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Early childhood health during conflict: The legacy of the Lord's Resistance Army in Northern Uganda

by

Sarah Bridges and Douglas Scott

Abstract

This study finds evidence of irreversible health deficits amongst young children who were exposed to the Lord's Resistance Army insurgency in Northern Uganda (1987-2007). The causal effect of the conflict is found to be a 0.65 standard deviation fall in height-for-age z-scores amongst children exposed for a period of more than six months. In contrast, the health impacts of shorter periods of exposure are found to be relatively minimal. These findings highlight the need for a swift resolution to conflict, in particular where it impacts heavily upon civilian populations, without which, the health consequences of protracted wars may extend far beyond the current generation.

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Sarah Bridges and Douglas Scott

Outline

The Authors

Corresponding Author: douglas.scott1@nottingham.ac.uk

Sarah Bridges (sarah.bridges@nottingham.ac.uk) and Douglas Scott are respectively Associate Professor and Teaching Fellow at the University of Nottingham, School of Economics.

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1 Introduction

Few conflicts on the continent of Africa have gained as much notoriety as the twenty-year war fought between the government forces of Uganda and the Lord's Resistance Army (LRA). Under the leadership of the self-proclaimed spiritual medium Joseph Kony, the shockingly brutal tactics employed by the LRA against the civilian population drew international condemnation. Although attempts have been made to analyse the post-war recovery of those caught up in the conflict (Blattman, 2009; Blattman and Annan, 2010; Bozzoli and Brück, 2010; Adelman and Peterman, 2014; Fiala, 2015), there exists no direct study of the impact of the war on the physical health of the civilian population. This paper exploits spatial and temporal variation in the spread of the conflict to measure the causal effect of the war on the health outcomes of children living in the affected districts. Evidence is found of irreversible health deficits for children exposed to the conflict for a period of more than 6 months, with children in this group experiencing an average shortfall in height-for-age z-scores of 0.65 standard deviations. In contrast, however, there is no evidence of significant height deficits amongst those exposed to the fighting for shorter periods of time. These results are found to be robust to alternative samples, aimed at addressing potential sources of bias, and alternative definitions of conflict exposure, with a similar pattern of results also observed in other anthropometric measures of health status. Given potential links between early childhood health and outcomes in later life (Strauss and Thomas, 2007), the deficits experienced by these children are likely to impact the economic prospects of war-affected regions for many years to come.[1]

The remainder of this section presents a review of the relevant literature to which this study contributes. Section 2 provides a brief history of the LRA conflict which took

[1] See Alderman et al. (2006) on malnutrition in Zimbabwe and completed grades of education, Maccini and Yang (2009) on the impact of rainfall shocks on health, education and asset wealth in Indonesia, and Dercon and Porter (2014) on the long-run health and income effects experienced by survivors of the 1984 Ethiopian famine.

place in northern Uganda, while a description of the data used, and the characteristics of the sample, can be found in Section 3. The empirical strategy employed to estimate the causal effect of the conflict on health outcomes is outlined in Section 4, with the main results of this analysis reported in Section 5. A comprehensive study of robustness and potential sources of heterogeneity can be found in Section 6 and 7, before a summary of the key findings and concluding remarks are presented in Section 8.

1.1 Previous Studies

This paper makes a contribution to three specific strands of the literature. Firstly, the analysis adds to the growing number of studies which endeavour to quantify the impact of conflict on early childhood health. For example, Bundervoet et al. (2009) provide evidence of a cumulative effect of exposure to the 1993-2005 Burundian civil war on a sample of children aged between 6 months and 5 years. Each additional month of exposure to the war is found to decreases children's height-for-age z-scores by 0.047 standard deviations, with an average differential between exposed and non-exposed children of -0.348 to -0.525. Akresh et al. (2012b) use a similar methodology to estimate the effect of the 1998 Eritrean-Ethiopian war on children's health, yielding comparable results. Their findings indicate that children alive during the war, and living in a war-affected region, would be between 0.447 and 0.454 standard deviations shorter than those who were not exposed to the conflict. More recently, Minoiu and Shemyakina (2014) show similar results for children exposed to the 2002-2007 civil war in the Côte d'Ivoire.[2]

Secondly, these results contribute to the literature looking specifically at the effects of the LRA insurgency in northern Uganda. Amongst these studies, Blattman and Annan (2010) analyse the labour market outcomes of children who were previously

[2]Other notable contributions on the impact of conflict on children's health can be found in Akresh et al. (2011), which covers the civil war preceding the 1994 Rwandan genocide, Shemyakina (2017), in relation to politically motivated violence in Zimbabwe, and Akresh et al. (2012a) who focus on the height deficits of adults born during the Nigerian civil war of 1967-1970.

abducted by the rebels to serve as child-soldiers.[3] The authors estimate the loss of human capital from time spent away from education and employment, coupled with the psychological distress of increased exposure to violence, led to 33% lower wages for former abductees. Much attention has also been given to the economic consequences of the widespread displacement caused by the conflict. For example, Fiala (2015) finds evidence of a negative impact on both consumption and asset wealth amongst previously displaced households, with only wealthier households showing later signs of recovery. In another analysis of conflict-driven displacement, Adelman and Peterman (2014) find that resettled households experienced significant losses in access to agricultural land upon return to their former locations. Evidence also exists of less tangible impacts of the LRA conflict. For example, Rohner et al. (2013) find an increase in ethnic identity following the fighting, hampering economic recovery in more fractionalised communities, while Bozzoli et al. (2011) show that exposure to the conflict reduces individual's expectations of their future life situation and economic prosperity. Links have also been found between exposure to violence and increased political participation amongst ex-combatants (Blattman, 2009), although this may only take place locally, as a response to the immediate needs placed upon communities, rather than as a result of an increased concern over politics at the national level (De Luca and Verpoorten, 2015).

Finally, this study contributes to the literature on gender bias in childhood health outcomes and the potential for heterogeneity in the impact of negative shocks. For example, Baird et al. (2011) analyse a sample of 59 low-income countries and find relatively higher infant mortality amongst female children in response to fluctuations in per-capita GDP, while Rose (1999) finds that positive rainfall shocks increase the probability of survival for girls in rural India (relative to male children). There is, however, little evidence of a gender bias in the small number of papers that specifically

[3]It is estimated that between 60,000 and 80,000 children and young adults were abducted during the conflict, mostly from the northern, Acholi districts, which were formerly Kitgum and Gulu (Blattman and Annan, 2010).

address childhood health outcomes in response to conflict shocks. For example, Minoiu and Shemyakina (2014) uncover no evidence of significant heterogeneity in height-for-age z-scores of male and female children who were exposed to conflict in Côte d'Ivoire. Similarly, Akresh et al. (2011) do not find evidence of a gender bias as a result of the Rwandan civil war, in spite of a clear bias towards male children in response to crop failures in other parts of the country. A more recent study by Dagnelie et al. (2018) does find lower survival rates among female children during the 1997-2003 civil war in the Democratic Republic of Congo. However, the authors attribute this to an adverse selection effect, driven by the lower probability of survival for male children in utero, rather than a gender bias influencing their subsequent survival prospects.

2 The War in Northern Uganda

As with many other violent disputes in East Africa, the origins of Uganda's LRA conflict can be traced to the long-standing political and ethnic divisions within the country. Historically, Uganda was divided between the predominantly Bantu South, and the Nilotic (Nilo-Hamitic) and Central Sudanic people of the North and Northwest (Rohner et al., 2013). Following independence from British rule in 1962, the North provided the majority of Uganda's military power, paving the way for a series of brutal Northern dictatorships, which would serve to concentrate political power within the hands of those loyal to the current head of state. In 1986 this dominance ended with the defeat of the de facto government forces (largely comprised of the Northern Acholi and Langi ethnic groups) by the National Resistance Army (NRA) led by Yoweri Museveni, a Southerner and veteran of the campaign which ousted the notorious dictator Idi Amin (Allen, 2013). Following the NRA victory, defeated Northern soldiers retreated back to their homelands, with many crossing the border into southern Sudan. From the remnants of these forces a number of armed resistance groups initially formed in opposition to the new government. By 1988 most of these groups had either signed peace agreements with Museveni's government or been defeated by forces loyal to the new regime. The decision to stop fighting was not unanimous, however, and a small number of soldiers, who were unwilling to accept the outcome of peace negotiations, gathered under the leadership of Joseph Kony, in what would become the Lord's Resistance Army (Allen, 2013).

Kony belonged to the Acholi ethnic group and it was the districts of Gulu and Kitgum (known as Acholi-land) which would initially become the centre of the LRA insurgency.[4] There existed little local support for the poorly financed rebel group prior to 1995, making them almost entirely reliant on the abduction and forced conscription of civilians (often children) to maintain their numbers (Blattman, 2009). Although the LRA's stated aim was to overthrow the Ugandan government, increasing Kony began to target civilian populations, proclaiming that Acholi society must be 'purified' to overcome its oppressors (Doom and Vlassenroot, 1999; Allen, 2013). Following an initially slow campaign, the number of violent attacks started to escalate in 1995, when the LRA received support from the Sudanese government, in the form of arms, provisions and land to establish bases in southern Sudan (Dolan, 2009). Attacks on civilians increased notably during this period, occurring seemingly at random, and with overwhelming brutality (Doom and Vlassenroot, 1999; Blattman and Annan, 2010). Many of the rural inhabitants of Acholi-land and neighbouring districts sought protection closer to local towns or military outposts and from 1996 the government began forcibly relocating the

[4]These two districts were later subdivided into seven districts (Amuru, Nwoya, Gulu, Agago, Lamwo, Pader and Kitgum). However, for clarity and consistency with the empirical analysis which follows, district names are recorded as they stood in 1991, which corresponds to the earliest birth year recorded for children in the studied sample (see Section 3.1).

Acholi population to internally displaced people (IDP) camps situated in these locations. The camps were intended to shield civilians from the LRA attacks, but in reality, they offered little protection. Instead, they were characterised by overcrowding, poor sanitation and an abundance of disease (Bozzoli and Brück, 2010).

During the late 1990s, the plight of northern Uganda was gaining international attention, placing pressure on the Sudanese government to cease support for the LRA. In 2002 the Ugandan military (with support from the US) obtained permission from Khartoum to launch operation 'Iron Fist', a military incursion against the LRA bases in southern Sudan. However, Kony and almost all senior LRA members survived the raid and the rebels outflanked the government forces, attacking new territories in Lira, Apac and Soroti (Allen, 2013). The failure of this operation marked a rapid increase in the number of attacks and fatalities attributed to the LRA, with the period between 2002 and 2005 constituting the height of the violence experienced during the campaign (Rohner et al., 2013; De Luca and Verpoorten, 2015). By 2004 approximately 1.5 million people were estimated to be internally displaced as a result of the fighting (International Crisis Group, 2004) and increased global awareness of this humanitarian crisis, along with the numerous atrocities committed by the LRA, led the International Criminal Court to issue an arrest warrant against Kony and four of his senior commanders (Dolan, 2009). With global attention fixed on the conflict, pressure was placed on both sides to reach a peaceful solution. In mid-2006 the government of Uganda agreed to engage in peace talks with the rebels, resulting in the signing of a cessation of hostilities agreement in Juba (Sudan) on 26th August 2006. Although Kony never signed the final peace agreement, these talks began the effective end of the LRA war in northern Uganda (Dolan, 2009).

3 Data

3.1 Health and Demographic Data

The individual-level health data used in this analysis comes from three waves of the Uganda Demographic and Health Survey (DHS), collected in 1995, 2000 and 2006.[5] Data is provided on a number of key childhood health indicators, including height-for-age, weight-for-age and weight-for-height. The DHS surveys also contain demographic, health and education measures relating to the child's mother and the characteristics of the household. In order to accurately link this data to specific locations and events, the sample considered only includes observations for children whose mothers were present in the same DHS sample cluster since the child's birth.[6] This initial sample consists of a cross-section of 9496 children, born between 1991 and 2006, and aged less than 5 years old at the time of the survey.[7] The geographical coverage of the three surveys varies to some degree, as does the ages of the children selected for height and weight measurements (children were only measured before 48 months in 1995 survey). However, the identification strategy employed, coupled with evidence from estimations on alternative samples (Section 6.2), suggests that the main findings of this analysis are not unduly influenced by this.

The primary outcome of interest is the height-for-age z-score of children within the sample, which measures the number of standard deviations from the (age and gender-specific) median height of a child in a healthy reference population.[8] This is a long-run

[5]At the time of writing, all Uganda DHS data used in this study is available on request from dhsprogram.com/data.

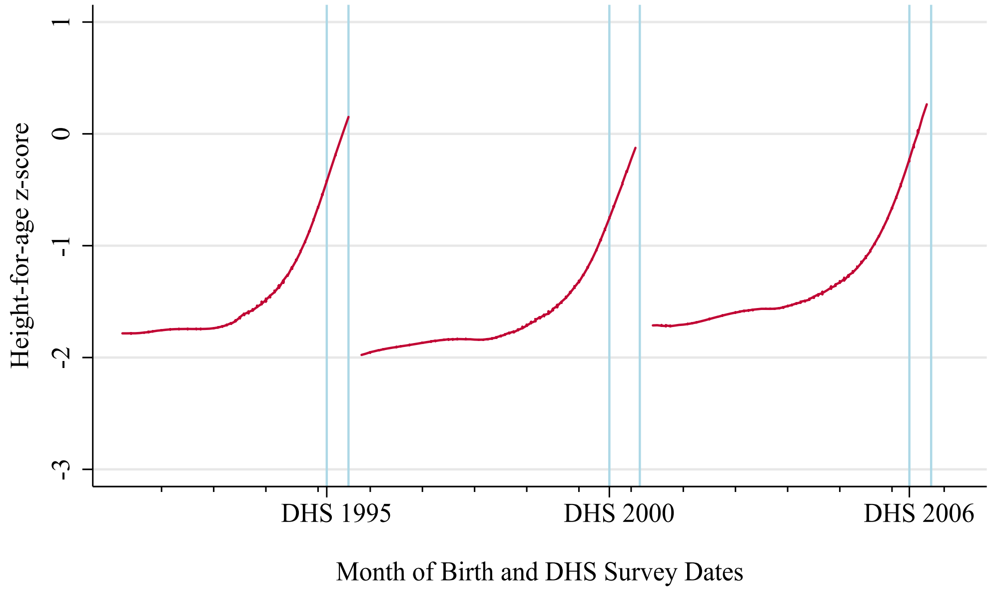
[6]The likelihood of bias in the estimated impact of conflict on health, due to a correlation between household relocation and health status, is discussed in Section 6.1.

[7]However, the main analysis is conducted using only a sub-sample of 9202 children who were born either before or during the fighting (see Section 3.3).

[8]The impact of conflict exposure on other anthropometric measures is considered in Section 6.6.

measure of exposure to poor health and nutrition, implying that an accumulation of past health deficits should still be visible in the data, even amongst older children.[9]

Figure 1: Height-for-Age z-scores by Month of Birth



The curves in Figure 1 illustrate the relationship between height-for-age z-scores and a child's month of birth, generated using locally weighted, scatter-plot smoothing (LOWESS). Each separate curve represents data points from a different DHS survey, with the start and finish dates of the three data collections shown by the vertical lines in Figure 1. In each case, the far left of the curve represents the oldest children at the time of survey, while the z-scores of younger children will be represented by the area where the curve is closest to (or within) the time period where the survey took place. Figure 1 clearly shows that each curve slopes upward towards the dates of the respective survey, indicating that as children in the sample grow older their height lags increasingly

[9] This measure is also indicative of an individual's future health and economic status. An extensive literature has found strong links between early childhood height and physical and cognitive development, morbidity, mortality, schooling and economic productivity in later life. See Strauss and Thomas (2007) for a review.

behind that of the reference population.[10] As only around 1 in 10 children in the sample were directly exposed to the fighting, this suggests that, even in the absence of conflict, children born in Uganda during this period are likely to have faced substantial health challenges.

3.2 Conflict Data and Localities

Using the sub-county locations of the DHS clusters and the children's dates of birth, health outcomes are linked to information on LRA conflict events obtained from the Armed Conflict Location Events Database (ACLED).[11] For the purposes of this analysis, conflict events are defined as any recorded battle or act of one-sided violence, where the LRA is listed as one of the actors. The ACLED dataset records 1947 such events, occurring between January 1987 and March 2007.

The twenty-year duration of the LRA insurgency presents clear challenges for identification. For example, no children in the DHS data were measured prior to the first event taking place.[12] A second concern relates to the geographical proximity of the children's households to the recorded locations of where events actually took place.[13] Therefore, to mitigate these concerns, while fully exploiting the spatial and temporal variation of the fighting, Uganda is sub-divided into 309 *localities*, along county and subcounty administrative boundaries. These localities are constructed by sub-dividing any county, where the distance between two border locations exceeds 50kms, along

[10] A cumulative deficit in height-for-age, especially before 3 years of age (see Fig 1), conforms with a long-recognised pattern in low-income countries (Martorell and Habicht, 1986).

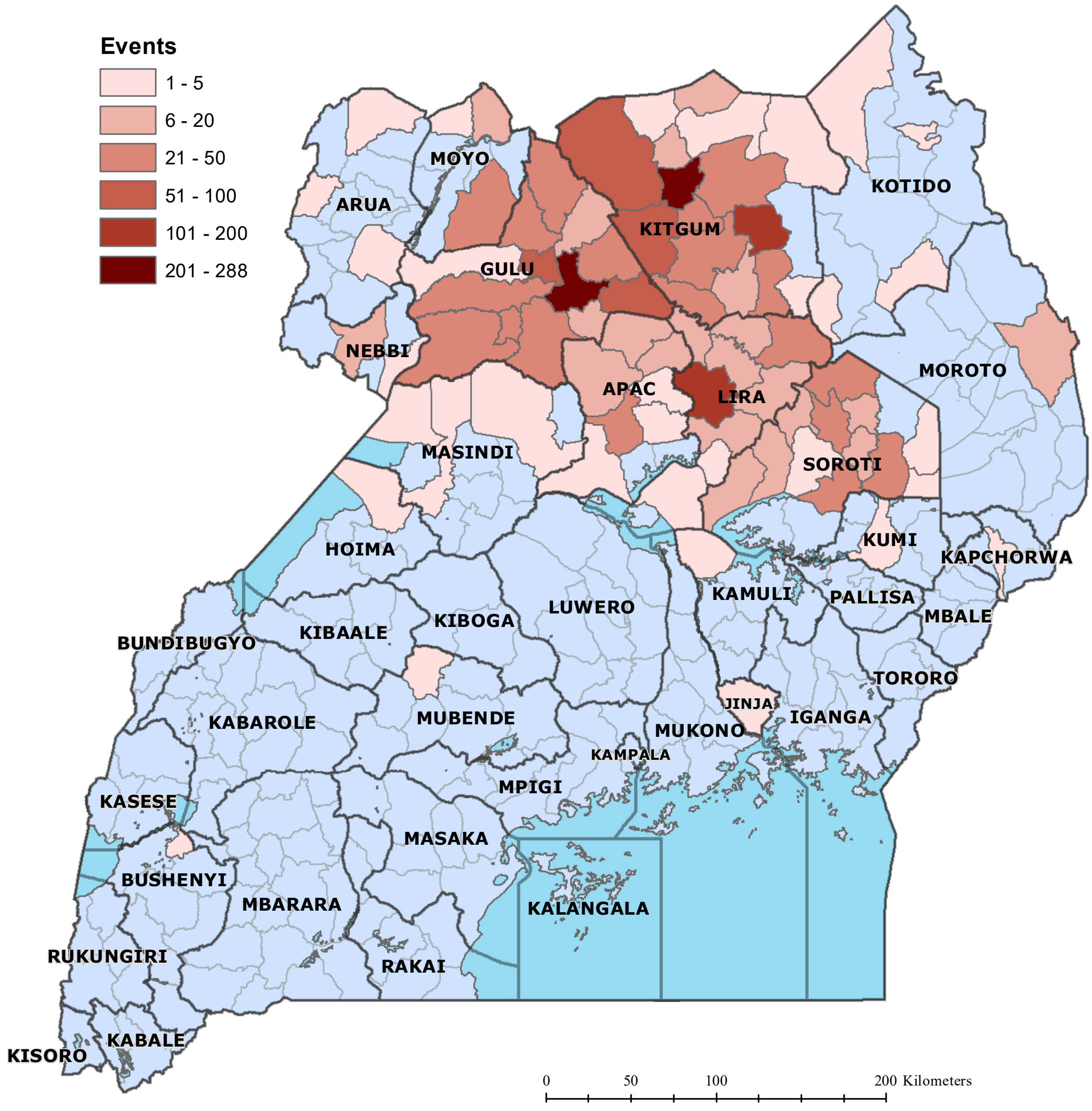
[11] Events occurring from the 1st of January 1997 onwards are taken from the current version of ACLED, accessed from https://www.acleddata.com/data/ on 17th June 2019 (Raleigh et al., 2010). Events taking place before this date are obtained from an earlier version of the same data, compiled by the Peace Research Institute Oslo (Raleigh and Hegre, 2005).

[12] One earlier DHS survey was conducted in Uganda in 1988/89. However, other than the West Nile region (Arua, Moyo and Nebbi districts in Fig 2), the survey was only conducted in the south and south-west of the county.

[13] Studies using a similar methodology have classified children living more than 100kms from any conflict event as exposed to the fighting. For example, see Akresh et al. (2012b) and Minoiu and Shemyakina (2014).

subcounty administrative boundaries (if possible). For counties/municipalities where this distance never exceeds 20kms, the area is combined with an adjoining county.[14] A description of the areas covered by the localities can be found in Appendix 1.

Figure 2: Number of Recorded LRA Conflict Events, by Locality



Source: Based on ACLED dataset (Raleigh and Hegre, 2005; Raleigh et al., 2010)

[14]One exception to this approach occurs in the case of the geographically small area of Gulu municipality, which occupies a location directly between Aswa and Omoro counties. In this instance, the three counties/municipalities are combined, and then subdivided along subcounty lines thereafter.

Figure 2 shows the extent of the LRA conflict, which took place between 1987 and 2007, along with the sub-division of Uganda's 38 districts (as of 1991) into the 309 localities. Darker shaded areas represent localities that experienced a greater number of events, based on the ACLED dataset (Raleigh and Hegre, 2005; Raleigh et al., 2010). The highest intensity of fighting can clearly be observed in the Northern Acholi and Langi sub-regions (Kitgum, Gulu, Apac and Lira), as well as the district of Soroti, further to the southeast.

3.3 Exposure to Conflict

The initial approach to assigning whether or not a child is considered as being exposed to the fighting is based on the methodology used by Bundervoet et al. (2009) and requires first defining a *conflict window* for each locality where at least one event took place. This conflict window represents the time period between (and including) the calendar month where the first and last recorded events occurred in the locality. The simplest definition of exposure assigns any child who was alive during the conflict window as exposed to the conflict, while omitting from the sample all children who were born after the conflict window. Initial estimations will, therefore, only utilise observations from children who were either exposed to the conflict or measured prior to any fighting taking place. In the analysis which follows, a number of alternative definitions of conflict exposure are considered, both in the initial estimations and by way of robustness checks in Section 6. The table provided in Appendix 2 provides a more detailed description of the 49 localities in the sample which experienced at least one event, henceforth, referred to as *conflict localities*.

Columns 1 to 3, in Table 1, compare the characteristics of children in conflict and non-conflict localities, whereas columns 4 to 6 report the same variables for exposed and non-exposed children, within conflict localities. One of the clearest disparities lies in the difference between the average heights of children and their mothers, across the two sets of results. Surprisingly, Table 1 suggests that, on average, mothers and children are actually taller in the areas where the fighting took place (relative to areas which were unaffected). Furthermore, children who were exposed to the fighting, within these areas, appear significantly taller than those who were not exposed. This seemingly counterintuitive finding can be understood by recognising that the majority of the fighting took place in the districts of Gulu, Kitgum, Lira, Apac and Soroti (see *Household Characteristics* in Table 1), where the Nilotic ethnic groups, which dominate these areas, have far closer historical links to the famously tall Dinka people of southern Sudan or the Maasai of Kenya and northern Tanzania than those in the south and southwest of Uganda (Shoup, 2011). On closer examination of Table 1, it is also clear that, within the observations from conflict localities, children exposed to the fighting have a higher probability of coming from one of these five districts (see columns 4 to 6). Therefore, the over-representation of Nilotic children in the exposed group (within the conflict areas) would also potentially explain the significant height (and possibly weight) disparity in column 6.[15]

To formally test the likelihood of underlying anthropometric differences between ethnic groups, Appendix 3 reports an analysis of the relationship between ethnicity and height, conducted on a sample of women who would have achieved adult stature before the LRA insurgency began in 1987. This simple empirical analysis confirms that adult women from the groups which dominate the five most affected districts have significant height advantages over those in other conflict localities and, indeed, elsewhere in Uganda. A naïve analysis which does not recognise this would (at best) understate the health impacts of the LRA insurgency on those who were most affected by the conflict.

[15] For example, repeating the tests reported in Table 1, column 6, with the addition of district fixed effects, fully negates any significant difference in height or weight, between exposed and non-exposed children (height-for-age p-value = 0.730, weight-for-age p-value = 0.606).

Table 1: Descriptive Statistics

Variable	(1) Conflict	(2) *Locality* Non-Conflict	(3) Diff. (1)-(2)	(4) Exposed	(5) *Conflict Exposure* Not Exposed	(6) Diff. (4)-(5)
	Mean	Mean	*p*-value	Mean	Mean	*p*-value
Child's Characteristics						
Height-for-age z-score	−1.34	−1.55	0.065*	−1.19	−1.57	0.009***
Weight-for-age z-score	−0.99	−1.11	0.134	−0.87	−1.18	0.010**
Height-for-weight z-score	−0.19	−0.18	0.818	−0.16	−0.24	0.228
Child is female	0.52	0.51	0.347	0.51	0.54	0.202
Child age (years)	2.14	2.04	0.030**	2.24	1.98	0.012**
Birth order 1-3	0.46	0.46	0.853	0.44	0.49	0.155
Birth order 4-6	0.32	0.33	0.608	0.35	0.29	0.042**
Birth order 7+	0.22	0.20	0.506	0.21	0.22	0.761
Mother's Characteristics						
Mother's age (years)	28.54	28.17	0.190	28.99	27.85	0.036**
Mother's height (cms)	160.85	157.87	0.000***	161.18	160.36	0.379
Mother is married/cohabiting	0.91	0.91	0.909	0.91	0.91	0.902
Mother has no education	0.31	0.26	0.207	0.26	0.39	0.036**
Mother has primary education	0.58	0.61	0.235	0.61	0.54	0.150
Mother has secondary education	0.11	0.13	0.596	0.13	0.08	0.232
Mother is head	0.90	0.92	0.118	0.92	0.87	0.135
Mother is daughter of head	0.07	0.05	0.046**	0.06	0.08	0.329
Mother not head/daughter	0.03	0.03	0.639	0.02	0.05	0.139
Mother's time in location	13.04	11.79	0.155	11.96	14.66	0.053*
Household Characteristics						
Urban area	0.20	0.18	0.844	0.30	0.04	0.011**
Gulu, Kitgum, Lira, Apac, Soroti	0.61	0.02	0.000***	0.66	0.53	0.487
Household size (time of survey)	6.78	6.54	0.196	6.62	7.03	0.337
Household head is male	0.82	0.83	0.485	0.80	0.85	0.015**
Household head's age (years)	36.20	35.64	0.194	35.96	36.55	0.485
Observations	1447	7755		869	578	

Test standard errors clustered at the locality * p<0.1, ** p<0.05, *** p<0.01

The measures in Table 1 also suggest significant variation in the mean ages of children between groups, with evidence of relatively older children present in conflict localities and also in the group who were exposed to the fighting. In the latter case, a higher probability of being exposed to the war, amongst relatively older children, would almost certainly be a consequence of having a longer period of time in which an event can occur, whereas the fact that this group are older, on average, would account for a higher birth order and also mothers who are relatively older when the survey is conducted. The reason behind the difference in the mean ages of children in conflict and non-conflict localities is not initially so clear, however. One explanation is that this may be related to the differences in the sampling methodology in the three DHS survey waves. In the 1995 wave, only children who were younger than 4 provided height and weight measurements (as opposed to children younger than 5 in the 2000 and 2006 surveys). The 1995 survey also did not cover the district of Kitgum, where all but one of the 17 localities were affected by the insurgency. Therefore, in 1995, both older children and conflict localities are relatively under-sampled.

A significant difference in the mean ages of children between the groups in Table 1 clearly presents a possible threat to identification.[16] However, it is important to recognise that the identification strategy outlined in the following section addresses this by only estimating the effects of the LRA conflict using variation within birth cohorts. Similarly, all variables which show significant heterogeneity between the groups in Table 1 (such as the gender of the household head or the education level of the mother) are added as additional controls in a separate set of estimations, to assess the effect of their inclusion on the main coefficients of interest.[17]

[16]Assuming relatively older children will have accumulated larger height deficits (see Figure 1), the measured effect of conflict exposure would be downward biased if this disparity in ages was not acknowledged in the identification strategy outlined in Section 4.

[17]Differences in the educational attainment of the children's mothers may reflect a relatively higher number of children in urban areas who were exposed to the fighting (see 1). Repeating the tests reported in Table 1, controlling for rural/urban status, produces p-values in excess of 0.25 for all education groups.

4 Empirical Strategy

To attempt to measure the causal effect of the war on the height-for-age z-scores of affected children, three alternative definitions of conflict exposure are considered. The baseline model (1) follows Bundervoet et al. (2009) in measuring the impact of the LRA insurgency on children who were both living in affected localities and exposed to the conflict. Given a higher relative mean age of exposed children, coupled with possible differences in the underlying anthropometrics of those in conflict and non-conflict localities (see Appendix 3), the following baseline specification identifies the effect of exposure to the war, using only variation within localities and within birth cohorts.

$$haz_{ijt} = \alpha_j + \delta_t + \beta_1(Conf\ Locality_j * Exposed_i) + \phi_1 female_i + \varepsilon_{ijt} \quad (1)$$

In model (1), haz_{ijt} represents the height-for-age z-score of child i, living in locality j, who was born in year t, while the terms α_j and δ_t represent locality and birth cohort (year of birth) fixed effects. $Conf\ Locality$ takes value 1 if the child comes from an area which experienced at least one conflict event (0 otherwise) and the $Exposed$ term in this baseline model is simply a binary indicator for whether or not a child was alive during the conflict window. In the first set of estimations, only a control for the child's gender is included. The final term ε in model (1) denotes a random, idiosyncratic error.

One potential drawback of model (1) is that only a relatively small number of conflict localities contain both exposed and non-exposed children (see Appendix 2). Given the inclusion of the locality fixed effect α_j, the coefficient of interest β_1 will only be estimated using variation within this small subset of localities. Furthermore, due to the longer duration of the fighting in the worst affected districts (resulting in fewer pre-war observation) the areas where variation in the binary measure of exposure exist will commonly be found on the peripheries of the most intense fighting.[18] In light of this, model (2) replaces $Exposed$ with the variable $Ex\ Duration$, measuring the number of months a child was alive during the conflict window. In (2) the coefficient β_2 measures the effect of an additional month of exposure, under the implicit assumption of a linear relationship between months of exposure and childhood health. All other terms in (2) have the same interpretation as before.

$$haz_{ijt} = \alpha_j + \delta_t + \beta_2(Conf\ Locality_j * Ex\ Duration_i) + \phi_1 female_i + \varepsilon_{ijt} \quad (2)$$

A third definition of exposure is shown in model (3), which relaxes the assumption that the marginal health impact of an additional month in the conflict window is uniform across all possible exposure durations. In (3), children in affected localities who were exposed to the violence are assigned to one of two groups, dependant on the time they were alive during the conflict window. The coefficients β_3 and β_4 measure the effect of exposure to the fighting in a conflict locality (for the given durations), relative to those children who were not directly exposed to the war. The initial estimation of (3) separates the exposed sample at a conflict duration of 6 months, while in the results in Section 5 also defined the two groups around a split point of 12 months.

$$\begin{aligned} haz_{ijt} = {} & \alpha_j + \delta_t + \beta_3(Conf\ Locality_j * Ex\ 1-6\ months_i) \\ & + \beta_4(Conf\ Locality_j * Ex > 6\ months_i) + \phi_1 female_i + \varepsilon_{ijt} \end{aligned} \quad (3)$$

[18] The mean duration of the conflict windows in localities from the worst affected districts (Gulu, Kitgum, Lira, Apac and Soroti) is approximately 110 months, compared to only around 35 months outside of these districts. Furthermore, a relatively lower percentage of the sampled children in these districts were not exposed to the fighting (only 16.4%, as opposed to 39.7% elsewhere, based on the table in Appendix 2).

In each of the previous models, identification relies on the assumption that the underlying time trend in children's heights would be the same in both conflict and non-conflict localities, had the insurgency not taken place. This may be an overly strong requirement, given the focus of the fighting in the Northern districts and the large economic, cultural and ethnic divide between the North and South of the country. Following the literature, therefore, this condition can be modified by the assumption that children in conflict and non-conflict localities, *within districts*, would display similar growth pattern in the absence of exposure. This requires the inclusion of a district-specific time trend in models (1) to (3), which is indicated in the case of the baseline model below by the term γ_{jt}.

$$haz_{ijt} = \alpha_j + \delta_t + \gamma_{jt} + \beta_1(Conf\ Locality_j * Exposed_i) + \phi_1 female_i + \varepsilon_{ijt} \quad (4)$$

The main results of this analysis also report estimations for each of the three definitions of exposure including a number of additional controls, relating to the child, their mother and the household in which they live. Following a discussion of the robustness of findings from the previous specifications, Section 7 also extends the main results to assess heterogeneity in the effect of conflict between different sub-sample groups. This section focuses on three potential sources of heterogeneity, the intensity of the fighting experienced by the child and the gender of either the head of the household or the child themselves.

5 Results

Table 2 reports results from estimations based on the models described in the previous section. The first three columns show measures of the β_1 interaction coefficient from the baseline model (1) (all terms in (1) are included in the estimations, but not reported in Table 2). Under the assumption of a common time trend in height-for-age z-scores, column 1 reports little impact of the war on children residing in conflict localities and exposed to the fighting (relative to those not directly affected). With the inclusion of the district-specific time trends in column 2, however, there is evidence of a 0.37 standard deviation height deficit amongst those who were exposed. Table 1 suggests several underlying characteristics may differ systematically between children in conflict and non-conflict localities (as well as between exposed and non-exposed children). After the inclusion of variables capturing the characteristics of the child, their mother, and the household,[19] column 3 indicates the estimate of β_1 is only minimally affected, suggesting that the causal effect of exposure to the war may be closer to -0.39.

The magnitude of the coefficients in columns 2 to 3 could be considered somewhat small, relative to comparable studies.[20] As previously noted, however, the localities which contain both exposed and non-exposed children tend to be found on the edges of the worst fighting.[21] As an alternative to the simple (yes/no) exposure variable, columns 4 to 6 report the effect of an additional month of exposure to the conflict, measured by β_2 in model (2). Again, significant coefficients are found in the estimations including district-specific time trends, with both column 5 and 6 reporting a 0.011 standard deviation deficit in height for each additional month spent within the conflict window.

[19] An alternative version of Table 2, including the estimated coefficients on all additional controls, is provided in Appendix 4.

[20] Bundervoet et al. (2009) found a -0.348 to -0.525 standard deviation height deficit in their study of the 1993-2005 civil war in Burundi, Akresh et al. (2012b) reported coefficients of -0.447 to -0.454 for the border war between Eritrea and Ethiopia, while Minoiu and Shemyakina (2014) found an effect of exposure to conflict between -0.250 and -0.414 (for the Côte d'Ivoire).

[21] For example, only a single locality in the Acholi-land districts of Gulu and Kitgum provides variation in the initial definition of exposure, while these two districts account for 1384 of the recorded events (71.1% of the total 1947 events).

Table 2: The Effects of Conflict Exposure on Height-for-Age

Dep. Variable: height-for-age z-score	(1)	(2)	(3)	(4)	(5)	(6)
Conf Locality * Exposed	-0.239	-0.369**	-0.388**			
	(0.187)	(0.186)	(0.195)			
Conf Locality * Ex Duration				0.001	-0.011**	-0.011**
				(0.003)	(0.005)	(0.005)
Observations	9202	9202	9202	9202	9202	9202
R^2	0.079	0.147	0.205	0.079	0.147	0.205
Locality Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Birth Cohort Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
District-Specific Trend	No	Yes	Yes	No	Yes	Yes
Controls†	No	No	Yes	No	No	Yes

	(7)	(8)	(9)	(10)	(11)	(12)
Conf Locality * Ex 1-6m	-0.191	-0.200	-0.234			
	(0.213)	(0.215)	(0.218)			
Conf Locality * Ex > 6m	-0.315*	-0.659***	-0.651***			
	(0.165)	(0.194)	(0.222)			
Conf Locality * Ex 1-12m				-0.231	-0.298	-0.317
				(0.197)	(0.201)	(0.204)
Conf Locality * Ex > 12m				-0.258	-0.566***	-0.585**
				(0.171)	(0.200)	(0.227)
Observations	9202	9202	9202	9202	9202	9202
R^2	0.079	0.148	0.206	0.079	0.147	0.205
Locality Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Birth Cohort Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
District-Specific Trend	No	Yes	Yes	No	Yes	Yes
Controls†	No	No	Yes	No	No	Yes
H0: Ex 1-6(12)m = Ex > 6(12)m						
p-value	0.293	0.005***	0.020**	0.710	0.083*	0.096*

Locality clustered standard errors in parentheses * p<0.1, ** p<0.05, *** p<0.01

In (7) to (9): Not exposed ($n = 578$), 1-6m exposure ($n = 218$), exposure > 6m ($n = 651$)
In (10) to (12): Not exposed ($n = 578$), 1-12m exposure ($n = 344$), exposure > 12m (n=525)
†Child controls include: female child and birth order (grouped)
Mother's controls include: height, age, marital and education status, and relationship to head.
Household controls include: urban DHS survey cluster, age and gender of the head
The full table of results is shown in Appendix 4

Columns 7 to 9 report results from estimations based on model (3). This approach splits the sample of children into groups, based on whether a child's duration of exposure is less than (equal to) or more than 6 months. The results in columns 8 and 9 show clear evidence of a greater deficit for those children who were exposed to the fighting for more than 6 months, with the results suggesting this may be in excess of -0.65 standard deviations (relative to those not affected). In contrast, it is not possible to reject the hypothesis of no impact for those exposed over shorter periods of time (at any of the levels reported). In columns 8 and 9, a Wald test of the equality of the impact of different exposure durations also confirms heterogeneity in the negative effects experienced by the two groups (*p*-values reported in Table 2).

The final set of results in columns 10 to 12 splits the sample of exposed children at 12 months, as opposed to 6. The results appear broadly similar to those in columns 7 to 9, although the estimated effect of inclusion in the longer exposure group appears less negative. There also exists weaker evidence of a significant difference between the shorter and longer periods of exposure when separating observations at 12 months duration (see *p*-values in Table 2). This pattern of results suggests an acceleration in the negative health effects of exposure to the LRA conflict between 6 and 12 months, and minimal evidence of further detrimental effects thereafter.

With no variance in the binary exposure measure in the majority of localities from the worst affected districts, the models which exploit variation in the length of exposure are preferable. Having split the sample of affected children at 6 months exposure, Table 2 also suggests little additional insight can be gained from also splitting the sample at 12 months. Therefore, the remainder of the analysis will focus attention on the estimations used to generate the results in column 6 and column 9 of Table 2 (with both additional controls and district-specific time trends).

6 Robustness

This section considers the robustness of the results reported in Table 2 (columns 6 and 9) to the use of samples intended to address potential sources of bias, alternative definitions of conflict localities (and the conflict window), and the use of alternative anthropometric health measures.

6.1 Endogenous Selection out of Conflict Exposure

Arguably, the clearest source of potential bias comes from an endogenous selection process governing which children are exposed to conflict. For example, if relatively wealthier households were more easily able to relocate to safer areas, and in the likelihood that there exists a positive correlation between the health status of children and the economic status of households, the results in Table 2 will be biased (downwards). Unfortunately, there exists no information on household migration in the Ugandan DHS surveys. However, this information is recorded in the Ugandan National Household Survey 2005/06 (UNHS), which was collected just prior to the 2006 DHS wave. The UNHS records whether household members moved to their current location since 2001 and provides information on the district of origin and their main reason for relocation.

Of the 2749 households in the UNHS, who either resided in one of the 16 conflict-affected district or moved from one of these areas, 283 had relocated with the stated reason of avoiding insecurity (see Appendix 5). The vast majority of these households (89.4%) had settled within the same district, however, implying that the bulk of conflict-driven relocation would have occurred at a relatively local level.[22] If households with

[22] A summary of the migration pattern of households from the affected districts, taken from the Uganda National Household Survey 2005/06, is provided in Appendix 5, where the migration history of the household is assumed to follow the relocation history of the household head.

healthier children were able to leave conflict areas, either before the fighting started or at a relatively earlier stage, there should exist a negative correlation between time in the current location and the child's height, within localities yet to be affected by the fighting. Testing for this correlation indicates that the relationship between time in location and height-for-age z-scores is found to be significantly negative ($p < 0.05$) only in three districts, Gulu, Hoima and Kotido.[23] To establish the extent of any possible bias in the results reported in Table 2 (columns 6 and 9), these estimations are repeated on a sample which omits observations from the three districts listed above. The results can be found in columns 1 and 2 of Table 3.

Comparing the estimated effects in Table 3 to the initial results suggest that the linear exposure duration effect (in column 1) may not be wholly robust to the omission of the three districts above, although the magnitude of the effect is only reduced slightly. However, in the case of the grouped results in column 2, any downward bias in the measured effects appears to be relatively small and certainly does not warrant any re-interpretation of the findings.[24]

6.2 Variation in Survey Coverage between Waves

As the population of interest is Ugandan children aged less than 60 months, two further potential sources of bias can be found in the districts selected for the DHS surveys and the ages of children measured in these surveys. The 1995 wave only measured children who were aged less than 4 years old and did not survey the Northern district of Kitgum.

[23] A description of the estimation used to test for a negative correlation between time in location and height-for-age z-scores can be found in Appendix 6.

[24] The reason that selection effects appear negligible may be linked to the seemingly random nature of the LRA attacks (Blattman and Annan, 2010; Adelman and Peterman, 2014). Furthermore, in the case of relocation to IDP camps, this was often involuntary, with little or no notice, making endogenous selection out of conflict exposure even less likely (Fiala, 2015).

In contrast, the survey conducted in 2000 omitted both Kitgum and Gulu, along with the districts of Kasese and Bundibugyo, while increasing the age range to 5 years of age.[25] Similarly, the final 2006 survey measured children up to 5 years old, but in this final wave, all districts of Uganda were surveyed.

The districts which were not surveyed in either 1995 or 2000 were omitted due to fears of insecurity, implying an obvious correlation between the probability of inclusion in the original DHS sample and conflict exposure. This suggests the estimated impact of the LRA conflict in Table 2 may contain a positive bias (Children in the worst affected areas were not surveyed). The absence of children aged 4 or over in the 1995 sample implies a further potential selection effect, although in this case, the sign of the bias is less clear.[26] To address these concerns, the key models are re-estimated on a sample of children which is consistent (both in age and geographical coverage) across all three DHS survey waves.

The results in columns (3) and (4) of Table 3 show the impact of the war on children aged less than 4 years, and not living in the districts of Gulu, Kitgum, Kasese and Bundibugyo. This alternative sample should be fully representative of a population with these characteristics. Unsurprisingly, given that this sub-sample omits over 1200 observations and considers children over a different age range, the magnitude of the coefficients varies to some degree (relative to those in column 6 and 9 of Table 2). However, the fact that the broad pattern of results remains unchanged is further reassurance that any sample selection bias is not sufficient to warrant a new interpretation of the previous results.

[25]The latter two Western districts were experiencing insecurity during this period, due to another rebel group ADF-NALU operating along the border of Uganda and the Democratic Republic of Congo.

[26]For example, the relative under-sampling of older children in 1995, and the likelihood of cumulative health deficits from longer periods of exposure, would be expected to generate a positive bias. However, if the effects of a given length of exposure are more detrimental to children at a younger age, the bias would be in the opposite direction.

Table 3: Alternative Samples and Assumptions on Exposure

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Variable: height-for-age z-score	*Gulu, Hoima and Kotido Omitted*		*Districts and Ages Consistent all DHS*		*Re-classify Conflict Localities in South*	
Conf Locality * Ex Duration	-0.009		-0.015**		-0.011**	
	(0.005)		(0.007)		(0.005)	
Conf Locality * Ex 1-6m		-0.220		-0.135		-0.369
		(0.224)		(0.246)		(0.303)
Conf Locality * Ex > 6m		-0.614***		-0.598***		-0.742***
		(0.234)		(0.223)		(0.269)
Observations	8889	8889	7973	7973	9202	9202
R^2	0.200	0.201	0.211	0.212	0.205	0.206
Locality Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Birth Cohort Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
District-Specific Trend	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
H0: Ex 1-6m = Ex > 6m						
p-value		0.040**		0.011**		0.055*

	(7)	(8)	(9)	(10)	(11)	(12)
	Children in IDP Camps Omitted		*Extending Conflict Window + 6m*		*Extending Conflict Window + 12m*	
Conf Locality * Ex Duration	-0.009*		-0.012**		-0.014***	
	(0.005)		(0.005)		(0.005)	
Conf Locality * Ex 1-6m		-0.213		-0.079		0.165
		(0.228)		(0.183)		(0.163)
Conf Locality * Ex > 6m		-0.638***		-0.617***		-0.611***
		(0.232)		(0.186)		(0.171)
Observations	9091	9091	9244	9244	9291	9291
R^2	0.205	0.206	0.204	0.205	0.204	0.205
Locality Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Birth Cohort Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
District-Specific Trend	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
H0: Ex 1-6m = Ex > 6m						
p-value		0.036**		0.002***		0.000***

Locality clustered standard errors in parentheses * p<0.1, ** p<0.05, *** p<0.01

6.3 Isolated Conflict Localities

Three conflict localities in Fig 2 stand out as being much farther South than the districts where the vast majority of the fighting took place. The localities in Bushenji, Mubende and Jinja, experienced only five events in total during the entirety of the LRA war. Arguably, it may not be appropriate to treat children exposed to these more isolated pockets of violence as experiencing a continuation of the main conflict in the North.[27] Therefore, as an alternative definition of exposure to conflict, the results reported in columns 5 and 6 of Table 3 are derived from re-classifying all children in these areas as not exposed to the conflict.

Table 3 indicates that the effect of the continuous measure of exposure (column 5) remains unchanged. However, the more negative coefficients in column 6 suggest that the inclusion of the children in these Southern localities (in the original estimations) may have served to moderate the estimated impact of the war. With the limited number of events in these areas, exposed and unexposed children (the base category in column 6) are likely to be more similar, relative to those in areas more central of the conflict, decreasing the measured effect. Although this clearly leads to a change in the magnitude of the coefficients, again, the overall interpretation of the results remains the same.

6.4 The Health Impacts of IDP Camps

Given the dire conditions experienced by those in the government-sanctioned IDP camps (WHO, 2005; Bozzoli and Brück, 2010), it initially seems plausible that the negative health impacts attributed to the war are, in reality, capturing the consequences of children being subjected to these conditions during displacement. Were this the case, the

[27] In the case of Jinja, in particular, where the two events which took place occurred more than 15 years apart, many of those children categorised as exposed to the conflict will have had relatively little direct experience of the fighting.

same detrimental health effects could potentially be observed anywhere where poor sanitation and disease were prevalent (even in the absence of armed conflict).

Within the final sample, only 111 children were measured while residing in an IDP camp, making it unlikely that these observations are responsible for determining the results in Section 5. However, this small number of observations does highlight that a relatively larger number of IDP children were not included in the sample due to the mother arriving in the DHS cluster location after the child was born.[28] If the impact of conflict exposure would have been worse for these children, the results in Table 2 will underestimate the true effect of the war. Therefore, to establish the magnitude of any bias, while ruling out the possibility that the remaining IDP observations exert undue influence on the results, columns 7 and 8 of Table 3 report estimates obtained from a sample which omits IDP children.

When considering the grouped lengths of exposure in column 8 of Table 3, the estimated health effects of the conflict, on children who had never lived in IDP camps, are similar to those obtained from the full sample. Where the impact of exposure duration on children's heights is assumed to be linear, column 7 indicates a slightly smaller effect, relative to Table 2. Overall, the results suggest that any positive bias, due to a higher probability of IDP children being dropped from the sample, is minimal. Furthermore, it is clear that the remaining observations from the IDP camps are not solely responsible for driving the results in Section 5.

6.5 Extending the Conflict Window

In the empirical strategy defined in Section 4, the negative effects of being exposed to the war are assumed to be limited to the period between the calendar months in which the first and last events take place. Although this simplifying assumption avoids the need to place an arbitrary limit on how long after the conflict window children's health

[28]From the original 205 observations of IDP children, 63 were omitted due to the mother relocating since the child's birth (30.7%), while this reason accounted for only around 19% of non-IDP children dropped from the original DHS data.

may still be affected, it risks understating the full impact of the fighting. To determine the sensitivity of results to alternative assumptions regarding the duration of exposure, the conflict window is extended by 6 months after the last event in columns 9 and 10 of Table 3, and by 12 months in columns 11 and 12.[29]

The linear effects reported in columns 9 and 11 appear to show an increasingly negative impact of an additional month of fighting, when extending the limit for exposure beyond the original conflict window. These results would suggest that the initial measure of 0.011 (column 6 in Table 2) may represent a conservative estimate of the cumulative effect of the conflict. The results in columns 10 and 12, instead, show evidence of a reduction in the estimated impacts for both grouped durations of exposure. This will come as a result of shifting the distribution of exposure duration upwards, such that some children born after the conflict (and dropped in the initial estimation) will now fall within the 1 to 6 month category, while some of those in this group will now be considered as exposed for a longer duration of time. Although the estimated effects of more than 6 months exposure are smaller in both columns 9 and 11, the results still imply a height deficit in excess of 0.6 standard deviations, with no significant impact for shorter periods of exposure.

6.6 Alternative Anthropometric Health Measures

Height-for-age z-scores are intended to detect evidence of long-term poor nutrition and exposure to disease. However, they represent only one potential anthropometric measure of health status available in the DHS data. If the height deficits uncovered in Section 5 are, indeed, measuring the causal effect of conflict exposure on childhood health, evidence should exist in more short-term measures of health status, in particular

[29] As children who were born after the last event were dropped from the original sample, extending the conflict window also increases the sample size used in these estimations.

amongst children who were surveyed while the fighting was still taking place. Table 4 presents an alternative set of estimations of the impact of the war on children's health, where the results shown in columns 3 to 6 replace the dependent variable with measures of short-run health status, based on children's weight (as opposed to their height). As these measures are intended to capture short term health deficits, observations coming from children who were measured after the conflict window are dropped from the sample for these estimations. This should serve to limit the possibility of any unrelated health shocks impacting a child's weight during the post-conflict period.

Table 4: Alternative Measures of Health Status

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Variable:	*Height-for-Age z-score*		*Weight-for-Age z-score*		*Weight-for-Height z-score*	
Conf Locality * Ex Duration	-0.013**		-0.016***		-0.007**	
	(0.006)		(0.004)		(0.003)	
Conf Locality * Ex 1-6m		0.219		0.065		-0.251
		(0.236)		(0.249)		(0.211)
Conf Locality * Ex > 6m		-0.580***		-0.947***		-0.672***
		(0.215)		(0.193)		(0.180)
Observations	8978	8978	8978	8978	8978	8978
R^2	0.206	0.207	0.192	0.195	0.125	0.126
Locality Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Birth Cohort Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
District-Specific Trend	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
H0: Ex 1-6m = Ex > 6m						
p-value		0.000***		0.000***		0.022***

Locality clustered standard errors in parentheses * p<0.1, ** p<0.05, *** p<0.01

As the results in Table 4 are estimated using a subset of the original sample, the first two columns represent identical estimations to columns 6 and 9 of Table 2 (including the original height-for-age measure of health status as the dependent variable). The pattern of results is broadly similar to that in Table 2, although the estimated coefficients on the grouped exposure terms are less negative (even positive in the shorter exposure group). This is likely due to a shift in the age distribution resulting from dropping those children measured after the conflict window. This approach will favour the inclusion of younger children in the two exposure groups, who should have experienced shorter durations of conflict, on average.[30]

The coefficients in columns 3 and 4 report estimates of the effect of conflict exposure on weight-for-age z-scores, which measure the deviation of a child's weight from that of the median child (of the same age and gender) in the reference population. Under the linear assumption in column 3, the results indicate that each additional month of exposure reduces a child's weight by 0.016 standard deviations, while the grouped duration coefficients in column 4 still show little evidence of health impacts for an exposure duration of 6 months or less. For children exposed to the conflict for more than 6 months, however, the estimated weight deficit is remarkably large at 0.947 standard deviations, indicating even greater heterogeneity in health impacts between the two groups, when using weight-for-age as a measure of health status.

The final set of estimations employ weight-for-height as the dependent variable, which records the deviation of a child's weight from the median child, of the same height, in the reference population. The results in columns 5 and 6 follow the same pattern as those in the previous estimations. Again, there is evidence of a significant deficit in weight for each additional month of exposure in column 5, while a strong negative impact is found in column 6, but only for those exposed for more than 6 months. In light of these results and those in columns 3 and 4, the similarity in the interpretation of effects obtained using weight, as opposed to height, as an indication of health status, provides further evidence in favour of the findings in Section 5.

[30]The mean age of children exposed to the war in the original sample was 26.9 months, yet this falls to 23.7 months with the omission of those measured after the conflict window.

7 Heterogeneity

Having established to what extent the main results in columns 6 and 9 of Table 2 are robust to alternative assumptions, this section considers heterogeneity in the estimated impacts of the war on childhood health status. Three potential sources of variation in the effect of the conflict are considered, heterogeneity between male and female children, heterogeneity between children belonging to male and female-headed households and heterogeneity over the intensity of the fighting experienced.

7.1 Heterogeneity by Child's Gender

To test for evidence of a difference in the effect of the conflict between male and female children, this study follows Minoiu and Shemyakina (2014) by interacting the conflict exposure terms in models (2) and (3) with a female indicator variable. As it is most likely that any gender bias would favour male children (Baird et al., 2011; Dagnelie et al., 2018), a negative coefficient on this interaction term, when included in model (2), would be evidence of an additional month of exposure to the war exerting a relatively higher toll on the health of female children, than males. Similarly, a negative coefficient on the interaction of the female indicator variable, with either of the grouped exposure terms in model (3), would signal inclusion in these groups implied relatively worse health outcomes for female children.

Table 5 reports results for the two sets of estimations, based on the models used to generate the results in columns 6 and 9 of Table 2. These results are shown in the first two columns of the table. Although the interaction terms are negatively signed in column 1 and the longer duration group in column 2, the results show no evidence of any additional effects of exposure to conflict amongst female children.[31]

[31] The absence of any evidence of a gender bias in conflict-related health outcomes mirrors the findings of Akresh et al. (2011) and Minoiu and Shemyakina (2014).

Table 5: Heterogeneous Effects of Conflict Exposure

Dep. Variable: height-for-age z-score	(1)	(2)	(3)	(4)	(5)	(6)
Conf Loc * Ex Duration	-0.010*		-0.011**		-0.011*	
	(0.006)		(0.005)		(0.005)	
Conf Loc * Ex 1-6m		-0.238		-0.177		-0.204
		(0.278)		(0.210)		(0.298)
Conf Loc * Ex > 6m		-0.630***		-0.668***		-0.612**
		(0.236)		(0.220)		(0.244)
Conf Loc * Ex Duration * Female Child	-0.002					
	(0.003)					
Conf Loc * Ex 1-6m * Female Child		0.010				
		(0.222)				
Conf Loc * Ex > 6m * Female Child		-0.036				
		(0.121)				
Conf Loc * Ex Duration * Female Head			0.001			
			(0.004)			
Conf Loc * Ex 1-6m * Female Head				-0.328		
				(0.259)		
Conf Loc * Ex > 6m * Female Head				0.111		
				(0.121)		
Conf Loc * Ex Duration * Intensity					-0.003	
					(0.006)	
Conf Loc * Ex 1-6m * Intensity						-0.054
						(0.239)
Conf Loc * Ex > 6 months * Intensity						-0.193
						(0.217)
Observations	9202	9202	9202	9202	9202	9202
R^2	0.205	0.206	0.202	0.203	0.202	0.203
Locality Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Birth Cohort Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
District-Specific Trend	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Locality clustered standard errors in parentheses * p<0.1, ** p<0.05, *** p<0.01

7.2 Heterogeneity by the Gender of the Household Head

It is possible that gender bias in the impact of the war may operate, not through the gender of the child, but through the gender of the head of the household. For example, if limited resources available during conflict were disproportionately under the control of males, or women experience increased vulnerability to crime as a result of the breakdown of law and order (Byrne, 1996), children within female-headed households may suffer additional health consequences not shared by those in households where the head was male.

Columns 3 and 4 of Table 5 report the interaction of measures of conflict exposure with the gender of the household head. In both sets of estimations, it is not possible to discern any significant health disadvantages amongst children in female-headed households. Taken in conjunction with the results in columns 1 and 2, these findings suggest that the magnitude of effects were not defined by the gender of those affected.

7.3 Heterogeneity by the Intensity of Fighting

The final results in Table 5 report estimates intended to determine whether the negative health impacts of the war are weighted towards children in areas where the intensity of the conflict was greatest. The measure used to represent the intensity of the fighting experienced is the average number of days where a conflict event took place (event days), across all months where the child was alive during the conflict window.[32] Interacting this intensity measure with the conflict exposure term in column 5 generates a coefficient which measures how the health impact of an additional month of exposure changes, as a result of a child experiencing one more event day per month exposed. In the grouped duration model (column 6), the coefficients on the interaction terms measure how an additional event day per month modifies the effects of inclusion in either of the two groups.

[32]Based on this approach, the mean value of conflict intensity is 0.3 event days per month exposed, although the median is only 0.03 event days. Skewing of the distribution towards lower conflict intensity occurs due to 47% of those children born within the conflict window experienced a conflict intensity of 0, implying that all events occurred outside of the period between the month they were born and the month they were surveyed.

In a similar manner to the gender interactions in the previous sections, there is no evidence of significant heterogeneity, associated with the intensity of the fighting experienced (at the levels shown in Table 5). Instead, these results suggest negative health effects are predominantly determined by length of exposure, as opposed to the concentration of events within this time period.

8 Conclusion

This study exploits spatial and temporal variation in the spread of the LRA insurgency in northern Uganda to estimate the causal effect of exposure to conflict on the health status of children. Linking data on 9202 children, aged between 0 to 5 years old, to the locations of 1497 LRA conflict events, evidence is found of irreversible health deficits amongst those exposed to the fighting for more than 6 months. The main results of the analysis imply that, on average, children within this group display height-for-age z-scores which are 0.65 standard deviations lower than those who were not directly impacted by the war. Furthermore, amongst children in this group (aged 0 to 5) a deficit in excess of 0.6 standard deviations is found using a number of alternative samples and definitions of exposure.[33] When considering the height deficits amongst the sample of children impacted by the war for shorter periods of time, the negative effects are found not to be significantly worse than those experienced by children who were unaffected by the fighting.[34]

[33]Interestingly, one such alternative sample found that results were robust to the omission of observation from IDP camps, suggesting camp conditions did not generate additional long-run health deficits, over and above those observed for children who were exposed to the fighting elsewhere.

[34]The main results also suggest a cumulative deficit in height, of 0.11 standard deviations, for each additional month of exposure, although the linear effect is found not to be robust to the omission of districts where endogenous selection out of conflict exposure is more likely.

The heterogeneity in health impacts between affected children in the two duration of exposure groups can also be observed in more short-run anthropometric measures of health status. Estimates employing both weight-for-age and weight-for-height measures follow an identical pattern amongst children measured in areas still exposed to the fighting. The negative effects of more than 6 months exposure on weight-for-age z-scores are particularly alarming, suggesting an average deficit approaching 1 standard deviation, relative to those who were not directly exposed to the conflict. Heterogeneous effects within the different groups of exposure duration appear largely absent, however, with no evidence in the sample of any gender bias in the negative health impacts of the war, either between male and female children or those living in male of female-headed households, and no significant heterogeneity observed amongst children who experienced different intensities of fighting. While the absence of such heterogeneity implies the negative health effects of the conflict were not disproportionately weighted towards one specific group, it also suggests that no group was capable of protecting themselves from these effects better than any other.

The extensive literature on the long-run negative impacts of early childhood health shocks suggests the indirect effect of the LRA insurgency may be felt in the loss of health, education and economic wellbeing of those affected by the conflict at an early age. Although *ex-post* interventions aimed at rebuilding the war-affected communities show promising results (Blattman et al., 2013, 2016), the findings of this study, instead, draw attention to the need for policies aimed at ensuring a swifter resolution to such long-running conflicts. Indeed, it appears likely that the irreversible health deficits of such events can be largely avoided if civilian populations can be returned to a state of stability within a relatively short period of time. In the absence of a timely resolution, however, communities affected by armed violence may be forced to carry the burden of war, long after the last shots have been fired.

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Appendices

Appendix 1

Figure A1: Overview of Localities

Table A1: Overview of Localities

	District	*Locality*		*District*	*Locality*		*District*	*Locality*
1	Apac	Chawente	78		Tingey County	155		Rugaaga
2		Kole North	79	Kasese	Bukonjo North	156		Ruhaama County
3		Kole South	80		Bukonjo South	157		Rwampara County
4		Kwania North	81		Busongora North	158		Sanga
5		Maruzi North	82		Lake Katwi	159	Moroto	Checkwii East
6		Oyam North	83		Muhokya	160		Iriri
7		Oyam South	84	Kibaale	Bugangaizi West	161		Karita
8	Arua	Ajia	85		Buyaga East	162		Lorengedwat
9		Aringa South	86		Buyaga West	163		Lotome
10		Ayivu County and Arua Mn	87		Buyanga West	164		Matheniko South/Moroto Mn
11		Beleafe	88	Kiboga	Kiboga Central	165		Nabilatuk
12		Kei	89		Kiboga East	166		Namalu
13		Koboko County	90	Kisoro	Kisoro District	167		Rupa
14		Madi-Okollo South	91	Kitgum	Aruu Central	168	Moyo	Adropi
15		Maracha County	92		Awere	169		Obongi South
16		Odupi	93		Chua Central	170		West Moyo County East
17		Rigbo	94		Chua West	171		West Moyo County West
18		Terego West	95		Lira - Palwo	172	Mpigi	Busiro North
19		Vurra South	96		Lokung	173		Busiro South and Entebbe Mn
20	Bundibugyo	Bwamba North	97		Padibe	174		Butambala East
21		Harugali	98		Paimol	175		Butambala West
22	Bushenyi	Buhweju County	99		Parabongo	176		Gomba East
23		Bunyaruguru Central	100		Patongo	177		Kabulasoke
24		Igara County	101	Kotido	Abim	178		Kyadondo North
25		Kajara County	102		Alerek	179		Maddu
26		Katerera	103		Jie North	180		Mawokota North
27		Ruhinda County	104		Kaabong	181		Mawokota South
28		Rushenyi County	105		Kapedo	182	Mubende	Bukuya
29		Sheema County	106		Kathile	183		Busujju East
30	Gulu	Amuru	107		Lolelia	184		Buwekula Central
31		Anaka (Payira)	108		Nakaperimoru	185		Buwekula North
32		Aswa/Omoro East	109		Napore (Karenga)	186		Kasambya
33		Aswa/Omoro South	110		Sidok (Kopoth)	187		Kassanda South
34		Aswa/Omoro West/Gulu Mn	111	Kumi	Bukedea North	188		Kitenga
35		Bobi	112		Bukedea South	189		Maanyi
36		Lamogi	113		Ngora North	190		Mityana County
37		Pabbo	114		Ngora South	191	Mukono	Bbaale South
38	Hoima	Bugahya East	115	Lira	Dokolo North	192		Buikwe North
39		Bugahya North	116		Erute South and Lira Mn	193		Buikwe South
40		Buhanguzi East	117		Kioga East	194		Kome Islands
41		Buhanguzi West	118		Moroto County East	195		Mukono North
42	Iganga	Bugweri County	119		Otuke East	196		Mukono South
43		Bukooli North	120	Luwero	Bamunanika South	197		Nakifuma Central
44		Bukooli West	121		Baruli Central	198		Ntenjeru County
45		Bunya North	122		Kakooge	199		Seeta
46		Bunya South	123		Kalungi	200	Nebbi	Jonam South
47		Busiki County	124		Katikamu North	201		Okoro County
48		Buyinja	125		Katikamu South	202		Padyere Central
49		Kigulu County	126		Kikyusa(Kamira)	203	Pallisa	Budaka County
50		Luuka North	127		Nakaseke Central	204		Butebo County
51		Luuka South	128		Nakaseke South	205		Kibuku County
52	Jinja	Jinja District	129	Masaka	Bukomansimbi County	206		Pallisa County Central
53	Kabale	Ndorwa County/Kabale Mn	130		Bukoto East and Masaka Mn	207	Rakai	Kabula North
54		Rubanda East	131		Bukoto West	208		Kabula South
55		Rubanda West	132		Kalungu County	209		Kooki North
56		Rukiga County	133		Lwemiyaga County	210		Kooki South
57	Kabarole	Bunyangabu County	134		Mawogola South	211		Kyebe
58		Burahya Central/Fort Portal	135		Mijwala	212		Kyotera County
59		Kahunge	136	Masindi	Budongo	213	Rukungiri	Bujumbura South
60		Kamwenge	137		Buruuli Central	214		Bwambara
61		Kitagwenda County	138		Kibanda South	215		Kinkiizi North
62		Kyaka North	139		Kiryandongo	216		Kinkiizi South
63		Mwenge North	140		Mutunda	217		Rubabo County
64		Mwenge South	141	Mbale	Bubulo County	218	Soroti	Kaberamaido County
65		Mwenge West	142		Budadiri County	219		Kalaki County
66		Nkoma	143		Bulambuli South	220		Kasilo County
67	Kalangala	Kyamuswa East	144		Bungokho County/Mbale Mn	221		Orungo
68		Mazinga	145		Manjiya County	222		Soroti County North
69	Kampala	Kampala District/Makindye	146	Mbarara	Buremba	223		Soroti County South/Soroti Mn
70	Kamuli	Budiope East	147		Ibanda Central	224		Usuk
71		Budiope West	148		Ibanda North	225		Usuk County West
72		Bugabula East	149		Isingiro North	226	Tororo	Bunyole County
73		Bugabula West	150		Isingiro South	227		Kisolo (West Budama) County
74		Bulamogi County	151		Kashari East/Mbarara Mn	228		Samya - Bugwe County
75		Buzaaya County	152		Kashari West	229		Tororo County and Tororo Mn
76	Kapchorwa	Binyini	153		Kashongi			
77		Kongasis County	154		Kazo Central			

Localities in Figure A1 but not listed above, were not surveyed in the DHS waves used in this study

Appendix 2

Table A2: A Description of Conflict Localities

District	Locality Name	Obs.	Conflict Window: Start	End	Total Months	Exposed: Yes	No	Months Exposed: Mean	s.d.
Apac	Kole North	48	2002m7	2006m6	48	5	43	2.54	9.31
Apac	Kwania North	44	2005m1	2005m1	1	6	38	0.14	0.35
Apac	Maruzi North	33	1994m4	2006m4	145	33	0	24.00	16.08
Apac	Oyam North	28	1987m7	2005m3	213	28	0	25.75	17.83
Apac	Oyam South	104	2002m3	2005m3	37	10	94	2.09	6.99
Gulu	Amuru	1	2005m2	2006m8	19	1	0	17.00	.
Gulu	Anaka (Payira)	9	1998m11	2006m8	94	9	0	31.11	18.33
Gulu	Aswa/Omoro East	9	1998m6	2005m7	86	5	4	11.78	12.72
Gulu	Aswa/Omoro South	7	1998m11	2006m2	88	7	0	20.29	20.96
Gulu	Aswa/Omoro West/Gulu Mn	52	1988m1	2006m8	224	52	0	20.12	12.29
Gulu	Bobi	3	2000m5	2005m10	66	3	0	12.67	3.51
Gulu	Lamogi	5	1998m9	2006m7	95	5	0	29.00	16.00
Gulu	Pabbo	16	1987m4	2005m2	215	16	0	18.13	14.14
Kitgum	Aruu Central	11	2001m4	2006m7	64	11	0	24.91	13.67
Kitgum	Awere	5	1998m4	2004m12	81	5	0	15.00	15.28
Kitgum	Chua Central	9	1996m4	2006m8	125	9	0	22.00	11.94
Kitgum	Chua West	7	1990m5	2007m3	203	7	0	15.14	9.96
Kitgum	Lira - Palwo	5	1998m4	2005m12	93	5	0	24.40	16.53
Kitgum	Lokung	7	2004m4	2005m7	16	7	0	12.43	3.46
Kitgum	Padibe	3	1991m5	2005m5	169	3	0	25.00	11.53
Kitgum	Parabongo	7	1997m2	2006m8	115	7	0	30.43	23.35
Kitgum	Patongo	3	1988m6	2005m12	211	3	0	14.33	11.02
Lira	Dokolo North	42	2003m8	2004m2	7	2	40	0.33	1.51
Lira	Erute South and Lira Mn	118	1987m3	2005m4	218	118	0	23.34	14.87
Lira	Kioga East	42	2004m1	2004m2	2	5	37	0.21	0.61
Lira	Moroto County East	78	1988m6	2004m1	188	78	0	25.91	18.29
Lira	Otuke East	25	1998m5	2005m10	90	13	12	12.04	12.93
Soroti	Kaberamaido County	39	1987m8	2003m11	196	39	0	23.64	15.22
Soroti	Kalaki County	1	1987m8	2003m11	196	1	0	16.00	.
Soroti	Orungo	4	2003m3	2005m9	31	4	0	15.75	14.08
Soroti	Soroti County North	2	2003m6	2003m12	7	2	0	7.00	0.00
Soroti	Soroti County South/Soroti	64	1987m3	2005m9	223	64	0	24.05	14.20
Soroti	Usuk County West	4	1998m4	2004m11	80	4	0	26.50	14.84
Arua	Kei	41	1998m7	1998m7	1	9	32	0.22	0.42
Moyo	West Moyo County East	2	2001m5	2005m4	48	2	0	19.00	19.80
Moyo	West Moyo County West	18	1996m9	2001m3	55	10	8	17.67	19.83
Nebbi	Jonam South	19	1997m10	1997m10	1	8	11	0.42	0.51
Nebbi	Padyere Central	38	1996m9	2006m8	120	26	12	19.32	19.81
Kotido	Abim	3	2003m5	2003m5	1	3	0	1.00	0.00
Kotido	Kaabong	5	2004m6	2004m6	1	5	0	1.00	0.00
Moroto	Matheniko South/Moroto Mn	21	1998m12	2004m2	63	9	12	5.48	8.65
Jinja	Jinja District	154	1987m10	2003m6	189	154	0	24.65	15.60
Kamuli	Budiope West	65	2004m2	2004m2	1	5	60	0.08	0.27
Kapchorwa	Binyini	2	2003m3	2003m4	2	2	0	2.00	0.00
Hoima	Bugahya North	24	1995m10	1996m7	10	1	23	0.21	1.02
Masindi	Budongo	26	2001m3	2005m12	58	3	23	4.77	13.80
Masindi	Kiryandongo	4	2005m11	2005m11	1	4	0	1.00	0.00
Mubende	Buwekula North	46	2000m9	2000m9	1	28	18	0.61	0.49
Bushenyi	Katerera	34	2000m12	2000m12	1	17	17	0.50	0.51

Appendix 3

As discussed in Section 3.3, the majority of LRA conflict events occurred in districts dominated by Nilotic ethnic groups, with the former districts of Gulu, Kitgum, Lira, Apac and Soroti accounting for 1842 of the 1947 recorded battles or acts of one-sided violence listed in the ACLED dataset (94.6%). The ethnic Acholi (Gulu and Kitgum), Langi (Lira and Apac) and Iteso (Soroti), within these areas, share anthropological links to some of the tallest people in Africa, notably the Dinka of southern Sudan, and the Maasai (Samburu) and Turkana, of neighbouring Kenya (Shoup, 2011).

To establish whether significant height differences exist between the adult women of these Nilotic groups and the predominantly Bantu African groups further South, a sample of 1720 adult women is taken from the 1995 DHS survey. This sample only includes women who were at least 18 years old (to 49 years old) in 1986 and, therefore, should have achieved full adult height before the LRA conflict began.[35]

The first model in Table A3 reports results from a simple bivariate regression of women's ethnicity on height, where the dependent variable is a binary indicator of belonging to one of the three ethnic groups (Acholi, Langi or Iteso). The second estimation reports similar results, disaggregating the groups to establish whether height disparities are apparent in all three ethnicities (relative to those not in these groups). Based on this simple analysis, the average height advantage of these women appears to be upward of 4.7 centimetres, with significant results for all groups individually. Furthermore, controlling for variations in the ages of women, in models 3 and 4, does nothing to change this interpretation. The results in models 5 to 8 repeat the estimations

[35]Unfortunately, the 1995 survey is the only relevant DHS wave where ethnicity is recorded. However, the dominance of the Nilotic groups, in the districts listed, is supported by the self-reported ethnic affiliation of the sample of women from this survey. In Gulu, 94.87% of the women identified as being a member of the Acholi group, in Lira and Apac, 89.5% and 93.6% identified as Langi, while the Iteso ethnic group accounted for 73.3% in Soroti district.

for the sub-sample of women coming only from conflict localities. The similarities in the magnitude of the coefficients strongly suggests that the disparity in height between these ethnic groups and others is also present within conflict localities.

Table A3: Ethnicity as a Determinant of Height - Women 18+ in 1986

Dep. Variable: height (cms)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Acholi/Langi/Iteso	4.757***		4.817***		4.282***		4.538***	
	(0.415)		(0.418)		(0.617)		(0.653)	
Acholi		4.012***		4.173***		3.460***		3.895***
		(0.539)		(0.575)		(0.725)		(0.888)
Langi		5.478***		5.466***		4.722***		5.005***
		(0.518)		(0.545)		(0.696)		(0.716)
Iteso		4.357***		4.450***		3.894***		4.051***
		(0.554)		(0.563)		(0.812)		(0.845)
Observations	1720	1720	1720	1720	295	295	295	295
R^2	0.070	0.071	0.083	0.084	0.101	0.104	0.173	0.176
Age Fixed Effects	No	No	Yes	Yes	No	No	Yes	Yes

Standard errors in parentheses * p<0.1, ** p<0.05, *** p<0.01

Appendix 4

Table A4: Table 2 Results - Control Coefficients Reported

Dep. Variable: height-for-age z-score	(1)	(2)	(3)	(4)	(5)	(6)
Conf Locality * Exposed	-0.239	-0.369**	-0.388**			
	(0.187)	(0.186)	(0.195)			
Conf Locality * Ex Duration				0.001	-0.011**	-0.011**
				(0.003)	(0.005)	(0.005)
Female child	0.146***	0.149***	0.152***	0.147***	0.148***	0.151***
	(0.031)	(0.032)	(0.031)	(0.031)	(0.032)	(0.031)
Birth order 4-6			-0.101**			-0.102**
			(0.046)			(0.046)
Birth order 7+			-0.296***			-0.296***
			(0.065)			(0.066)
Mother's height (cms)			0.049***			0.049***
			(0.003)			(0.003)
Mother married/cohabiting			0.036			0.037
			(0.067)			(0.067)
Mother's age (years)			0.017***			0.017***
			(0.004)			(0.004)
Mother primary educated			0.053			0.053
			(0.046)			(0.046)
Mother secondary educated			0.251***			0.252***
			(0.060)			(0.060)
Mother is daughter of head			-0.041			-0.040
			(0.101)			(0.101)
Mother not head/daughter			-0.240**			-0.238**
			(0.104)			(0.106)
Mother's time in location			-0.001			-0.001
			(0.002)			(0.002)
Urban DHS cluster			0.424***			0.421***
			(0.068)			(0.068)
Head's age (years)			0.005**			0.005**
			(0.002)			(0.002)
Head is male			0.057			0.055
			(0.051)			(0.051)
Observations	9202	9202	9202	9202	9202	9202
R^2	0.079	0.147	0.205	0.079	0.147	0.205
Locality Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Birth Cohort Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
District-Specific Trend	No	Yes	Yes	No	Yes	Yes

Locality clustered standard errors in parentheses * p<0.1, ** p<0.05, *** p<0.01

Table 2.A4 Continued

Dep. Variable: height-for-age z-score	(7)	(8)	(9)	(10)	(11)	(12)
Conf Locality * Ex 1-6m	-0.191	-0.200	-0.234			
	(0.213)	(0.215)	(0.218)			
Conf Locality * Ex > 6m	-0.315*	-0.659***	-0.651***			
	(0.165)	(0.194)	(0.222)			
Conf Locality * Ex 1-12m				-0.231	-0.298	-0.317
				(0.197)	(0.201)	(0.204)
Conf Locality * Ex > 12m				-0.258	-0.566***	-0.585**
				(0.171)	(0.200)	(0.227)
Female child	0.146***	0.149***	0.153***	0.146***	0.148***	0.152***
	(0.031)	(0.032)	(0.031)	(0.031)	(0.032)	(0.031)
Birth order 4-6			-0.101**			-0.102**
			(0.046)			(0.046)
Birth order 7+			-0.295***			-0.295***
			(0.066)			(0.066)
Mother's height (cms)			0.049***			0.049***
			(0.003)			(0.003)
Mother married/cohabiting			0.037			0.036
			(0.067)			(0.067)
Mother's age (years)			0.017***			0.017***
			(0.004)			(0.004)
Mother primary educated			0.053			0.054
			(0.046)			(0.046)
Mother secondary educated			0.250***			0.253***
			(0.060)			(0.060)
Mother is daughter of head			-0.040			-0.040
			(0.101)			(0.101)
Mother not head/daughter			-0.239**			-0.241**
			(0.105)			(0.105)
Mother's time in location			-0.001			-0.001
			(0.002)			(0.002)
Urban DHS cluster			0.423***			0.422***
			(0.069)			(0.068)
Head's age (years)			0.005**			0.005**
			(0.002)			(0.002)
Head is male			0.057			0.056
			(0.051)			(0.051)
Observations	9202	9202	9202	9202	9202	9202
R^2	0.079	0.148	0.206	0.079	0.147	0.205
Locality Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Birth Cohort Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
District-Specific Trend	No	Yes	Yes	No	Yes	Yes

Locality clustered standard errors in parentheses * p<0.1, ** p<0.05, *** p<0.01

Table A4 reports identical results to those found in Table 2, with the inclusion of the coefficients on the control variables (listed beneath Table 2). Focusing on controls at the level of the child, significant differences in height-for-age z-scores are notable between children's gender groups, although, this is likely to only represent the extent to which Ugandan children (of either gender) fit the growth patterns of the reference population. The variables representing birth order clearly influences the child's height, with those in the first three positions having significant height advantages over sibling born later. The characteristics of the child's mother also clearly exert influence on the results, while both the age of the head and the mother appear positively correlated with childhood height.[36] Interestingly, the relationship between these two household members shows evidence of a relative height deficit for children who are neither, the child or grandchild of the head (However, this does not necessarily imply a causal effect). Unsurprisingly, children in urban locations (as defined by the original DHS clusters) are taller than their rural counterparts, on average, yet there is no evidence of any overall effect on children's height associated with the gender of the household head, the marital status of the child's mother or the time she has spent in the current DHS cluster location.

[36]The head of the household and the mother of the child are different household members for 86.4% of the observations within the sample used in Table 2.

Appendix 5

Table A5 summarises the migration data taken from the Ugandan National Household Survey 2005/06.[37] Of those 669 households who migrated from one of the affected districts (listed in Table A5), only 147 left the original district (21.4%). Furthermore, within the group of 283 households who relocated specifically to avoid insecurity, only 30 (10.6%) moved to a new district.

Table A5: Uganda National Household Survey 2005/06 Migration History

Migrated Since 2001:		*For Any Reason*				*To Avoid Insecurity*			
District From	Sample Total	Total	Same District	Same Region	New Region	Total	Same District	Same Region	New Region
Mubende	289	44	39	1	4	0	0	0	0
Jinja	164	46	20	10	16	0	0	0	0
Kamuli	320	37	23	12	2	0	0	0	0
Kapchorwa	39	4	3	1	0	0	0	0	0
Soroti	141	39	27	4	8	15	10	1	4
Kotido	68	3	1	0	2	1	0	0	1
Moroto	57	5	2	0	3	3	1	0	2
Apac	316	61	38	22	1	11	5	6	0
Gulu	213	65	58	3	4	46	43	2	1
Kitgum	166	129	121	3	5	118	115	1	2
Lira	240	135	122	11	2	82	72	10	0
Arua	367	34	31	1	2	0	0	0	0
Moyo	57	16	15	1	0	7	7	0	0
Nebbi	116	17	12	0	5	0	0	0	0
Hoima	86	11	5	4	2	0	0	0	0
Masindi	110	23	9	0	14	0	0	0	0
Total	2749	669	526	73	70	283	253	20	10

[37] Uganda Bureau of Statistics (2008), Uganda National Household Survey 2005/2006, Version 1.0 of the public use dataset, provided by the National Data Archive. www.ubos.org

Appendix 6

Table A6: Mother's Time in Location on Height-for-Age, by District

District	Obs.	dy/dx	se	t stat	p-value
Apac	337	−0.001	0.014	−0.094	0.926
Arua	536	−0.004	0.004	−0.896	0.373
Bushenyi	378	−0.002	0.005	−0.442	0.660
Gulu	102	−0.215	0.020	−10.578	0.000***
Hoima	141	−0.033	0.017	−1.999	0.049**
Kamuli	651	0.000	0.010	0.010	0.992
Kapchorwa	85	−0.001	0.003	−0.248	0.805
Kitgum	63	−0.005	0.008	−0.664	0.509
Kotido	111	−0.031	0.011	−2.816	0.006***
Lira	305	0.000	0.003	−0.048	0.962
Masindi	117	−0.006	0.005	−1.054	0.295
Moroto	115	−0.007	0.011	−0.623	0.535
Moyo	119	0.000	0.005	0.082	0.935
Mubende	398	0.001	0.008	0.191	0.849
Nebbi	139	0.013	0.007	1.963	0.053*
Soroti	224	0.004	0.002	1.618	0.110
Total	3975				

Locality clustered standard errors reported * $p<0.1$, ** $p<0.05$, *** $p<0.01$

The results shown in Table A6 report the marginal effects and standard errors of an additional year in the current location (based on the mother's time in location) on height-for-age z-score, by district. These marginal effects are based on an estimation of the model shown below.

$$haz_{idt} = \delta_t + District_d + \theta_1(Time\ in\ Location_i) + \theta_1(District_d * Time\ in\ Location_i) + \theta X_{idt} + \upsilon_{idt} \tag{a1}$$

In model (a1) haz_{idt} measure the height-for-age z-score of a child who resides in district d. The variable $District$ represents a district fixed effect, while $Time\ in\ Location$ measures the number of years the child's mother has lived in the current DHS cluster.

The term X represents the same control variables used in generating the results in Table 2. As the majority of relocation appears to have occurred within districts (see Appendix 5), only observations taken from children in the conflict-affected districts, who lived in localities which had not yet been affected by the insurgency, are used in the estimations.

The results indicate the presence of a negative correlation between time in location and height in observations from pre-conflict localities in Gulu, Hoima and Kotido districts. This negative correlation could represent a selection effect, driven by a relocation away from more severely affected localities, amongst relatively healthier children (see discussion in Section 6.1).