invariant variable also include those variables that changes very slowly over time such as poverty.

[9]Of course, time-invariant district level characteristics such as distance to Durand Line, nearest rivers, and elevation of the district are dropped from this specification.

[10]This is also true for specification where I control for district fixed effects.

[11]In the second specification, it also includes mother and household level characteristics whereas in the first specification, the district level characteristics are also included in this vector.

There are a couple of potential concerns that can threaten the identification strategy. First, the two shocks may be correlated. That is, it may be possible that violence causes flood or vice versa. While the nature of conflict in Pakistan is not such that it may increase the probability of flood, the reverse may be true. In order to examine this possibility, I analyse whether the occurrence of flood in a district has any impact on the number terrorist attacks in the next seven months, including the last month of the flood, as well as on total number of attacks in the next one year. The results for both floods have been reported in Table A1 in the Appendix. There is no evidence that these floods have any significant impact on the level of violence.[12] Hence, we can conclude that two shocks are not correlated.

Second, the shocks may lead to behavioural responses. For example, mothers could change their fertility behaviours in response to terrorist attacks and floods. In addition, there could also be the situation of changing the time of conception. In other words, there could have been selection into pregnancy. Another behavioural response could be migration. People may migrate from flood prone or conflict-affected districts to safe areas. In both these cases, if the mother belongs to a specific group of characteristics (for example, educated class, rich families) which may also be correlated with better health of the fetus, the results may overestimate the effects of the flood and violence. As discussed in the next section, there is no evidence of these behavioural changes and, hence, the identification is robust.

Table 1

Descriptive Statistics

Variables	Observations	Mean	Std. Dev.
Birth Weight	1,796	2959.6	993.1
=1 if Low Birth Weight (<2.5kg)	1,796	0.246	0.431
=1 if Small Birth Size	11,702	0.194	0.395
=1 Miscarriage	14974	0.109	0.311
=1 Stillbirth	13608	0.019	0.138
=1 Neonatal Death	13341	0.043	0.203
=1 Infant Death	13341	0.059	0.236
=1 Male	14075	0.513	0.499
Mother's Education	8279	3.899	5.033
Mother's Age	8279	29.90	6.652
=1 if Married	8279	0.987	0.112
=1 if Employed	8279	0.188	0.391
Household Size	8279	9.360	5.154
=1 if Poorer	8279	0.199	0.399
=1 if Middle	8279	0.191	0.393
=1 if Richer	8279	0.190	0.392
=1 if Richest	8279	0.204	0.403
=1 Urban	8279	0.440	0.496
Number of Prenatal Visits	7440	3.369	3.464
Violent Districts	121	0.247	0.433
Flooded Districts 2010	121	0.578	0.495
Flooded Districts 2011	121	0.198	0.393
Distance from Afghan Boarder	121	274.7	170.6
Distance from Nearest River	121	25.26	16.04
Mean District Elevation	121	762.1	1091.7
Standard Deviation of Elevation	121	222.4	303.6

Note: Violent districts are the one which experienced above 19 terrorist attacks during the period 2007-2012.

[12]Although not reported here, I also checked if monthly violence one year (and two years) before the flood increase the probability of flood in these districts. The results were statistically insignificant.

5. RESULTS

5.1. Effect on Birth Weight

I begin the analysis by examining the effects of floods and terrorism on birth weight. The results are presented in Table 2. The first column shows the results when child, maternal, and districts characteristics are controlled. In column 2, I include the district fixed effects whereas mother fixed effects are controlled for in the third column.

Table 2

Effect on Birth Weight

Variables	(1) Model 1	(2) Model 2	(3) Model 3
In utero * Flood * Violence	278.685	295.985	705.364***
	(248.096)	(232.943)	(231.561)
In utero * Violence	232.308**	184.448*	336.475***
	(96.356)	(95.078)	(90.372)
In utero * Flood	-1.687	-103.400	40.883
	(139.504)	(135.079)	(95.589)
In utero	-37.004	-11.499	-63.234
	(91.538)	(88.187)	(141.014)
Observations	1,735	1,735	737
R-squared	0.091	0.177	0.076
District FE	NO	YES	NO
Mother FE	NO	NO	YES

Note: ***, ** and * show significance at 1 percent, 5 percent and 10 percent levels respectively. Standard errors are clustered at district level.

The results in column 1 show that there is no effect of maternal exposure to floods on birth weight both in conflict-affected and unaffected districts. However, in-utero exposure to violence has a positive and statistically significant effect on birth weight. Specifically, living in a district that have experienced more than 19 terrorist attacks during the period 2007-2012 increases birth weight by approximately 232 grams. This result holds even when I include the district fixed effects in column 2. However, when controlled for unobserved time-invariant maternal heterogeneity in column 3, the coefficient for the interaction of natural calamity and conflict becomes significant as well.

Another measure for assessment of poor fetal health is to see if the child falls in the category of low birth weight (less than 2500 gram). The analyses for this indicator are presented in Table 3. The results for our preferred specification in column 3 show that in-utero exposure to violence reduces the probability of low birth weight by 13.5 percentage points. The findings in Tables 2 and 3 are consistent in that both show a positive impact of exposure to violence on birth outcome. This result may appear surprising at first as one would expect a negative impact on birth weight at least for the reasons that exposure to violence could result in acute maternal stress [Brown (2015)]. This outcome, however, is not completely alien to the literature on violence and birth weight. Similar findings are reported in Torche and Villarreal (2014) where the local homicide rates in Mexico increase birth weight and reduce the probability of falling in the low birth weight category. The study attributes this surprising result to women's use of prenatal care when faced with increased violence. This suggests that, in a stressful environment created by a surge in violence, women may adjust their behaviour accordingly to protect their pregnancies.

Table 3

Effect on Probability of Low Birth Weight

Variables	(1) Model 1	(2) Model 2	(3) Model 3
In utero * Flood * Violence	-0.160*	-0.191**	-0.104
	(0.092)	(0.088)	(0.095)
In utero * Violence	-0.046	-0.009	-0.135**
	(0.043)	(0.041)	(0.056)
In utero * Flood	-0.015	-0.013	-0.096
	(0.056)	(0.058)	(0.068)
In utero	-0.005	-0.019	0.106
	(0.045)	(0.047)	(0.065)
Observations	1,735	1,735	737
R-squared	0.090	0.176	0.055
District FE	NO	YES	NO
Mother FE	NO	NO	YES

Note: ***, ** and * show significance at 1 percent, 5 percent and 10 percent levels respectively. Standard errors are clustered at district level.

In order to see if the same mechanism is at work here, I examine the effect on prenatal care use measured by the number of antenatal care visits. The results are reported in Table 4. Since the data on antenatal care visits is available only for the last birth, it is not possible to estimate the maternal fixed effects specification. Nonetheless, the results in columns 1 (without district fixed effect) and column 2 (with district fixed effects) confirm that mothers in conflict-affected districts increase prenatal care visits. While this increase in prenatal care use may explain the positive relationship between violence and birth weight, it is may not be the only channel for this mediation. For example, it could also be the case that pregnant women restrict their mobility in conflict affect districts. This would provide them with more time to rest and take care of their health which in turn could be beneficial for fetuses' health. Due to lack of data, however, these aspects cannot be empirically verified.

Table 4

Effect on Prenatal Care

Variables	(1) Model 1	(2) Model 2
In utero * Flood * Violence	-1.010	0.249
	(1.185)	(1.179)
In utero * Violence	1.377**	1.017*
	(0.663)	(0.523)
In utero * Flood	0.331	0.566
	(0.409)	(0.445)
In utero	-0.247	-0.241
	(0.368)	(0.247)
Observations	1,281	1,281
R-squared	0.196	0.281
District FE	NO	YES

Note: ***, ** and * show significance at 1 percent, 5 percent and 10 percent levels respectively. Standard errors are clustered at district level.

Before further discussion, it is important to mention here that majority of births in Pakistan takes place in non-institutional setting, mostly at homes, and it is highly unlikely that these children are weighted at birth. According to the Demographic and Health Survey report (2012-13) for Pakistan, only 12 percent of the children born during the period 2007-2012 are weighted at birth. This raises an important concern about the representativeness of the sample. Families who prefer to visit health facilities for deliveries may be different in characteristics from those who utilise non-institutional settings. To check this, a variable is constructed that takes the value 1 if the child is weighted at birth and 0 otherwise. It is then regressed on several maternal and household characteristics.[13] The results are presented in Table 5. Columns 1 and 2 show the results for all districts where as columns 3 and 4 display the same for non-violent and violent

Table 5

Characteristics of Birth Weight Measurement

Variables	(1) All Districts	(2) All Districts	(3) Non-Violent Districts	(4) Violent Districts
Mother's Age	0.002***	0.002***	0.001**	0.002**
	(0.001)	(0.000)	(0.001)	(0.001)
Mother's Education	0.022***	0.016***	0.015***	0.018***
	(0.002)	(0.002)	(0.002)	(0.003)
Marital Status	-0.007	-0.005	-0.001	-0.008
	(0.007)	(0.007)	(0.009)	(0.010)
Mother's Employment	-0.007	0.005	-0.002	0.020*
	(0.009)	(0.006)	(0.008)	(0.010)
Husband's Education	0.001*	0.001**	0.001*	0.001
	(0.001)	(0.000)	(0.001)	(0.001)
Household Wealth	0.074**	0.049***	0.041***	0.062***
	(0.028)	(0.011)	(0.012)	(0.017)
Household Size	-0.004***	-0.002**	-0.001*	-0.003
	(0.001)	(0.001)	(0.001)	(0.002)
Urban	0.033**	0.014	0.031***	-0.013
	(0.016)	(0.010)	(0.012)	(0.011)
Constant	-0.103***	-0.172***	-0.145***	-0.075
	(0.031)	(0.040)	(0.038)	(0.080)
Observations	14,075	14,075	8,911	5,164
R-squared	0.222	0.338	0.280	0.400
District FE	NO	YES	YES	YES

Note: ***, ** and * show significance at 1 percent, 5 percent and 10 percent levels respectively. Standard errors are clustered at district level.

[13]Children who are born in non-institutional settings such as homes are less likely to be weighted at birth. On the other hand, those who are born in formal health facilities such as hospitals are always weighted. Therefore, the probability of weighting a child at birth is a reasonable proxy for whether or not the parents used a health facility for delivery.

districts respectively. These findings suggest that older, educated mothers, and educated fathers are more likely to weight a child at birth (or visit a health facility for delivery). Moreover, wealthy households, and families living urban areas especially those in non-violent districts prefer formal health care system. Household size, nonetheless, is negatively associated with weighting a child at birth.[14] These findings are consistent with other studies [see, for instance, Da Vanzo (1984); Moreno and Goldman (1990); Ebomoyi, *et al*. (1991); Eggleston, *et al*. (2000)]. They confirm the notion that this group of children weighted at birth is not a representative sample of the overall population of the country and, therefore, the results in Tables 2 and 3 cannot be generalised. Subsequently, I now turn to another indicator of fetuses' health - size at birth – data for which is available for all births during the period 2007-2012 and is therefore a more representative sample.

5.2. Effect on Birth Size

A mother's subjective measure of a baby's size at birth is found to be highly correlated with birth weight [Blanc and Wardlaw (2005); Channon (2011)] and is therefore used as a proxy when data on birth weight is not available [Ghosh (2006); Magadi, *et al*. (2001); Magadi, *et al*. (2007)]. The results for the impact on birth size are presented in Table 6. There appears to be no effect of either shock even when the district fixed effects are included. However, when unobserved maternal heterogeneity is controlled for, the results in column 3 exhibit that in-utero exposure to floods in the conflict-affected districts increases the probability of small size at birth by 8.1 percentage points compared to unexposed (to both flood and violence) fetuses. This indicates the detrimental effects of the interplay of floods and violence on fetuses' health. On the other hand, exposure to floods in non-violent districts does not have any statistically significant impact on birth size. Together these results suggest that, while the overall response to the natural disasters by the government and civil society was very effective (Fair et al. 2014), the presence of conflict in some districts had a negative effect on access to aid in these areas [Ghorpade (2015)] that might have led to these harmful effects on fetuses.

Surprisingly, in-utero exposure to violence has a positive effect on birth size. Specifically, a child who is born in a district that has been victim of conflict is 5.6 percentage points less likely to be small at birth to a child who is born in non-violent district. This is an unexpected result since exposure to violence is found to result in acute maternal stress [Brown (2015); Camacho (2008)]. One possible reason could be the positive selection into birth. In order to verify this, I examine an important pregnancy outcome—the likelihood of miscarriage—against a live birth. The results, reported in Table 7, show that in-utero exposure to violence increases the probability of a miscarriage by 3.4 percentage points. This implies that weak fetuses could not survive in detrimental environment such as maternal stress and/or nutritional deprivation. Hence, the fetuses who made it to birth are the healthier ones; this corroborates positive selection on fetal health. Once again, flood exposure in non-violent district does not have any effect on miscarriages.

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[14]This may not be surprising since families with bigger household size are usually the ones who belong to middle or lower-income class, live in the rural areas, and have lower education [*Pakistan Demographic and Health Survey* (2012-13)]. Consequently, they are less likely to visit a health facility or measure weight at birth.

Table 6

Effect on Probability of Small Size at Birth

Variables	(1) Model 1	(2) Model 2	(3) Model 3
In utero * Flood * Violence	0.013	0.019	0.081**
	(0.037)	(0.032)	(0.039)
In utero * Violence	-0.020	-0.034	-0.056**
	(0.027)	(0.023)	(0.028)
In utero * Flood	0.008	-0.012	-0.001
	(0.022)	(0.021)	(0.025)
In utero	-0.002	0.010	0.001
	(0.020)	(0.019)	(0.019)
Observations	11,186	11,186	8,947
R-squared	0.027	0.056	0.017
District FE	NO	YES	NO
Mother FE	NO	NO	YES

Note: ***, ** and * show significance at 1 percent, 5 percent and 10 percent levels respectively. Standard errors are clustered at district level.

Table 7

Effect on Probability of Miscarriage

Variables	(1) Model 1	(2) Model 2	(3) Model 3
In utero * Flood * Violence	-0.024	0.002	-0.006
	(0.020)	(0.020)	(0.027)
In utero * Violence	0.037***	0.026**	0.034*
	(0.010)	(0.013)	(0.019)
In utero * Flood	0.008	0.004	0.007
	(0.011)	(0.012)	(0.015)
In utero	-0.020**	-0.020**	-0.032***
	(0.008)	(0.008)	(0.011)
Observations	13,345	13,345	10,625
R-squared	0.045	0.068	0.062
District FE	NO	YES	NO
Mother FE	NO	NO	YES

Note: ***, ** and * show significance at 1 percent, 5 percent and 10 percent levels respectively. Standard errors are clustered at district level.

An interesting but puzzling result is the insignificant effect of the interplay of flood and conflict on miscarriages. One would expect that since conflict in areas unaffected by flood increases miscarriages, it would also have similar effects in flooded areas considering that it is an adverse shock. One possible explanation could be that issues related to mental health such as anxiety and depression are considered trivial in a developing country like Pakistan. Consequently, the likelihood of pregnant mothers to visit health care centres to seek psychological assistance is low. In fact, the physical distance of a health care unit as well as the amount of time spent to reach to that unit negatively influences the overall health care utilisation [Shaikh and Hatcher (2004)]. This lack of concern about anxiety and depression disorders, especially in early part of pregnancy, and underutilisation of health care system in general may result in miscarriages. In case of a natural disaster like flood, however, the government and aid agencies try to establish temporary medical camps in affected villages and the Internally Displaced Persons' (IDPs) camps. This may increase the probability of prenatal care utilisation and thereby reduce the likelihood of miscarriages. However, since these camps are mostly temporary, the prenatal care may reduce once these are removed. Subsequently, the fetuses who survived the miscarriages may still suffer which could result in smaller birth size.

Another important pregnancy outcome is still birth. I check this outcome against the probability of a live birth and these analyses are shown in Table 8. In none of the specification we see an effect on still birth. This may be due to the increase in the probability of miscarriages [Valente (2011)]. Looking together at the findings in Tables 6, 7 and 8, we can conclude that exposure to floods and terrorism lead to miscarriages and smaller birth sizes but does not affect still births.

Table 8

Effect on Probability of Still Birth

Variables	(1) Model 1	(2) Model 2	(3) Model 3
In utero * Flood * Violence	-0.009	-0.007	0.001
	(0.006)	(0.006)	(0.010)
In utero * Violence	0.004	0.006	0.003
	(0.004)	(0.004)	(0.008)
In utero * Flood	0.003	0.004	0.000
	(0.004)	(0.005)	(0.006)
In utero	-0.002	-0.003	0.005
	(0.003)	(0.003)	(0.004)
Observations	12,516	12,516	9,971
R-squared	0.009	0.018	0.017
District FE	NO	YES	NO
Mother FE	NO	NO	YES

Note: ***, ** and * show significance at 1 percent, 5 percent and 10 percent levels respectively. Standard errors are clustered at district level.

5.3. Effect on Sex Ratio and Neonatal and Infant Deaths

I further examine the impact of exposure to the two shocks on gender of the baby born, neonatal deaths, and infant deaths in Table 9. Since, in comparison to female fetuses, the fragility of male fetuses in inadequate health environment is well established [Kraemer (2000); Trivers and Willard (1973)], one would expect a skewed sex ratio at birth in favour of girls [Fukuda, *et al*. (1998); Almond and Mazumder (2008)]. The results in Panel A of Table 9, however, do not provide a conclusive evidence in this regard. In the specification using the mother fixed effects, there is no evidence of an increase in the probability of female births. This indicates the absence of heterogeneity across gender in fetal losses. Both male and female fetuses are equally likely to experience a miscarriage.

Table 9

Effect on Probability of Female Birth and Neonatal and Infant Deaths

Variables	Model 1	Model 2	Model 3
Panel A: =1 if Female			
In utero * Flood * Violence	-0.060	-0.077*	-0.087
	(0.037)	(0.040)	(0.070)
In utero * Violence	0.038	0.062**	0.057
	(0.025)	(0.026)	(0.041)
In utero * Flood	0.021	0.020	0.024
	(0.019)	(0.022)	(0.035)
In utero	-0.006	-0.012	-0.029
	(0.018)	(0.019)	(0.029)
Panel B: =1 if Neonatal Death			
In utero * Flood * Violence	0.006	0.010	-0.003
	(0.016)	(0.016)	(0.024)
In utero * Violence	0.005	0.008	0.011
	(0.009)	(0.008)	(0.012)
In utero * Flood	-0.002	0.002	0.006
	(0.009)	(0.010)	(0.012)
In utero	-0.002	-0.005	0.008
	(0.006)	(0.006)	(0.010)
Panel C: =1 if Infant Death			
In utero * Flood * Violence	0.002	0.012	0.024
	(0.023)	(0.021)	(0.032)
In utero * Violence	0.007	0.005	0.000
	(0.013)	(0.011)	(0.016)
In utero * Flood	0.006	0.010	0.005
	(0.011)	(0.013)	(0.018)
In utero	0.007	0.004	0.010
	(0.007)	(0.007)	(0.013)
Observations	13,468	13,468	10,734
District FE	NO	YES	NO
Mother FE	NO	NO	YES

Note: ***, ** and * show significance at 1 percent, 5 percent and 10 percent levels respectively. Standard errors are clustered at district level.

Neonatal mortality is another measure of the health of a new born. The effects of in-utero exposure on the probability of death in the first 4 weeks after birth are examined Panel B (Table 9). Interestingly, while we observe a decrease in birth size of children exposed to these shows, there is not effect on the neonatal mortality. Similar results are witnessed for infant mortality in Panel C. Hence, once the children survive the miscarriage, their probability of death in the first 4 weeks or the first year of life after birth does not change due to adverse conditions experienced during pregnancy.

5.4. Robustness Checks

In the year 2007, a few districts of the province of Baluchistan were hit by a flood. This flood was nowhere near in intensity and coverage to the floods of 2010 and 2011. Subsequently, this flood was not included in the analysis. Although small in intensity, this flood may still raise concerns about the estimates. Therefore, as a first robustness check, I drop all the births taken place in the year 2007. This will remove the influence, if there is any, of the in-utero exposure to the 2007 flood. The results for both birth size and miscarriages, shown in Panel A of Table 10, are qualitatively similar to the main results in Tables 6 and 7, confirming their robustness.

Another possible concern could be about the duration of flood exposure. In the main analysis, the flood exposure is constructed based on the duration of monsoon rains and the prevalence of floodwater on dry land. All the children who were in utero during this time are considered exposed to flood. However, it is possible that children who were conceived after this time window might also be exposed to the adverse effects of flood. As another robustness check, I increase this time window by three more months. This means that children who were born in April, May and June of 2011, and May, June and July of 2012 are now part of the exposed group. Using this sample of children as the treated group, I redo the analysis and the results are reported in Panel B (Table 10). It is obvious from the table that these results are insensitive to change in the definition of flood exposure.[15]

Overall, the analyses in Table 10 validate the robustness of the effects that the flood and terrorism have on these important pregnancy and birth outcomes.

Table 10

Robustness Checks

	Small Birth Size		Miscarriage	
Variables	Model 1	Model 2	Model 3	Model 4
Panel A: Drop Children Born in 2007				
In utero * Flood * Violence	0.019	0.082**	0.000	-0.015
	(0.032)	(0.039)	(0.020)	(0.030)
In utero * Violence	-0.034	-0.055*	0.023*	0.039*
	(0.023)	(0.028)	(0.013)	(0.022)
In utero * Flood	-0.014	-0.003	0.006	0.010
	(0.021)	(0.025)	(0.011)	(0.017)
In utero	0.010	0.002	-0.020**	-0.034***
	(0.019)	(0.019)	(0.008)	(0.013)
Observations	11,103	8,886	11,530	9,249
Panel B: Change Duration of Flood Period				
In utero * Flood * Violence	0.003	0.071**	0.007	0.000
	(0.031)	(0.035)	(0.019)	(0.024)
In utero * Violence	-0.023	-0.045*	0.023	0.029*
	(0.024)	(0.025)	(0.015)	(0.017)
In utero * Flood	0.001	0.014	-0.003	-0.003
	(0.020)	(0.024)	(0.011)	(0.014)
In utero	-0.007	-0.012	-0.013*	-0.019*
	(0.020)	(0.022)	(0.007)	(0.011)
Observations	11,186	8,947	13,345	10,625
District FE	YES	NO	YES	NO
Mother FE	NO	YES	NO	YES

Note: ***, ** and * show significance at 1 percent, 5 percent and 10 percent levels respectively. Standard errors are clustered at district level.

[15] Although not report here due to space limitation, I also change the exposure period by different months and found similar results.

5.5. Heterogeneous Effects

I check heterogeneity in effects on birth sizes and miscarriages across three main dimensions; place of residence, socio-economic status, and mother's education. In case of natural disaster like flood, the rural areas are usually the ones which are most affected in terms of food insecurity and access to health services. Therefore, I split the sample based on rural and urban residency. Panel A of Table 11 demonstrates that the adverse influence of these shocks on pregnancy and birth outcomes are observed only in rural areas. This may imply that people in the urban areas were able to cope with the situation *ex post* due to better facilities in the urban area. On the other hand, rural residents could not prevent fetuses from the negative influence of these shocks.

Table 11

Heterogeneous Effects

	Small Birth Size		Miscarriage	
Variables	Model 1	Model 2	Model 3	Model 4
Panel A: Place of Residence	Rural	Urban	Rural	Urban
In utero * Flood * Violence	0.109**	0.058	-0.025	0.037
	(0.051)	(0.070)	(0.038)	(0.037)
In utero * Violence	-0.084**	-0.024	0.045*	0.014
	(0.033)	(0.039)	(0.026)	(0.028)
In utero * Flood	-0.003	-0.006	0.026	-0.035
	(0.034)	(0.036)	(0.019)	(0.024)
In utero	0.004	-0.004	-0.043***	-0.015
	(0.025)	(0.028)	(0.013)	(0.021)
Observations	5,367	3,580	6,411	4,214
Panel B: Socio-economics Status	Lower SES	High SES	Lower SES	High SES
In utero * Flood * Violence	0.109**	-0.130	-0.011	-0.006
	(0.042)	(0.104)	(0.027)	(0.045)
In utero * Violence	-0.061*	-0.049	0.040**	0.017
	(0.032)	(0.044)	(0.017)	(0.038)
In utero * Flood	-0.018	0.134**	0.006	0.019
	(0.028)	(0.064)	(0.017)	(0.029)
In utero	0.004	-0.006	-0.030**	-0.043*
	(0.020)	(0.044)	(0.012)	(0.025)
Observations	7,437	1,510	8,861	1,764
Panel C: Mother's Education	<8 Years	>=8 Years	<8 Years	>=8 Years
In utero * Flood * Violence	0.084*	0.118	-0.008	-0.000
	(0.048)	(0.086)	(0.028)	(0.045)
In utero * Violence	-0.077*	0.003	0.036*	0.033
	(0.040)	(0.038)	(0.021)	(0.023)
In utero * Flood	-0.008	0.017	0.004	0.017
	(0.028)	(0.047)	(0.017)	(0.027)
In utero	0.009	-0.015	-0.029**	-0.044**
	(0.021)	(0.033)	(0.012)	(0.022)
Observations	6,829	2,118	8,174	2,451
District FE	NO	NO	NO	NO
Mother FE	YES	YES	YES	YES

Note: ***, ** and * show significance at 1 percent, 5 percent and 10 percent levels respectively. Standard errors are clustered at district level.

Similarly, since families from low and middle income groups are more vulnerable to shocks [Currie and Hyson (1999); Currie and Vogl (2013)], I examine the heterogeneity between the richest and rest of the income groups based on the wealth index. The findings in Panel B corroborate that this is indeed the case. There is no effect on birth size and miscarriage in the group of richest families. I also redefined these income classes by including rich and middle income groups in the higher socio-economic status (SES) families. However, the analysis concludes that it is only the richest class on the wealth index that has been able to protect the fetuses from miscarriages and bad health endowments at birth.

An educated mother is more informed about health hazards during pregnancy and is more conscious and better able to protect the fetus during adverse shocks. This is confirmed by the results shown in Panel C where mothers with 8 or more years of education are able to prevent fetal losses as well as unhealthy birth outcomes for children in terms of smaller birth size.[16]

The effect heterogeneity in Table 11 concludes that the negative influences of these shocks are observed mainly in rural areas, by lower socio-economic status (SES) families, and by less or uneducated mothers. These are important findings regarding preventive health care policies.

5.6. Mechanisms

In this section I examine some of the potential channels discussed in the literature. One of the most discussed pathways in literature is nutritional deficiency. The shocks can have adverse effects on household income thereby reducing household consumption, especially food consumption, which in turn could result in nutritional deprivation. Since data on nutritional status at the time of pregnancy is not available, I use weight-for-height Z-score (WHZ) for children born after 2009 as a proxy for short term nutritional status to capture the effects of floods in violent and non-violent districts.[17] The results are reported in Panel A of Table 12. Column 1 shows the effect on WHZ whereas column 2 exhibits whether these shocks increase the probability of a child being wasted or acutely malnourished. These results provide no evidence of nutritional deficit. In fact, although marginally significant, flood in non-conflict districts reduces the probability of being wasted. This may not be surprising given that the response of the government and non-governmental organisations (NGOs) was very effective, especially in districts unaffected by conflict. As discussed earlier, children and pregnant women who were screened and were found to be at the risk of malnutrition were treated under the Supplementary Feeding Program (SFP) (UNDP 2012). Hence, this channel may be ruled out.

[16]Completion of 8 years of education is equivalent to graduation from middle school in Pakistan. Given the different school structures and the varying quality of education across different tiers, this is a very relevant cut-off to consider a person to be able to read and write in Urdu (national language) with ease.

[17]The height-for-age Z-score (HAZ) is not used because it captures the long-term undernutrition and may dilute the effects of recent floods.

Table 12

Mechanisms

Variables	Model 1	Model 2
Panel A: Nutritional Status	Child WHZ	Child WHZ < -2
Flooded District * Violent District	0.225	1.132
	(4.464)	(0.756)
Flooded District	0.256	-1.131*
	(4.001)	(0.672)
Violent District	0.228	-0.114
	(0.372)	(0.072)
Observations	1,692	1,692
Panel B: Prenatal Health Care	Number of Visits	Early Initiation
In utero * Violence * Flood	-0.285	0.019
	(0.221)	(0.043)
In utero * Violence	0.167	0.005
	(0.189)	(0.029)
In utero * Flood	-0.091	-0.012
	(0.173)	(0.031)
In utero	0.051	-0.007
	(0.141)	(0.026)
Observations	7,120	5,321
District FE	YES	YES
Mother FE	NO	NO

Note: ***, ** and * show significance at 1 percent, 5 percent and 10 percent levels respectively. Standard errors are clustered at district level.

Another important channel is the use of antenatal care. For this purpose I use two measures; number of prenatal care visits and whether or not the health care was initiated in first trimester of gestation. The data on antenatal care is available only for the latest pregnancy and therefore it is not possible to use a maternal fixed effect for these analyses. However, it is possible to control for district fixed effects. The findings for both measures are reported in Panel B. No evidence is found that these shocks independently or their interaction reduce the number of antenatal care visits or delay the initiation of health care. However, it is important to mention that the average number of prenatal visits (3.3) is already below the optimal number of antenatal visits 8-12 [Zolotor (2014)]. In a catastrophic situation, the prenatal care must increase to deal with the complications (such as mental health deterioration) resulting from the new circumstances. The fact that these visits did not increase may also be attributed to the prevalence of these shocks.

There are two other possible channels; disease outbreak and maternal depression. Since, there is no evidence of any large-scale disease outbreak in the aftermath of floods [Fair, *et al*. (2014)], it is tempting to suggest that psychological depression during pregnancy might have played the major role in these harmful pregnancy and birth outcomes. Exposure to shocks leads to the release of stress hormones such as cortisol and Corticotrophin Releasing Hormone (CRH). Excessive levels of cortisol, especially in the early part of gestation, are found to have detrimental effects on birth outcomes [Brown (2015); Gluckman and Hanson (2005)]. Unfortunately, the data on mothers' mental health is not collected in the DHS surveys. This prevents us from direct investigation of the validity of this mechanism. Nonetheless, lack of empirical support for other channels and the recent evidence about the causal relationship between shocks and mental health makes a compelling case for maternal stress to be the plausible mechanism at work here.

5.7. Behavioural Concerns

5.7.1 *Selection into Pregnancy*

As discussed in the section on empirical methodology, behavioural changes pose an important threat to the validity of identification strategy. The first one, in this regard, is whether mothers change their fertility decisions in response to the occurrence (or perceived threat of) flood and violence. In other words, whether or not there is selection into pregnancy across treated and untreated regions. Table 13 demonstrates the results for differences between affected and unaffected regions across various characteristics of women who were pregnant during floods and conflict. The characteristics include age and education of the women, number of pregnancies during the period 2007–2012, and household wealth index. The differences are insignificant for most of these attributes. Especially, the insignificant effect on the number of pregnancy across both affected and unaffected districts supports the view that women did not change their fertility decisions when exposed to these shocks. This confirms the validity of the identification strategy and, therefore, the robustness of our results.

Table 13

Selection into Pregnancy- Characteristics of Mothers Pregnant During Violence and Flood

Dependent Variables	Mother's Education		Mother's Age		Number of Pregnancies		Household Wealth	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Pregnant * Flood * Violence	-0.424	-0.114	-0.110	1.193*	0.012	0.065	-0.051	-0.014
	(0.407)	(0.276)	(0.611)	(0.675)	(0.077)	(0.064)	(0.042)	(0.033)
Pregnant * Violence	0.167	-0.273	0.228	-0.206	0.046	0.033	0.048	-0.001
	(0.314)	(0.179)	(0.399)	(0.297)	(0.064)	(0.040)	(0.036)	(0.016)
Pregnant * Flood	-0.101	0.058	-0.098	-0.282	0.016	0.043	-0.040	0.032*
	(0.221)	(0.188)	(0.285)	(0.318)	(0.039)	(0.033)	(0.029)	(0.017)
Pregnant	0.084	0.180	-0.081	0.059	-0.024	-0.045	-0.007	-0.020
	(0.187)	(0.168)	(0.237)	(0.236)	(0.033)	(0.029)	(0.021)	(0.013)
Observations	13,468	13,468	13,468	13,468	13,468	13,468	13,468	13,468
District FE	NO	YES	NO	YES	NO	YES	NO	YES

Note: *Shows significance at 10 percent level. Standard errors are clustered at district level.

5.7.2. *Migration*

The second potential behavioural change that can bias the results is systematic migration. If women of certain characteristics (e.g. educated, healthy, rich etc.) choose to migrate from affected to unaffected regions, the results would be overestimating the impact of these shocks. There are three reasons why this is not the case. First, only 3.8 percent of the household members have migrated in the past 10 years; this time interval also includes the four year period (2003-2006) when the districts were not affected by violence or any major flood [PDHS (2012-13)]. For the sample of women who were in the child-bearing age (14-49 years) in the year 2007, only 5.5 percent have migrated in the past six years. Second, among those who migrated, only 2.46 percent (or 0.13 percent of the entire women sample) migrated to escape violence and only 0.19 percent did so due to flood/drought. It is highly unlikely that this small sample of migrants would bias the main results. Third, and to corroborate this statement, I dropped the migrant sample and re-run the analyses. The results (available upon request) are qualitatively similar and authenticate the identification strategy.

6. CONCLUDING REMARKS

Simultaneous exposure to natural calamities and conflict shocks is a phenomenon that has been largely understudied. This is despite the fact that majority of the population that has experienced adverse climatic shocks in the last decade or so belongs to conflict-affected countries. Studying the combine effect of these shocks would be helpful in identifying how the adverse effects of climatic shocks are exacerbated in areas that have already been victims of violent conflicts. Subsequently, appropriate measures could be taken by the government and international community to reduce vulnerability of the potential victims *ex ante* as well as enhance their ability to cope with disaster situations *ex post*.

Among the various adverse consequences of these shocks, probably the most worrisome is the effects on children in utero—the foetuses—for it could lead to deterioration in the long term welfare. Exposure to conflict can lead to the release of stress hormones which can be detrimental for the fetus. On the other hand, a natural disaster can both be a stressor and a cause of disease outbreak affecting pregnant women and their children. Similarly, both conflict and climatic shocks can lead to a decline in the household income which could then transform into nutritional deprivation. All these could affect the fetus's health and can cause miscarriages, still birth, lower birth weight and small size at birth.

Pakistan is one of those countries that have been victims of conflict and adverse climate shocks. While on one hand, the country has experienced a surge in terrorist attacks since 2007, on the other, two major floods hit the country in 2010 and 2011. This paper investigates the effects of these shocks on pregnancy and birth outcomes and finds that in-utero exposure to flood in conflict-affected districts increases the probability of small size at birth. Moreover, the study finds evidence of selection into birth in areas that have only been affected by violence. In other words, in-utero exposure to violence reduces the likelihood of small birth size but increases the probability of miscarriages. The impact on still birth was insignificant. As far as birth weight is concerned, the impact of shocks was positive but since this is not a representative sample, this result cannot be generalised. These findings imply that, while the response to floods in districts unaffected by violence was admirable in curtailing the adverse effects on pregnant women and children, the same may not be true for conflict-affected areas. The negative effects of conflict on access to aid have also transmitted to unborn children in the households.

The results that the negative influences of these shocks are observed only in rural areas, by lower socio-economic status (SES) families, and by less uneducated mothers are very important regarding preventive health care policies. These not only identify the potential target areas and groups for such policies but also highlight the importance of women's education in child health care. Furthermore, the fact that maternal stress is the most plausible channel questions the nature of health services related to prenatal care provided in health care centres. Psychological counselling during pregnancy requires more attention and should be provided at all health centres.

Future studies would extend this work by scrutinising the channels in more detail. Especially, the analysis using data on district level flood aid, damages to health centres, houses, and crops would better identify whether the main pathway is nutritional deprivation or prenatal care or both. Another important extension could be looking at whether mothers adjust their behaviour to terrorist attacks over a period of timing. For example, whether the terrorist attacks experienced in the early days of conflict had more psychological effects than the ones observed at a later date. Lastly, the effects from in-utero exposure can be disaggregated into different trimesters.

APPENDIX

Table A1

Impact of Floods 2010 and 2011 on Terrorist Attacks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A:								
Dependent Variables	Terrorist Attacks in							
	Sep 2010	Octo 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	Mar 2011	Next One Year
Flood 2010	-0.122	-0.075	0.056	0.015	-0.320	0.203	-1.163	-5.566
	(0.116)	(0.054)	(0.084)	(0.115)	(0.431)	(0.554)	(1.271)	(5.909)
Panel B:								
Dependent Variables	Terrorist Attacks in							
	Sep 2011	Octo 2011	Nov 2011	Dec 2011	Jan 2012	Feb 2012	Mar 2012	Next One Year
Flood 2011	-0.084	-0.036	-0.368	-0.040	-1.121*	-0.213	-0.557	-8.455
	(0.108)	(0.269)	(0.257)	(0.120)	(0.636)	(0.568)	(0.693)	(7.049)
District Characteristics	YES	YES	YES	YES	YES	YES	YES	YES
Province FE	YES	YES	YES	YES	YES	YES	YES	YES

Note: Standard errors are clustered at district level. District characteristics include distance to afghan border, distance to near river, mean elevation of the district, and standard of the elevation of the district. Next One Year shows the cumulative number of terrorist attacks in the next one year post flood period. Although not reported here, the cumulative attacks in next six months were also used in the analysis and there was no significant effect of floods in either case.

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