Detailed Geographic Information, Conflict Exposure, and Health Impacts*

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Abstract

We estimate the impact of exposure to conflict on health outcomes using geographic information on households' distance from conflict sites—a more accurate measure of shock exposure—and compare the impact on children exposed *in utero* versus after birth. The identification strategy relies on exogenous variation in the conflict's geographic extent and timing. Conflict-exposed children have lower height-for-age. Previous research finds that correcting for a household's wartime migration across regions leads to estimated negative impacts that are 13% larger. We find that using GPS information and taking into account how far the household is from the conflict leads to negative impacts of conflict exposure that are 2-3 times larger than if exposure is measured at the imprecise regional level. Results are robust to addressing endogenous migration.

Keywords: Child health; Conflict; Fetal origins hypothesis; Africa
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1. Introduction

Environmental and economic shocks experienced *in utero* and early childhood have been shown to be especially harmful not only because they affect health outcomes in the short-term but also because they influence health and economic outcomes in adulthood (see reviews by Strauss and Thomas, 2008; Currie and Vogl, 2013).[1] The possibility that early-life growth disturbances can affect future health outcomes is particularly relevant in sub-Saharan Africa, where armed conflict has occurred with greater frequency than in other regions of the world (Raleigh et al., 2010). Empirical assessment of the impacts of exposure to conflict on child health has recently started to receive attention in the literature.[2] A significant challenge in measuring impacts stems from the lack of detailed geographic information in most nationally representative surveys, which makes it difficult to identify children who are exposed to early life shocks.

This brief note builds on a previous assessment (Akresh et al., 2012) of the effects of the 1998-2000 Eritrea-Ethiopia conflict on subsequent health outcomes of children by using detailed geographic information on the location of households.[3] This geographic location data allows us to identify effects of conflict exposure more accurately than prior studies and importantly, serves as an opportunity to assess the implications of conducting such impact analyses with and without detailed geographic information. Most other research on *in utero* and early childhood exposure to

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[1] Research exploring the impact of shocks focuses on different adverse events such as malnutrition (Maluccio et al., 2009; Maccini and Yang, 2009), famine (Dercon and Porter, 2014), conflict (Bundervoet et al., 2009; Akresh et al., 2011; Mansour and Rees, 2012; Akbulut-Yuksel, 2014; Valente, 2015; Akresh, 2016), diseases (Almond, 2006; Bleakley, 2007; Bhalotra and Venkataramani, 2012), pollution (Currie et al., 2009), and natural disasters and extreme weather events (Currie and Rossin-Slater, 2013; Aguero, 2014; Caruso, 2014, 2017; Rosales-Rueda, 2014).

[2] Early research on conflict focuses on understanding the causes of war and its growth-reducing role (Collier and Hoeffler, 1998; Miguel et al., 2004; Harari and La Ferrara, 2013; Burke et al., 2015). The size of the long-term economic consequences of conflicts is debated in the literature (see Davis and Weinstein (2002) for Japan; Bellows and Miguel (2009) for Sierra Leone). Research also examines the relationship between conflict exposure and education (Akresh and de Walque, 2008; Miguel and Roland, 2011; Shemyakina, 2011; Swee, 2015).

[3] The 1998-2000 Eritrea-Ethiopia conflict was based on a land border dispute between the two countries. Eritrea, which was formerly a province of Ethiopia, became independent in 1993 following a long guerrilla conflict, but sections of the new border were never officially demarcated. Fighting began in May 1998 over these disputed areas, which have been described as desolate and inconsequential. Most of the conflict's casualties were soldiers, as civilians left the conflict areas, leaving the armies to fight over empty villages.

shocks generally focuses on variation in shock exposure at a larger regional level (Almond et al., 2012; Adhvaryu et al., 2016a; Adhvaryu et al., 2016b; Shah and Steinberg, 2017).

To identify the impact of conflict-related shocks, this paper utilizes Demographic and Health Survey (DHS) data from Eritrea and Ethiopia and makes use of variation in conflict exposure among children in survey households. The paper addresses the traditional difficulty in correctly classifying a child's exposure by using GPS data on the distance between survey villages and conflict sites. As opposed to the typical approach of comparing children in potentially large geographic regions that did and did not experience war, the GPS-based measure of conflict exposure that we use is more likely to capture the actual conflict exposure a child had. This prevents a meaningful amount of misclassification in children's exposure to shocks. For example in previous research (Akresh et al., 2012), in Eritrea, 24% of households within 100 kilometers (km) of conflict sites were previously coded as being in non-conflict regions. In Ethiopia, 28% of households within 100-300 km of conflict sites were previously coded as being in non-conflict regions and 2.2% of households that were more than 300 km from conflict sites were coded as being in a conflict region. As a result, there is a sizable difference in the estimated effects of conflict for some children; those in households residing closer to conflict sites have two to three times larger negative impacts on height-for-age Z-scores than what is estimated if the less precise regional measures of exposure is used.[4]

Taken as a whole, our findings indicate a significant underestimation of the impacts on the height-for-age Z-scores of children who resided in places that were most affected by the

[4] The distinction between region and GPS-based measures of conflict exposure is the key differences between this paper and the most closely related prior work by Akresh et al. (2012). While previous research found that correcting for a household's war-time migration across regions led to estimated negative impacts that are 13% larger, we find that taking into account how far the household is from the conflict leads to negative impacts of conflict exposure that approximately double in magnitude in Eritrea and triple in Ethiopia. Due to data limitations, it is not possible to correct for both wartime migration across regions and GPS distance to the conflict, but it is clear that the GPS correction is substantially larger.

Eritrea-Ethiopia conflict. Based on the average number of months that children were exposed to the conflict, results using the region-based measure indicate overall reductions of 0.73 and 0.26 standard deviations in Eritrea and Ethiopia, respectively. Classifying conflict exposure based on GPS distance from conflict sites reveals that children nearest to the fighting suffered even larger effects (1.37 and 0.76 standard deviations in Eritrea and Ethiopia, respectively), and the negative impacts diminished as distance from the conflict increased. These results highlight the importance of measuring exposure to shocks with detailed geographic information rather than region-based indicators.[5] Despite the specific context of the Eritrea-Ethiopia conflict, the results offer important insights on the implications of different ways of classifying exposure to conflicts as well as other shocks. As a greater number of surveys begin to collect GPS data, studies of the impacts of such shocks should account for the possibility that impacts will differ based on the way in which researchers define exposure.

2. Background on the Eritrean-Ethiopian Conflict

The Eritrean-Ethiopian conflict lasted two years and began due to a border dispute.[6] The fighting that occurred during the conflict was in the three border areas of Badme, Tsorona-Zalambessa, and Bure (see Figure 1 for a regional map of Eritrea and Ethiopia highlighting these areas). Both countries claimed sovereignty over these areas. The conflict officially began in May 1998 in the Badme area, which was then under Ethiopian control. Both countries subsequently spent substantial funds to grow their armies, augment their military equipment, and fortify their borders. The conflict ended in December 2000 after a peace agreement was signed.[7] The exact

[5] This paper also contributes to the literature on the health effects of shocks experienced *in utero* versus during early childhood. Results indicate that the magnitude of the negative height effects during both critical periods (*in utero* and after birth) is similar in size.
[6] Human Rights Watch (2003) and Akresh et al. (2012) provide additional background details about the conflict.
[7] For the analysis in this paper, we treat this as the date the war ended, but results are consistent if we use June 2000, the date when the Cessation of Hostilities agreement was signed, as the time when the war ended.

timing and location of the violence plays a key role in our empirical strategy for identifying the effects of the conflict on child health. Specifically, conflict intensity was greatest near three locations (Badme, Tsorona-Zalambessa, and Bure) along the border between Eritrea and Ethiopia. Locations far from these three border areas experienced little or no fighting.[8]

3. Data

3.1 Demographic and Health Surveys: Eritrea (2002), Ethiopia (2000 and 2005)

Our analyses make use of three waves of DHS data from Eritrea and Ethiopia. The data are nationally representative cross-sectional surveys that gather information on demographic topics of mothers and young children. The 2002 Eritrea DHS collected detailed information on the date of birth, GPS location, and height of 5,139 children under five born before, during, or after the conflict. The 2000 Ethiopia DHS collected similar information for 9,619 children under five, all of whom were born before or during the conflict. To have children in the conflict regions of Ethiopia who were not exposed to conflict, we use the 2005 Ethiopia DHS that has information for 4,217 children under five. Our analyses rely on DHS data on children's health outcomes (described below) and geographical information on their residence at the time of the survey.

3.2 Health Outcomes

Since child height (conditional on age and gender) can be sensitive to past growth failures due to malnutrition or illness, it is generally accepted as a good way to capture long-term health disturbances (World Health Organization, 1995). Using height information from the DHS for children 0-60 months old, we compute Z-scores for each child's height-for-age, where the Z-score is defined as the difference between the child's height and the mean height of the same-aged international reference population divided by the reference population's standard deviation.

[8] While exact figures of the number of casualties due to the conflict are difficult to ascertain, most estimates of the total number of fatalities, mainly among soldiers, range from 70,000-100,000 (Human Rights Watch, 2003).

3.3 Measures of Conflict Exposure

We construct three measures of a child's exposure to the Eritrea-Ethiopia conflict. ***Region-based measure***: this is defined at the region-birth cohort level and is a continuous measure of the number of months of conflict exposure. This allows us to exploit variation across two dimensions: spatial (variation across regions in exposure to the conflict) and temporal (within a given region, the timing of whether a child was *in utero* or early childhood during the conflict period). Specifically, we use information on a child's region of residence and date of birth to calculate the number of months the child was exposed to the conflict *in utero* (defined as 9 months prior to the date of birth) and the number of months a child was exposed to the conflict after birth. The exposure measure is set to zero months if the child resided in a region not affected by the conflict. As discussed in Section 2, the fighting took place in the border areas near Badme, Tsorona-Zalambessa, and Bure, so in Eritrea, the conflict regions are defined as Gash Barka, Debub, and Debubawi Keyih Bahri, while in Ethiopia they are Tigray and Afar.

GPS-based measure: To address potential misclassification of children as "conflict-exposed" simply because they live in a region that experienced fighting (regardless of the proximity of their village to conflict sites) or as "not conflict-exposed" simply because they live in a non-conflict region (even if their village is near to conflict sites), we define two GPS-based conflict exposure measures. First, we calculate a continuous measure of relative proximity to conflict sites using the distance from each survey village to the nearest conflict site.[9] Second, we define conflict exposure based on categorical distance bands of less than 100km, 100-200 km, 200-300 km, and greater than 300 km. In creating these proximity measures, we use distance to

[9] We define relative proximity as the maximum distance in that country from a conflict site minus the household's actual distance to the nearest conflict site divided by 100. The survey village in the data that is closest to a conflict site is 17 kilometers away. To be clear, in the survey villages no fighting took place, but the conflict measure captures proximity to conflict battles that occurred in the border areas between Ethiopia and Eritrea.

the nearest conflict site even if it crosses region boundaries. Each distance measure is interacted with the number of months of exposure to create the two GPS-based conflict exposure measures.

4. Empirical Identification Strategy

We examine how height-for-age Z-scores of children vary as a function of different durations of exposure to the conflict and variation in the degree to which their area of residence was affected by the conflict. We first estimate the following regression using a region-based measure of conflict exposure:

(1) $HAZ_{ijt} = \alpha_j + \delta_t + \beta_1 Total\ Months\ War\ Exposure\ by\ Region_{ijt} + \beta_2 X_{ijt} + \gamma_{jt} + \varepsilon_{ijt}$

where HAZ_{ijt} is the height-for-age Z-score for child *i* in region *j* who was born in period *t*, α_j are region fixed effects, and δ_t are year of birth cohort fixed effects. *Total Months of War Exposure by region*$_{ijt}$ measures the total number of months a child was alive or *in utero* during the conflict and living in a conflict region (it equals zero for children in regions unaffected by the conflict). ε_{ijt} is a random, idiosyncratic error term. The regressions include household and individual level controls (X_{ijt}), such as child gender and household head schooling. To address the potential for differential time trends in height-for-age Z-scores across regions, the regressions also include region-specific time trends (γ_{jt}). The coefficient β_1 measures the effect of an additional month of conflict exposure on children's height-for-age Z-scores. Identification of the effect of conflict in this model comes from variation in the duration of exposure (conditional on adjustments for age cohort effects) rather than a simple comparison of conflict and non-conflict regions.

Building on Equation (1), we also estimate the following regression to gauge whether conflict impact differs by exposure *in utero* and after birth:

(2) $$HAZ_{ijt} = \alpha_j + \delta_t + \beta_1 Months\ War\ Exposure\ In\ Utero_{ijt} + \beta_2 Months\ War\ Exposure\ After\ Birth_{ijt} + \beta_3 X_{ijt} + \gamma_{jt} + \varepsilon_{ijt}$$

where *Months War Exposure In Utero*$_{ijt}$ measures the number of months a child was *in utero* during the war period and living in a conflict region and *Months War Exposure After Birth*$_{ijt}$ measures the number of months a child was alive during the war and living in a conflict region.

Finally, we estimate the effect of each additional month of exposure to the conflict using categorical and continuous measures of proximity to conflict sites based on the GPS coordinates of the survey villages and the conflict sites:

(3) $HAZ_{ijt} = \alpha_j + \delta_t + \beta_1(Total\ Months\ War\ Exposure\ 0-100km)_{ijt}$

$$+\beta_2(Total\ Months\ War\ Exposure\ 100-200km)_{ijt}$$

$$+\beta_3(Total\ Months\ War\ Exposure\ 200-300km)_{ijt}$$

$$+\beta_4 X_{ijt} + \gamma_{jt} + \varepsilon_{ijt}$$

(4) $HAZ_{ijt} = \alpha_j + \delta_t + \beta_1 Total\ Months\ War\ Exposure\ by\ Proximity_{ijt}$

$$+\beta_2 X_{ij} + \gamma_{jt} + \varepsilon_{ijt}$$

where *Total Months War Exposure by Proximity* measures the number of months a child was alive or *in utero* during the war by proximity from conflict sites, *Total Months War Exposure 0-100km* measures the number of months a child was alive or *in utero* during the war and living within 0-100km from conflict sites. The other categorical exposure variables are defined similarly but for different distances from conflict sites, and those residing more than 300km from conflict sites are the reference group.[10]

[10] For both the region and GPS-based exposure measures, there is a possibility of bias due to children residing in a different location at the time of the survey from their residence during the war. We address this issue for each of the three exposure measures. First, for the region-based measure, we estimate alternative regressions in which all children from households that reported having lived during the conflict in a different location than their current village are reclassified as having resided in a conflict region during the conflict. This is a conservative approach to dealing with the bias due to endogenous migration as some children who moved during the conflict and currently reside in a non-war region might have been living in another non-war region during the war. This procedure involves reclassifying 10.9% and 5.9% of children in Eritrea and Ethiopia, respectively. In Eritrea (but not Ethiopia), we also have data on the region of residence at the time of the conflict, and we can tell that only 3.9% of children should have been reclassified instead of 10.9%. Second, for the GPS-based categorical measure, the child's place of

5. Empirical Results (*War Region and Geospatial Location*)

Table 1 presents our main results for Ethiopia (columns 1-3) and Eritrea (columns 4-6) comparing the region and GPS-based exposure measures.[11] Columns 1 and 4 estimate Equation 1 and show that for children exposed to the conflict *in utero* or after birth, each additional month of exposure using the region-based measure results in a significant reduction of height-for-age Z-scores (by 0.017 in Ethiopia and 0.039 in Eritrea). Given the average duration of conflict exposure for children in each country, this equates to reductions of 0.23 and 0.73 in the Z-scores of children residing in war regions in Ethiopia and Eritrea.

In columns 2 and 5, we estimate Equation 3 in which we define households' proximity to conflict sites using categorical GPS distance bands. The results indicate that exposure at any distance within 300 km of conflict sites (relative to the reference group of children living more than 300 km from conflict sites) is negatively related to child outcomes. Importantly, results also show that within 300 km of conflict sites there is a decreasing gradient in the effect of conflict as a function of distance from conflict sites, with those children living within 0-100 km of the conflict sites experiencing larger negative impacts of conflict exposure. For those children closest to the conflict sites (within 100km), negative impacts are three times larger in Ethiopia and two times larger in Eritrea compared to the less precise region-based exposure measures.

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residence is based on the *potential* residence at the time of the war, whereby any child who moved during the war is reassigned to the closest distance category (0-100 km) regardless of residence at the time of the survey. We adopt this extremely strong assumption because the DHS survey only provides the migration data at the region level. Third, for the GPS-based continuous proximity measure, the child's place of residence is based on the *potential* residence at the time of the war, whereby any child who moved during the war is assumed to have been living at a conflict site. This implies that we assign the migrant child a distance of 0 kilometers to the conflict site and that the proximity measure will attain its largest possible value for these children. In Eritrea and Ethiopia, respectively, 15 and 18 percent of the children in the sample were re-assigned a distance to the conflict site of zero kilometers.

[11] In all regressions, we include child age and region fixed effects, region-specific time trends, DHS round fixed effects (for Ethiopia), child gender, and the following household characteristics: household head's gender, age, years of schooling, mother's height, household size, number of children in the household under age 5, and whether the household resides in an urban area. Correlation among the error terms of children living in the same local area and experiencing similar health shocks might bias the OLS standard errors downward, so in all regressions we cluster the standard errors by enumeration area, which corresponds to local clusters of villages (Moulton, 1986).

When we estimate Equation 4 (columns 3 and 6), we find that each additional month of conflict exposure *in utero* or after birth for children living in close proximity to the conflict sites is associated with a Z-score reduction of 0.004 per km of added proximity in Ethiopia and 0.015/km in Eritrea. Since the mean proximity index among children residing less than 100 km from conflict sites is 9.98 in Ethiopia and 3.19 in Eritrea, *each* additional month of exposure for a child with the average proximity index living within 100 km of the conflict sites led to a Z-score reduction of 0.040 and 0.048 in Ethiopia and Eritrea, respectively. If these children were exposed for the mean conflict duration, they would suffer overall Z-score reductions of 0.619 and 0.901 standard deviations in Ethiopia and Eritrea, respectively. These results underscore the importance of geographical data for illuminating the effects of conflict and accurately measuring the size of these effects.

Another important result pertains to the distinct effect of exposure to the conflict *in utero* as opposed to early childhood. Results in Table 2 columns 1 and 4 show that in both Ethiopia and Eritrea, we find that the effects of exposure after birth (measured at the region-level) are larger (reductions in the Z-scores of 0.019 and 0.047 for each month of exposure in Ethiopia and Eritrea, respectively), although we cannot reject equality in Eritrea. In Ethiopia, there is no statistically significant effect on height-for-age Z-scores of *in utero* exposure to conflict. In contrast, in Eritrea, *in utero* exposure does result in a significant reduction of Z-scores by 0.034 for each month of exposure.

Regressions in columns 2 and 5 in Table 2 use the GPS-based categorical measure of conflict exposure. In columns 3 and 6, we use the GPS-based continuous measure. We separately examine the effect of exposure *in utero* and after birth. Results indicate that in the areas closer to conflict sites, exposure in both periods result in negative impacts on height-for-age Z-scores.

Importantly, results for both *in utero* and after birth exposure are also considerably larger in magnitude than the region-based measures. This is true in both Ethiopia and Eritrea. Effects of exposure *in utero* and after birth are roughly comparable in magnitude.

In Appendix Tables 1 and 2, we present the results from addressing the issue that children's residence at the time of the survey might not reflect their residence during the conflict. When conflict exposure is classified based on the child's potential residence at the time of the conflict, the effects on height-for-age Z-scores continue to be statistically significant and remain similar in magnitude, indicating our results are robust to an extremely conservative adjustment for migration during the conflict.

6. Conclusion

This note highlights the differences in using region-based and GPS-based measures of conflict exposure on the medium-term health consequences of the Eritrea-Ethiopia conflict. The findings show large negative effects on the height-for-age Z-scores of children exposed to the conflict. Since children and households in a number of other resource-limited settings, particularly in Africa, have been exposed to conflicts that feature internal displacement and disruptions of health services, this paper has relevance for the larger literature on the medium- and long-term effects of armed conflicts.

The empirical methods used in this paper overcome several challenges to identifying the causal effect of conflict exposure. We classify children's conflict exposure based on the geographical coordinates of their residence. We also compare children exposed to the conflict for varying durations and at different stages (*in utero* and after birth). We find the effects of *in utero* and after birth exposure to the conflict are similar in magnitude. Focusing on the estimates of children's conflict exposure based on GPS distance from conflict sites indicates that the Eritrea-

Ethiopia conflict led to overall reductions of 0.76 to 1.37 standard deviations (approximately 1 to 2 inches) in Ethiopia and Eritrea, respectively, and the impact was less substantial as distance from conflict sites increased. These effect sizes of conflict exposure based on the distance from conflict sites are approximately two to three times larger (for Eritrea and Ethiopia, respectively) than the effect sizes of conflict exposure defined on the basis of politically demarcated subnational units, which is the standard approach taken in much of the research that examines the impacts of exposure to shocks. Future research focusing on exposure to conflict, as well as other types of early-life disturbances, can work to better incorporate currently available GPS data that can be linked to individual survey data to determine how much exposure misclassification affects the magnitudes of the effect sizes (Bruck et al, 2013).

As height-for-age Z-scores are important health indicators of children and are associated with health and employment outcomes later in life, the results in this paper offer insight on the likely long-term effects of conflicts. Using available estimates of the effect of early childhood height on school attainment and wages, the results in this paper suggest that the conflict may lead to reductions in adult wages of about 8% and 14% in Ethiopia and Eritrea, respectively.[12]

From a policy standpoint, these results suggest that accurately measuring shock exposure may lead to significantly different estimations for the full economic cost of these type of events and affect the cost-benefit analysis of any potential alleviation policy. This issue not only affects the estimation of the impact of wars but also may be relevant when analyzing other aggregate shocks such as climate and political shocks.

[12] We base this rough back-of-the-envelope calculation on the estimate that a one standard deviation reduction in height correlates with 0.678 fewer grades completed in Zimbabwe (Alderman et al., 2006) and that the return to an extra year of school in Ethiopia is 15% (Krishnan et al., 1998).

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Figure 1: Eritrea and Ethiopia Regional Map Indicating Conflict Sites

Notes: The main fighting between Eritrea and Ethiopia occurred around the areas of Badme, Tsorona-Zalambessa, and Bure, which are noted on the map. Map source: Constructed by Leonardo Lucchetti and Rafael Garduño-Rivera in ArcGIS.

Table 1: Impacts of War Exposure on Children's Height-for-age Z-score

Dependent Variable: Height-for-age Z-score	Ethiopia			Eritrea		
	(1)	(2)	(3)	(4)	(5)	(6)
Total Months of War Exposure (by region)	-0.017*** [0.005]			-0.039*** [0.007]		
Total Months of War Exposure (0-100 km)		-0.049*** [0.012]			-0.073*** [0.022]	
Total Months of War Exposure (100-200 km)		-0.033** [0.016]			-0.059*** [0.008]	
Total Months of War Exposure (200-300 km)		-0.015* [0.009]			-0.056*** [0.008]	
Total Months of War Exposure (by relative proximity)			-0.004*** [0.001]			-0.015*** [0.002]
Observations	13,836	13,836	13,836	5,139	5,139	5,139
P-value testing equality between distance variables:						
0-100 km = 200-300 km		0.013			0.468	
0-100 km = 100-200 km		0.403			0.568	
100-200 km = 200-300 km		0.294			0.708	

Notes: Robust standard errors in brackets, clustered at the enumeration level. * significant at 10%, ** significant at 5%, and *** significant at 1%. All specifications include child age fixed effects, region fixed effects, region-specific time trends, DHS round fixed effects (for Ethiopia), child gender, and controls for household characteristics (noted in the text). Columns 1-3 measure outcomes for children from Ethiopia while columns 4-6 measure outcomes for children from Eritrea. In columns 1 and 4 "Total months of war exposure (by region)" measures the number of months a child was alive or *in utero* during the war period and living in a war region. The war regions in Ethiopia are Tigray and Afar. The war regions in Eritrea are Gash Barka, Debub, and Debubawi Keyih Bahri. In columns 2 and 5, "Total months of war exposure (by distance bands)" measures the number of months a child was alive or *in utero* during the war period and living within 0-100 km, 100-200 km, 200-300 km, or more than 300 km respectively from conflict sites. The reference group is children living more than 300 km from conflict sites. In columns 3 and 6 "Total months of war exposure (by relative proximity)" measures the number of months a child was alive or *in utero* during the war period by proximity to conflict sites. Proximity is defined as the maximum distance in that country from a conflict site minus the household's actual distance to the nearest conflict site divided by 100. The child's place of residence is based on the residence at the time of the survey. Data source: 2002 Eritrea and 2000 and 2005 Ethiopia Demographic and Health Surveys.

Table 2: Impacts of War Exposure on Children's Height-for-age Z-score, by Timing of Exposure

Dependent Variable: Height-for-age Z-score		**Ethiopia**			**Eritrea**	
	(1)	(2)	(3)	(4)	(5)	(6)
Months of War Exposure *In Utero* (by region)	0.009			-0.034***		
	[0.013]			[0.004]		
Months of War Exposure After Birth (by region)	-0.019***			-0.047***		
	[0.005]			[0.004]		
Months of War Exposure *In Utero* (0-100 km)		-0.036**			-0.073***	
		[0.017]			[0.026]	
Months of War Exposure *In Utero* (100-200 km)		-0.017			-0.060***	
		[0.024]			[0.010]	
Months of War Exposure *In Utero* (200-300 km)		-0.016			-0.058***	
		[0.012]			[0.009]	
Months of War Exposure After Birth (0-100 km)		-0.055***			-0.072**	
		[0.013]			[0.029]	
Months of War Exposure After Birth (100-200 km)		-0.040**			-0.059***	
		[0.016]			[0.010]	
Months of War Exposure After Birth (200-300 km)		-0.014			-0.053***	
		[0.009]			[0.010]	
Months of War Exposure *In Utero* (by relative proximity)			-0.003**			-0.021***
			[0.001]			[0.003]
Months of War Exposure After Birth (by relative proximity)			-0.004***			-0.011***
			[0.001]			[0.003]
Observations	13,836	13,836	13,836	5,139	5,139	5,139
P-value testing equality between distance variables:						
0-100 km (*in utero*) = 200-300 km (*in utero*)		0.293			0.575	
0-100 km (*in utero*) = 100-200 km (*in utero*)		0.496			0.621	
100-200 km (*in utero*) = 200-300 km(*in utero*)		0.965			0.876	
0-100 km (after birth) =200-300 km(after birth)		0.004			0.510	
0-100 km (after birth) =100-200 km(after birth)		0.459			0.670	
100-200 km(after birth)=200-300 km(after birth)		0.134			0.584	

Notes: Robust standard errors in brackets, clustered at the enumeration level. * significant at 10%, ** significant at 5%, and *** significant at 1%. All specifications include child age fixed effects, region fixed effects, region-specific time trends, DHS round fixed effects (for Ethiopia), child gender, and controls for household characteristics (noted in the text). In columns 1 and 4 "Months of war exposure *in utero* (by region)" measures the number of months a child was *in utero* during the war period and living in a war region. "Months of war exposure after birth (by region)" measures the number of months a child was alive during the war period and living in a war region. The war regions in Ethiopia are Tigray and Afar. The war regions in Eritrea are Gash Barka, Debub, and Debubawi Keyih Bahri. In columns 2 and 5, "Months of war exposure *in utero* (by distance bands)" measures the number of months a child was *in utero* during the war period and living within 0-100 km, 100-200 km, 200-300 km, or more than 300 km respectively from conflict sites. "Months of war exposure after birth (by distance bands)" measures the number of months a child was alive during the war period and living within 0-100 km, 100-200 km, 200-300 km, or more than 300 km respectively from conflict sites. The reference group is children living more than 300 km from conflict sites. In columns 3 and 6 "Months of war exposure *in utero* (by relative proximity)" measures the number of months a child was *in utero* during the war period by proximity to conflict sites. "Months of war exposure after birth (by relative proximity)" measures the number of months a child was alive during the war period by proximity to conflict sites. Proximity is defined as the maximum distance in that country from a conflict site minus the household's actual distance to the nearest conflict site divided by 100. Data source: 2002 Eritrea and 2000 and 2005 Ethiopia Demographic and Health Surveys.

Online Appendix Tables

Table A.1: Impacts of War Exposure on Children's Height-for-age Z-score, Based on Potential Residence at the Time of the War

Dependent Variable: Height-for-age Z-score	Ethiopia			Eritrea		
	(1)	(2)	(3)	(4)	(5)	(6)
Total Months of War Exposure (by region)	-0.014***			-0.040***		
	[0.004]			[0.007]		
Total Months of War Exposure (0-100 km)		-0.010**			-0.090***	
		[0.005]			[0.015]	
Total Months of War Exposure (100-200 km)		-0.013			-0.054***	
		[0.008]			[0.007]	
Total Months of War Exposure (200-300 km)		-0.004			-0.045***	
		[0.005]			[0.007]	
Total Months of War Exposure (by relative proximity)			-0.003***			-0.007***
			[0.001]			[0.002]
Observations	13,836	13,836	13,836	5,139	5,139	5,139
P-value testing equality between distance variables:						
0-100 km = 200-300 km		0.297			0.001	
0-100 km = 100-200 km		0.761			0.012	
100-200 km = 200-300 km		0.336			0.069	

Notes: Robust standard errors in brackets, clustered at the enumeration level. * significant at 10%, ** significant at 5%, and *** significant at 1%. All specifications include child age fixed effects, region fixed effects, region-specific time trends, DHS round fixed effects (for Ethiopia), child gender, and controls for household characteristics (noted in the text). Columns 1-3 measure outcomes for children from Ethiopia while columns 4-6 measure outcomes for children from Eritrea. In columns 1 and 4, the child's place of residence is based on the *potential* region of residence at the time of the war, whereby any child who moved during the war is reassigned to a war region regardless of residence at the time of the survey. This is a conservative approach to dealing with the bias due to endogenous migration as some children who moved during the war and currently reside in a non-war region might have been living in another non-war region during the war. In columns 2 and 5, the child's place of residence is based on the *potential* residence at the time of the war, whereby any child who moved during the war is reassigned to the closest distance category (0-100 km) regardless of residence at the time of the survey. In columns 3 and 6, the child's place of residence is based on the *potential* residence at the time of the war, whereby any child who moved during the war is assumed to have been living at a conflict site. This implies that the migrant child is assigned a distance of 0 kilometers to the conflict site and that the proximity measure will attain its largest possible value for these children. “Total months of war exposure” variables are defined as in Table 1. Data source: 2002 Eritrea and 2000 and 2005 Ethiopia Demographic and Health Surveys.

Table A.2: Impacts of War Exposure on Children's Height-for-age Z-score, by Timing of Exposure, Based on Potential Residence at the Time of the War

Dependent Variable: Height-for-age Z-score	**Ethiopia**			**Eritrea**		
	(1)	(2)	(3)	(4)	(5)	(6)
Months of War Exposure *In Utero* (by region)	0.001			-0.033***		
	[0.010]			[0.008]		
Months of War Exposure After Birth (by region)	-0.015***			-0.050***		
	[0.004]			[0.009]		
Months of War Exposure *In Utero* (0-100 km)		-0.009			-0.082***	
		[0.011]			[0.025]	
Months of War Exposure *In Utero* (100-200 km)		-0.001			-0.061***	
		[0.012]			[0.010]	
Months of War Exposure *In Utero* (200-300 km)		0.003			-0.051***	
		[0.024]			[0.009]	
Months of War Exposure After Birth (0-100 km)		-0.011**			-0.088***	
		[0.005]			[0.017]	
Months of War Exposure After Birth (100-200 km)		-0.014			-0.048***	
		[0.008]			[0.009]	
Months of War Exposure After Birth (200-300 km)		-0.004			-0.040***	
		[0.005]			[0.009]	
Months of War Exposure *In Utero* (by relative proximity)			-0.002			-0.020***
			[0.001]			[0.003]
Months of War Exposure After Birth (by relative proximity)			-0.003***			-0.005***
			[0.001]			[0.002]
Observations	13,836	13,836	13,836	5,139	5,139	5,139
P-value testing equality between distance variables:						
0-100 km (*in utero*) = 200-300 km (*in utero*)		0.611			0.212	
0-100 km (*in utero*) = 100-200 km (*in utero*)		0.562			0.399	
100-200 km (*in utero*) = 200-300 km(*in utero*)		0.872			0.312	
0-100 km (after birth) =200-300 km(after birth)		0.220			0.002	
0-100 km (after birth) =100-200 km(after birth)		0.777			0.012	
100-200 km(after birth)=200-300 km(after birth)		0.285			0.096	

Notes: Robust standard errors in brackets, clustered at the enumeration level. * significant at 10%, ** significant at 5%, and *** significant at 1%. All specifications include child age fixed effects, region fixed effects, region-specific time trends, DHS round fixed effects (for Ethiopia), child gender, and controls for household characteristics (noted in the text). Children’s *potential* place of residence is defined as in Table A.1. “Months of war exposure *in utero*” and “Months of war exposure after birth” variables are defined as in Table 2. Data source: 2002 Eritrea and 2000 and 2005 Ethiopia Demographic and Health Surveys.