Long-term effects of violent conflict on second-generation health outcomes: evidence from Liberia

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Draft, May 2015

Please do not cite

Abstract

A recent body of literature has investigated the direct consequences of conflict on children's health outcomes. Most of these studies report strong negative impacts of exposure to violence on childrens' short-and long-term nutritional status. Yet it is unclear to what extent these negative impacts carry over to the next generation, born after the war. This paper examines the long-term effect of mothers' exposure to the 1989-2003 Liberian civil war, on their children's anthropometric outcomes. We use detailed district-level exposure to the war, including the intensity of violence in the village. We also use the mothers' migration history and whether they were born and live in the village during the war, to accurately measure exposure to violence. In addition we find that it matters at which age mothers got exposed. We find a strong negative and significant impact of mothers exposure to the war in utero on their children's HAZ-score. Results are robust to including controls, and district and child's birth cohort fixed effects.

Keywords: HAZ, children's health, conflict, Liberia
JEL Codes: I12, J13, O12, O15

1. Introduction

A country going through conflict experiences destruction of physical and human capital, with negative implications in terms of growth and development (e.g. Guidolin and La Ferrara, 2007; Collier and Hoeffler, 1998). A relatively recent strand of the literature has focused on the microeconomic impacts of conflict on health, particularly for young children. This focus is well placed, as a person's health status, especially during foetal and early childhood development is a strong predictor of future welfare, including educational attainment, socio-economic status, and life expectancy (see e.g Almond, 2006; Yamauchi, 2006; Alderman et al., 2006; Maccini and Yang, 2006). Most of these studies concentrate on assessing the effect of children's exposure to conflict on their long and short-term health status. For instance, Bundervoet et al., (2009) finds an average negative impact of 0.35 to 0.53 standard deviations for children's exposure to the Burundian civil war. Akresh et al.(2012) show that children exposed to the Ethiopian-Eritrean war are shorter by almost 0.42 standard deviations in comparison with their peers of the same population. Maccini and Yang (2009); Minoiu and Shemyakina (2012) and Barre and Domingues (2013) report similar findings.

These studies focus on the direct impact of children's exposure to conflict on their health outcomes. To the best of our knowledge, no one has yet examined temporal spillovers of violence to health outcomes from one generation to the next. Do negative impacts of violence sustain, and affect the generation(s) of children born some years after the ending of the war? The early childhood development literature for example implies negative health shocks experienced in utero, or at a very young age may be felt for life. On the other hand, one may argue that 'normal' life resumes after the war ends hence we may observe (some) convergence to outcomes of those that were not, or less exposed. We also intend to investigate whether it matters *who* (father or mother) got exposed, the age at exposure and whether there is a differential health impact for boys and girls.

We use detailed data from 332 children in 2600 Liberian households and 136 villages that we collected ourselves. We have anthropometric measurements for all under five-year children and information about whether mother and (or) father were born in the village, and the migration history for both parents to correctly identify exposure to the war. Following Akresh et al., (2012) and Domingues and Barre (2013) we hypothesize that the age at which parents got exposed matters and distinguish between in utero exposure; infants and very young children (0-3), childhood (4-12) adolescence (13-18) and adulthood (>18).

The remainder of the paper is organized as follow: section 2 outlines a framework that describes how conflict may impact on next generations not directly exposed to the violence. It also presents an historical overview and a course of the Liberian civil war. Section 3 discusses the data and presents descriptive statistics of our key variables. Section 4 presents the empirical framework as well as the main results we obtained. The main implications of the paper and potential caveats are discussed in section 5.

2. Theoretical framework

2.1 Related literature

Our paper hopefully speaks to three strands of literature. First we contribute to a growing microeconomics literature on the consequences of violent conflict (see e.g. Bundervoet et al. 2009; Akresh et al. 2011; Minuoi and Shemyakina, 2012; Akresh et al. 2012; Domingues and Barre, 2013). Despite the, often strong, negative impacts these scholars report, little is known about the underlying mechanisms. Clearly, violent conflict can affect people's health in multiple ways and the data are rarely rich enough to accurately discriminate between various channels. Devakumar et al., (2014) offer a theoretical framework that helps us understand the direct and indirect routes through which conflict affects current and future generations. Indirect channels may include the displacement of people, depletion of natural resources, destruction of social infrastructure and the redirection of governmental resources to military expenditure (Hoeffler and Reynal-Querol, 2003). Direct channels include foremost direct exposure to violent attacks, including rape and prostitution resulting in physical and (or) mental health traumas (see e.g. Bombay et al., 2009; Yehuda and Bierer 2008). In addition, increased infectious disease transmission during warfare (Gbobarah et al., 2002; Iqbal, 2006) and malnutrition due to food shortages may account for adverse health impacts as immediate results of the war (e.g. de Rooij et al., 1999; Neugebauer et al., 1999). We are able to assess the empirical importance of some of these channels in our analysis below.

Second, our study builds on research focusing on the persistence of early childhood conditions and outcomes later in life related to educational attainment (Currie and Moretti, 2007; Currie et al., 2010; Neelsen and Stratman, 2011) socio-economic outcomes (Black et al., 2007; Bleakley 2007; Case and Paxson, 2008; Smith, 2009; Kesternich et al., 2014) and health (van den Berg et al., 2006; Agüero and Deolalikar, 2012; Garces et al., 2002). It also relates to the strand of literature studying the role of fetal nutrition in people's future health and abilities (see Almond and Currie 2011b for a review). First noted within domain of epidemiology, several (development) economics have started to address these topics (e.g. Almond and Currie, 2011ab).

Third, and much related to the previous, the results speak to a small but emerging economics literature on the intergenerational impacts of economic shocks or social policies.[1] Almond and Chay (2006) for example provide suggestive evidence of a positive impact of the Civil Rights Act (1964) on black infants born in the late 1960s, who were less likely to give birth to infants with low birth weight and low scores on

[1] An interesting new study by Wantchekon et al. (2015) exploits the near random allocation of first missionary schools in Benin to estimate the impact of education on living standards, social networks and political participation for first generation students and their descendants. They report large effects for both first and second generations. Yet while positive impacts for the first generation were merely confined to "treated" students, these impacts managed to spill over to descendants of non-treated students in treatment villages.

other predictors of infant health, some two to three decades later, compared to black women born in the early 1960s in some of the Southern states of the US.

Almond et al., (2010) exploit exogenous variation in exposure (in time and across space) to the 1959-1961 Chinese famine, to examine its long-term effects on health and economic outcomes some thirty years later and find that in utero exposure to the famine has a negative impact on literacy, labor and marriage market outcomes and economic status. Moreover, women's exposure to the famine is associated with lower sex ratios among second-generation birth outcomes.

Fung and Ha (2009) build upon this idea focusing specifically on intergenerational impacts of the famine. Yet their results are mixed, and the authors offer no explanation for differential impacts across different age categories of exposure, type of outcomes (health versus education) and second and third generation outcomes considered.

Using a cross-country panel data set for 38 developing countries, spanning three decades, Bhalotra and Rawlings (2010) find strong evidence of persistent intergenerational health effects. Childhood health of the mother, (proxied by height), as well as her current health status affect health of the next generation. Overall persistence has declined over time but results disaggregated by continents demonstrate large divergence across regions, with persistence in fact rising in Africa.

2.2. The Liberian civil war

Liberia has been engaged in a raging civil war, starting on Christmas eve in 1989 with an invasion Liberian exiles led by Charles Taylor, from Ivory Coast into Nimba county. The Liberian war is commonly defined as a war in two parts: the first phase starting with the NPFL attacking villages in Nimba county and ending with the election of Charles Taylor as president in 1997. Between 1997 and 1999 there was a temporary pause in the violence, where civilians resumed their-day-today activities in agriculture, rubber tapping or small business (Bøas, 2005). Yet violence resumed late 1999 when rebels from the Liberians United for Reconciliation and Democracy (LURD) faction started fighting against Taylors' men from Lofa county in the Northeast, where LURD would attack villages to shoot, plunder and burn houses and Taylors' forces would subsequently chase out LURD and took what was left to loot or destroy. Early 2003 a new rebel group emerged under the name of the Movement for Democracy in Liberia (MODEL), supported by the Ivorian government fought Taylors' forces from the Southern part of the country, while advancing to Monrovia. The war ended in August 2003 with Charles Taylors' flight into exile in Nigeria and the signing of a peace agreement between the government and the two principal remaining rebel groups (LURD and MODEL).

Although violence commenced in the Northern part of the country, the ultimate goal was seizing the capital city; and most battles were clustered in and around (Greater) Monrovia (see Duyvesteyn, 2005 for a more elaborate analysis on this point). In addition, the main road connecting NPFL headquarters in

Gbarnga, Bong county to Monrovia, runs through the counties of Margibi and Montserrado where villages were bombed or attacked otherwise by rebel factions and the government army (Duyesteijn, 2005).[2]
The war had huge impacts on people's lives. Conservative estimates report about 60,000 people died and about 50 percent was displaced at some point in time during the war (Richards and Humphreys, 2005). Ellis (2007) notes that violent actors would generally demand villagers to provide them with food and shelter; took levies from artisanal diamond mining, rubber tapping and palm oil manufacturing or used locals as concubines, laborers and porters. Armed groups were particularly violent in "enemy" areas where they had no (family) ties, where they would "move into a village, take everything, kill and rape. They stay a couple of weeks and then move on" (Ellis, 2007). Although some parties to the conflict appeared worse than others (also see Lidow, 2010), all have been associated with indiscriminate violence towards civilians (e.g. Ellis, 2007; Human Rights Watch, 2003; Amnesty International, 2002).

3. Data

3.1 Data sources, sample and questionnaire design

We use survey data collected in 2012 and 2014 respectively by researchers from Wageningen University, the Netherlands. The data was collected as part of an impact assessment of the *MedeFinancieringStelsel* (henceforth referred to as MFS) II: the 2011-2015 grant framework of the Dutch Ministry of Foreign Affairs for Dutch NGOs aiming to achieve a sustainable reduction in poverty. One of the projects under evaluation comprised the implementation of an agricultural livelihoods program (PAMOJA, meaning "*together*" in Swahili) in rural areas in Liberia to improve food security, community cohesion and farmer's income. The program was implemented by a consortium of national and international NGOs, headed by ZOA, a Dutch NGO active in the country since 2003. The research was undertaken in three counties, closest to the Liberian capital Monrovia: Montserrado, Margibi and Bong county. Baseline data collection took place in March - April 2012 and the endline in May-June 2014. Two surveys were implemented: a community questionnaire that relied on interviews with the local chief and one or two elders of the village to obtain information on the village history, presence of public goods and local institutions. For the household questionnaire the household head or the spouse was invited to answer questions related to demographic, and socio-economic characteristics of the household and its members, including income and labor, land tenure and agriculture, expenditure and consumption and assets ownership. Households

[2] Also note that Margibi and Montserrado county (excluding Monrovia) are ethnic homogenous. More than 70 percent of the rural population in these areas belongs to the Kpelle group. Although violence targeted at specific ethnic groups occurred in the Northern regions at the start of the war, warring factions soon became multi-ethnic, often even killing their own people (Pugel 2007; Ellis, 2007).

were also asked to provide an account of their exposure to the civil war violence and we have information on their migration history to correctly classify exposure to violence. Anthropometric information of all children under five years of age was obtained using official instruments from UNICEF (scales and wooden boards to measure weight and height).

Data was collected in about 136 communities, in nine districts of Margibi, Montserrado and Bong county. Communities were considered eligible for selection if they satisfied three criteria: i) the selected community had not previously received a ZOA intervention; ii) the community had at least 20 households; and iii) communities were at least 5 km away from the next treatment community to avert potential spillover effects. In the second step of the selection process, some 20 to 30 households were randomly chosen to participate in the survey.

After the data cleaning process, we obtained anthropometric measures of 332 children under five years of age, from 267 households and 95 villages.

3.2 Descriptive statistics

Table 1 presents an overview of the key dependent and independent variables relevant for our analysis. Following others within the literature on violent conflict and child health outcomes, we focus on the Height-for-Age z-score (HAZ), calculated as the number of standard deviations of the actual height of a child from the median height of the children of his/her age as determined from the WHO reference population. The score is prefixed by a positive or negative sign, which depends on whether the child's actual height is higher or lower than the median height. Liberia has ranked among the lowest countries on the human development index for decades. It should thus be no surprise that mean HAZ-scores are well below (-1.44) the median height of the reference population. In fact, using a standard cut-off score of minus two standard deviations, the mean Liberian child in our sample would be classified as 'stunted' (42% of our sample). Stunting is commonly identified with chronic malnutrition. Other child characteristics include age of the child, and birth order. The children in our sample are on average 31 months old; with about 12 % being the first-born.[3]

Mother and father characteristics including year of birth are our key variables to measure temporal variation in exposure to violence. Following the most recent literature on this topic we create indicator variables for different age categories to assess at what age exposure matters most. Other household characteristics include level of education, ethnicity, religion, marital status, whether they were born in the village; and if and how long they left the village for a specific period of time. This information enables us to correctly classify exposure to the war. Some 44 (48) percent of mothers (fathers) indicated to have been

[3] Note that we have no information on women's fertility history and we hence refer to the oldest living child as first-born. Thus, possible children born earlier that died or left the household are not accounted for. The variable 'first-born' may thus be a somewhat inaccurate measure of being a true first-born to the mother.

away for some time. However, most of the mothers who have migrated have returned back during the outbreak of the war; as about 99% of the mothers where actually living in their area during the conflict's episode. For mothers we also include the age at the time the first child was born following the health literature that suggests a differential impact for young and older mothers.[4] Other relevant household controls include the number of children in the household that may indicate competition for food, and a SES-index to proxy for household wealth. To exploit spatial variation in war exposure we construct a district level violence variable. Yet, the Liberian war affected all counties and districts within our sample as they were "on the way to Monrovia", albeit some were marginally more exposed than others. We exploit this variation measuring the proportion of households that got attacked in a given district. As this variable is likely measured with (some) noise due to using self-reported accounts of violence, we also develop a binary dependent that is 1 for districts that experienced more than the median number of attacks, and zero otherwise.

[Insert Table 1 about here]

4. Empirical strategy

4.1 Specification of the econometric model

Our empirical identification strategy relies on spatial and temporal variation in parent's exposure to district-level violence to measure a causal impact of civil war violence on health outcomes of the next generation. We estimate the following regression:

$$HAZ_{ijt} = \alpha_j + \delta_t + \beta_1(wardistrict_j * warcohort_t) + \lambda X_{ijt} + \varepsilon_{ijt} \quad (1)$$

HAZ_{ijt} is the Height-for-Age Z score for child i born in time period t in district j, α_j are district fixed effects, δ_t are year of birth cohort fixed effects, X_{ijt} are child, parental and household characteristics and ε_{ijt} a random idiosyncratic error term. The war district term is explained in section 3.2 and interacted with the war cohort variable that measures the years of mothers' exposure to the war using mothers' year of birth.

There is increasing evidence that the impact of exposure to (violent) shocks differs with age (see Akresh et al. 2014; Barres and Domingues 2014). We therefore also estimate a model that captures exposure at different age categories.

[4] Again, earlier children not present in the household anymore are not accounted for.

4.2 Results

We start our analysis by observing whether there are any visual patterns in the data. Figure 2 presents the overall HAZ-score distribution of current under-five year olds in Liberia and two separate figures for children of parents living in high and low-conflicted areas respectively. HAZ-scores of children whose mothers lived in high-violence areas are significantly lower (-1.58 vs. -1.29, p=0.07) than those in the low-violence areas. Table 2 presents the results of a parsimonious regression as outlined in (1) but without controls. We find that HAZ-scores for children whose mothers lived in districts that got heavily attacked during the war are 0.33 standard deviations lower. Column 2 also reports a negative coefficient for the war cohort variable but it is small and insignificant. Also in column 3 that presents the interaction none of the variables is significant. One reason for not finding a robust effect may be that it matters at which age the mother was exposed to the war. If exposure at a young age is highly detrimental but say, exposure during adolescence has hardly any effect not, the true impact of the violence may be obscured by the aggregate. We therefore include indicator variables for four separate age categories. The results are presented in Table 4, with- and without district fixed effects and with child year of birth fixed effects. We now identify a small but non-negligible impact for children whose mothers got exposed to the war in utero. HAZ-scores are 0.05 standard deviations lower. Table 5 reports results for models that include child, parental and household controls. The coefficient for mothers exposed in utero is larger and now significant at 1 percent. Also, we identify a small negative impact for mothers exposed during their early childhood, in line with what the early childhood development literature suggests. Furthermore, in the column 3 of table 5, a positive effect of the birth order of the child has been found with the HAZ of children born first being 0.51 standard deviations higher. Last but not the least, mothers living in households with greater size tend to have children with HAZ-scores which are 0.084 standard deviations lower. Note that our district measure of violence or the interaction is never significant. Overall, the results likely indicate that the geographical variation is not strong enough to identify an effect. As documented in section 2, much of the fighting took place in the area between Monrovia and the NPFL headquarters in Gbarnga; exactly the area our sample is from.

5 Discussion

This paper is the first empirical study that tackles the issue of second-generation health impacts of civil war victims of violence exploiting spatial and temporal variation in mothers' exposure to the Liberian civil war. The results are consistent with other studies that investigate the impact of civil war violence on child health outcomes that were themselves exposed. Yet outcomes should be interpreted with some caveats

in mind. We only have data on survivors, or in other words, data do not include information on mothers who died during the conflict. If these mothers were more likely to have children that have a low Height for Age Z score, then our negative effects found would likely to be underestimated. Further, long-term outcomes as ours, may reflect both biological as well as social factors in response to violence exposure. As a next step we will try and shed light on the mechanisms explaining our results, including assessing a potential differential impact for boys and girls and mothers' versus fathers' exposure to the violence. Yet, our preliminary results suggest that the impact of civil war violence can be persistent and continues to have a profound effect on people's lives that only started long after the shootings stopped. This contrasts with some of the macro-economic literature that provide evidence of countries quickly returning to a steady-state growth path after the ending of the violence suggesting aggregate figures may obscure persistent negative impacts for those that were hit hardest.

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ANNEX

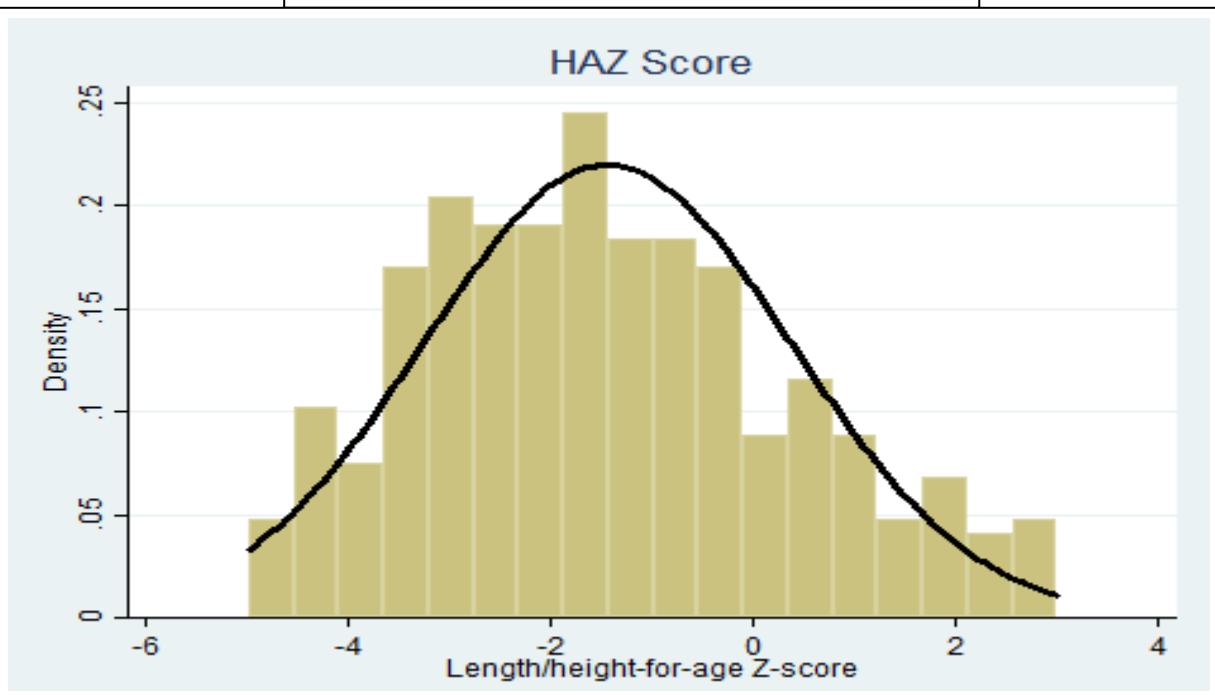
Table 1: Descriptive statistics

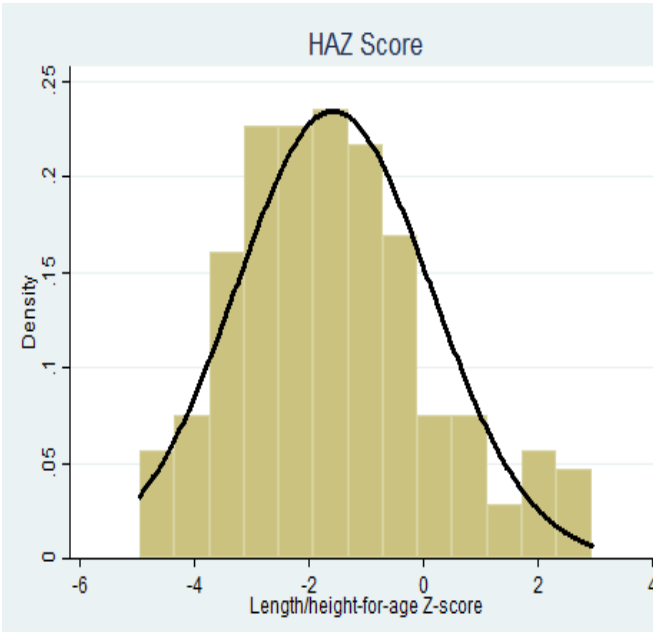
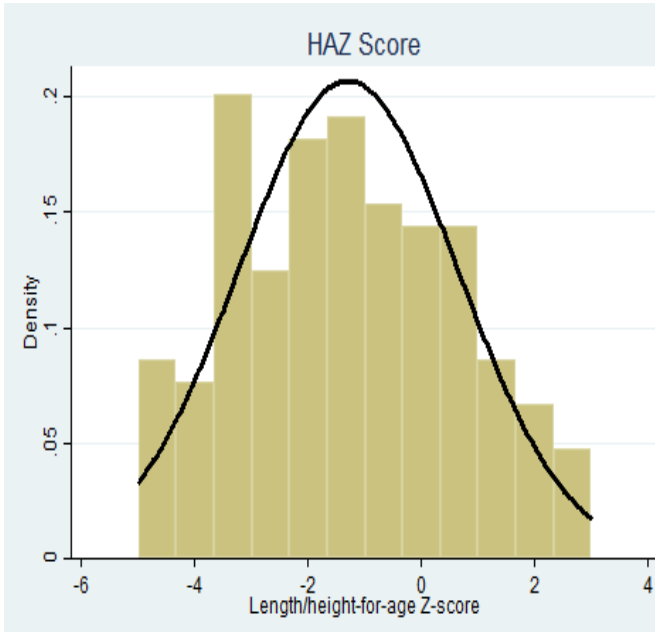
Variables	Number of Observation	Mean	Std. Dev.
Children Anthropometrics variables			
haz06	332	-1.44	1.817
Child Stunting (HAZ<-2)	332	0.42	0.49
Child_age	332	33.20	15.32
Female_child	332	0.48	0.50
Household_size	332	5.36	1.86
The Child is the first born	332	0.12	0.32
Mother's status variables			
Mother's age	332	33	9.13
Mother is Literate	332	0.19	0.39
Mother is Kpelle	298	0.79	0.40
Mother is Christian	294	0.93	0.25
Mother use safe water source drinking	328	0.52	0.50
Mother living in the village during the war	332	0.99	0.07
Mother's age at first born	319	20.05	6.813
Mothers' violence exposure variables			
district level mother's exposure to the war_dummy measure	332	0.53	0.50
district level mother's exposure to the war based on the number of attacks_continuous measure	332	0.38	0.041

Source: Liberia MFS baseline and endline survey, 2012 and 2014

Figure 1: Distribution of under five years old HAZ score in Liberia

Overall distribution



In high district affected areas (using a cut off point of the median of the district level violence)	In low district affected areas (using a cut off point of the median of the district level violence)
	

Source: Liberia MFS baseline and endline survey, 2012 and 2014

Table 2: Test of difference of HAZ score mean per conflict affected mothers

Group	Obs.	Mean	Std error	[95% Conf. Interval]		Diff (Mean 'Not attacked', Mean 'Attacked)
Mothers living in district lowly attacked	157	-1.29	0.15	-1.59	-0.98	Ha: diff > 0 Pr(|T| > |t|) = 0.076
Mothers living in district highly attacked	175	-1.58	0.13	-1.83	-1.32	

Source: Liberia MFS baseline and endline survey, 2012 and 2014

Table 3: Impact of mothers' exposure to conflict on child's health.

DEPENDANT VARIABLE (HAZ Score)	[1]	[2]	[3]
District level exposure	-0.33***** [0.17]		-0.25 [0.96]
Number of years the mothers spent under the war		-0.0045 [0.026]	0.0122 [0.077]
District level exposure Number of years the mothers spent under the war*			-0.006 [0.079]
Controls	**NO**	**NO**	**NO**
District level Fixed effects	**NO**	**YES**	**NO**
Child's Year of Birth Fixed effects	**YES**	**YES**	**YES**
R-squared	0.0371	0.0644	0.0374
Number of Obs	332	332	332

Notes: Robust standard errors in [ ] clustered at the district level, * significant at 10%; ** significant at 5%; *** significant at 1%

Data Sources: Liberia MFS baseline and endline survey, 2012 and 2014

Table 4: Impact of mothers' exposure to conflict on child's health by disentangling years of exposure at different age's category

DEPENDANT VARIABLE (HAZ Score)	[1]	[2]
District violence	-0.42 [0.39]	0.054 [0.39]
Mothers Years of exposure in Utero district level exposure*	0.054 [0.035]	0.021 [0.038]
Mothers Years of exposure at age 0-2 district level exposure*	0.0047 [0.045]	0.0035 [0.050]
Mothers Years of exposure at age 3-10 district level exposure*	-0.0079 [0.048]	0.0035 [0.050]
Mothers Years of exposure at age 11-17 district level exposure*	0.021 [0.020]	0.036 [0.023]
Mothers Years of exposure in Utero	-0.055** [0.017]	-0.066* [0.0134]
Mothers Years of exposure at age 0-2	-0.017 [0.036]	-0.035 [0.027]
Mothers Years of exposure at age 3-10	0.0096 [0.039]	-0.0042 [0.037]
Mothers Years of exposure at age 11-17	-0.0034 [0.017]	-0.0165 [0.021]
Controls	**NO**	**NO**
District level fixed effects	**NO**	**YES**
Child year of birth fixed effects	**YES**	**YES**
Number of observations	**332**	**332**
R^2	**0.0485**	**0.0761**

Notes: Robust standard errors in [ ] clustered at the district level, * significant at 10%; ** significant at 5%; *** significant at 1%

Data Sources: Liberia MFS baseline and endline survey, 2012 and 2014

Table 5: Impact of mothers' exposure to conflict on child's health by disentangling years of exposure at different age's category

DEPENDANT VARIABLE (HAZ Score)	[1]	[2]	[3]
Mothers Years of exposure in Utero district level exposure*	0.054 [0.034]	0.053 [0.037]	0.067 [.047]
Mothers Years of exposure at age 0-2 district level exposure*	0.023 [0.030]	0.021 [0.033]	0.016 [0.03]
Mothers Years of exposure at age 3-10 district level exposure*	-0.0005 [0.054]	0.0008 [0.051]	0.042 [0.06]
Mothers Years of exposure at age 11-17 district level exposure*	0.041 [0.027]	0.041 [0.026]	0.041 [0.024]
Mothers Years of exposure in Utero	-0.078*** [0.018]	-0.075*** [0.014]	-0.058* [0.031]
Mothers Years of exposure at age 0-2	-0.043** [0.0150]	-0.040* [0.018]	-0.047* [0.023]
Mothers Years of exposure at age 3-10	-.0062 [0.0407]	-0.0061 [0.040]	-0.019 [0.053]
Mothers Years of exposure at age 11-17	-0.012 [0.024]	-0.011 [0.023]	0.008 [0.016]
Treatment effect	0.16 [0.172]	0.165 [0.17]	0.22 [0.15]
Total savings of the mother	0.172 [0.245]	0.17 [0.23]	
Total number of assets	0.001 [0.044]	0.005 [0.053]	0.042 [0.040]

Access to a safe drinking water source	0.42 [0.303]	0.42 [0.29]	0.37 [0.25]
Household Size	-0.084* [0.040]	-0.087 [0.047]	
Mother is Literate	0.104 [0.36]		-0.23 [0.39]
Mother is Kpelle			0.15 [0.29]
The child is a first born			0.51* [0.24]
Mothers' age at the first born			0.001 [0.023]
Controls	**YES**	**YES**	**YES**
District level fixed effects	**YES**	**YES**	**YES**
Child year of birth fixed effects	**YES**	**YES**	**YES**
Number of observations	**328**	**328**	**279**
R^2	**0.1011**	**0.1007**	**0.1193**

Notes: Robust standard errors in [ ] clustered at the district level, * significant at 10%; ** significant at 5%; *** significant at 1%
Data Sources: Liberia MFS baseline and endline survey, 2012 and 2014