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By

Dimitri Tchakounte
University of Yaoundé II, Cameroon

and

Molambo Sambi Loic
University of Bangui, Central African Republic

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Contents

List of tables

List of figures

Abstract

For several decades, the Central African Republic (CAR) has been the scene of a succession of coups that have been accompanied by armed conflicts in many prefectures of the country. Children often suffer high rates of acute malnutrition during these armed conflicts. This study aims to analyse the impact of the 2003-2008 and 2012-2014 armed conflicts on child health using data from the 2010 and 2018 Multiple Cluster Surveys of the Central African Republic. Our identification strategy relies on exploiting both temporal and spatial variation across birth and prefectures cohorts to measure child exposure to the conflicts. From the difference-in-difference estimation, we find that height-for-age Z-scores and weight-for-age Z-scores are, respectively, 0.518 and 0.242 standard deviations lower for children born during the war. We also examine the impact of the total duration of exposure to conflicts, and the results indicate that an additional month of exposure significantly reduces both height-for-age and weight-for-age z-scores. We further perform robustness analysis, and the findings suggest that the effects are robust to considering the level of internally displaced persons across prefectures and the level of household wealth. As economic losses appear to be the most relevant mechanisms paired with the decline in child nutritional health in the CAR, interventions must promote agricultural empowerment of internally displaced persons, and initiate cash transfers and employment programmes aimed at rebuilding household assets in the absence of agricultural income. Moreover, rehabilitating basic social services, especially health infrastructure, can help alleviate the negative effects of conflict on child health through access to adequate health care during illness.

Keywords: Armed conflict; child health; height-for-age; weight-for-age; Central African Republic.

1. Introduction

Overview

According to the World Health Organization (2006), health is "a complete state of physical, social and mental well-being, and is not merely the absence of disease and infirmity." As such, it can be affected by non-strictly medical factors such as nutrition, drinking water and sewage systems, hygiene, education (Labourdette, 1992). For many years, several policies to improve the health of vulnerable populations, including women and children, have been defined. We may mention, for example, the Alma Ata conference in 1978, Lusaka in 1985, the Bamako Initiative (1987) and the World Summit for Children in 1990 with the common goal of "health for all" by 2000.[1] The international community has also focused on health in the Millenium Development Goals (MDGs),[2] which were reaffirmed with acuity in the context of Sustainable Development Goals (SDGs) as four goals out of 17 are directly related to health.

Health during childhood sets the stage for adult health. Therefore, investing in the health of children is justified not only because it fulfils a basic human right, but also because it is an investment with high social and private returns, and that poor health contributes to perpetuating poverty (Belli and Appaix, 2003). But it is recognized that malnutrition, a rapid form of weight loss brought on by starvation and/or disease (Loewenberg, 2015), has a whole range of effects that impede not only children’s nutrition and development in the short-term, but also their cognitive abilities and productivity in adulthood, with measurable economic impacts (Ruel and Hoddinott, 2008).

As indicated by Corley (2021), malnutrition refers to an imbalance between the intake of energy or nutrients and the body’s nutrition requirements. The term malnutrition encompasses both undernutrition (e.g., moderate and severe acute malnutrition; stunting, underweight; and micronutrient deficiencies) and overnutrition (e.g., overweight and diet-related noncommunicable-diseases). Malnutrition during childhood remains a global public health concern. In developing countries, this concern is acute since malnutrition causes almost half (45%) of child deaths, particularly in low socioeconomic communities of developing countries (Black et al, 2008; de Onis et al, 2013). Yet, child undernutrition is a factor in more than three million preventable childhood deaths (Yaya et al, 2020). In recent years, stunting and wasting have been gaining the attention of researchers on children's nutritional health

(Kamiya et al, 2018; McKenna et al, 2019; Shroff et al, 2009; Yaya et al, 2020). Stunting, which reflects chronic malnutrition, refers to a child who is too short for his age and it is associated with prolonged food insecurity or persistent illness. Wasting on its part, which reflects acute malnutrition, refers to a child who is too thin for his height, and illustrates an acute nutritional deficiency (McKenna et al, 2019).

In the world, 149 million children under the age of 5 years suffered from chronic malnutrition and 49 million children suffered from acute malnutrition in 2018 (UNICEF et al, 2019). In West and Central Africa, the prevalence of children who were stunted and wasted was 33.1% and 9%, respectively. In the Central African Republic (CAR), investigations from Multiple Indicator Cluster Survey (MICS) carried out from 2018 to 2019 indicate that 39.8% of children under the age of 5 years are suffering from stunting and 5.4% are wasted. Compared to 2010 (where prevalence of stunting and wasting were estimated at 38% and 7%, respectively), it appears that the situation regarding stunting has worsened, if the prevalence of wasting has improved. But the fact remains that effort must be made to reduce these rates since the under-five mortality rate, estimated at 103 deaths per 1,000 live births (MICS 2018-2019), is high and very far from the target of the third Sustainable Development Goal (SDG) by 2030 (reduce under-five mortality to no more than 25 per 1,000 live births).

According to MICS 2018-2019, the percentage of stunted children, estimated at 39.8% (21% at Bangui) has hardly changed, while the percentage of wasted children has dropped considerably and reached only 5.4% (5.9% in Bangui).

The government has made efforts to improve child health in the country. To this end, a National Health Development Plan (NHDP) was adopted in 2015 to reduce the ill-health condition of vulnerable groups by 2025. Concretely, this plan aims to : (i) ensure food security of vulnerable groups, especially children; (ii) rehabilitate and develop health infrastructures; (iii) increase the availability and quality of essential health care, especially food; (iv) reduce infant and maternal mortality; (v) stop the spread of endemic diseases; (vi) strengthen the health system; (vii) promote a favourable environment for health, including sustainable development, preparation and response to emergencies, etc. Internationally, the country is firmly committed to take action to achieve the SDGs following a recent analysis of some health indicators suggesting that the CAR is far from reaching the targets set under the SDGs.

Many factors (demographic and economic factors, insufficient dietary intake, infection and illness, lack of health services and socioenvironmental factors) can be associated with the poor infant and child nutritional status. Among environment factors, armed conflicts is an important driver of acute malnutrition (Brück and d'Errico, 2019; Corley, 2021). For 60% of people experiencing acute food insecurity, armed conflict is a key precipitating factor (Food Security Information Network, 2018). It is relevant to focus on armed conflicts in the CAR insofar as these conflicts are frequent and often associated with the multiple coups that the country has recorded for several decades. However, even if the war undermines majority of the territory and the capital , it should be noted that some areas are very often safe. Therefore, we can postulate that a position relatively far from the conflict zones implies very good health for children compared to zones closer. This hypothesis thus leads us to look with a certain sharpness for the effect that armed conflicts could have on children's health.

History of armed conflicts in CAR between 2003 and 2014

The CAR has been the scene of several military-political crises that have considerably affected the economic and social environment. These crises generated armed conflicts that unfolded over several periods and in different ways. The objective of this section is to present the history of armed conflicts in CAR between 2003 and 2014, including the dynamics of child nutritional health indicators, with particular emphasis on the 2003-2008 conflict and the inter-communal civil war of 2012-2014.

Armed conflicts between 2003 and 2008

The 2003 coup

On 15 March 2003, a military operation brought General Francois Bozizé to power, and formed a new transitional government. However, the capital, Bangui, due to the reinforcement of Chadian troops within the Central African Economic and Monetary Community, the southern and eastern part of the country was relatively spared from the abuses of the armed men. The north-west of the country was in the hands of armed gangs for a long period, without a substantial presence of regular troops capable of ensuring public order for the entire population. The population of the prefectures of Ouham and Ouham Pende, already the most affected during the fighting that occurred between November 2002 and March 2003,[3] was affected by conflicts which occurred during the 2004-2007 Central African rebellions (Beninga et al, 2017). At that time, 37.9% (29.8% in Ouham, 40.4% in Ouham Pendé, 36.5% in Bangui and 49.2% in Lobaye, the prefecture with the highest level) and 8.6% (9% in Ouham, 9.2% in Ouham Péndé, 8.7% in Bangui and 13.3% in Basse Kotto, the prefecture with the highest level) of children under the age of five years were suffering from stunting and wasting, respectively, according to MICS realized in 2000.

The 2004-2007 Central African rebellions and the global peace agreement of 2008

This period was marked by the creation of several armed groups among which were the Movement of Central African Liberators for Justice (MCLJ), the Democratic Front of the Central African People (DFCP), the People's Army for the Restoration of Democracy (PARD) and the Union of Democratic Forces for the Rally (UDFR), which operated with an avowed aim of seizing power by force. The consequence of this combination of facts is that from 2005 to 2007, several towns in northern CAR such as Birao, Sam-Ouandja, Ouanda-Djalle, Ouadda and Ndele, fell in the hands of rebels. To contain these rebel groups, the government entered into negotiations with them

(UN Security Council, 2010). Estimates of MICS carried out in 2006 show that 37.5% (25.4% in Bangui and 48.8% in Ouham, the prefecture with the highest level) and 28.3% of children (26.2% in Bangui and 37.1% in Mambéré-Kadéi) were affected by stunting and wasting, respectively.

On 21 June 2008, given the peace agreement of Birao on 13 April 2007, and the ceasefire agreement of Libreville on 9 May 2008, a global peace agreement was signed between the government and the Central African politico-military movements (comprised of the PARD, the DFCP and the UFDR) to put an end to the conflicts that had been going on since 2003, to organize the inclusive political dialogue and to plan local elections in 2009, and parliamentary and presidential elections in 2010 (MINUSCA, 2015). Compared to MICS 2006, data by MICS collected in 2010 illustrate that the prevalence of stunting has increased to 40.5% (26.4% in Bangui) while the prevalence of wasting has decreased and reached 23.5% (21.5% in Bangui).

Spatial and temporal intensity of the 2012–2014 armed conflicts Seleka progressions

The rebel coalition of Séléka, formed by members of the Convention of Patriots for the Salvation of the Kodro (CPSK), the Convention of Patriots for Justice and Peace (CPJP), the UDFR, and of the DFCP led by Michel Am Nondokro Djotodia, resumed offensive armed attacks on 10 December 2012, to conquer the capital city of Bangui. After taking five towns since the offensive began, the coalition captured the mining town of Bria, killing 15 government soldiers. It also took the city of Kabo. The Central African Republic President called on his Chadian counterpart for military aid. Chad agreed to send troops, around 150 men and around 20 vehicles, specifying that they would be confined to an intervention role. On 20 December 2012, the rebels drove government forces out of the town of Batangafo, but the latter managed to retake Kabo, taken two days earlier by the rebels (International Peace Information Service, 2018).

On 23 December 2012, the coalition captured Bambari, the third largest city in the country. On 25 December 2012, it took control of the city of Kaga-Bandoro while President Bozizé received his military advisers in the capital, Bangui. On the night of 28 December to 29 December 2012, the French Ministry of Defence announced the deployment of 150 French soldiers to a base in Libreville, belonging to a company of parachute infantry. France already had 250 soldiers in the M'Poko base, located near Bangui airport, as part of the Boali mission. The same day, the Seleka forces advanced a little farther, this time taking the town of Sibut, located about 160 kilometres from Bangui. The Central African armies, supported militarily by Chad, sent troops to Damara, the last “lock city” to save Bangui. On 11 January 2013, the government officially announced the signing of an agreement concluded in Libreville between government forces and the rebels. This agreement stipulated that the president in office, François Bozizé, would remain as head of state for the transition until 2016, when the next presidential elections were scheduled (Beninga et al, 2017).

Resumption of fighting and occupation of Bangui by the Seleka

On 17 March 2013 in Sibut, 100km from Bangui, the Seleka rebels broke off negotiations with the Central African Republic government to which they issued an ultimatum. They demanded the release of prisoners, the validation of the ranks of the rebel officers, the integration of 2,000 of their fighters into the national army and the departure of the South African soldiers. The Seleka claimed that if these demands were not granted within three days, they would resume their offensive.

On 22 March 2013, rebel forces left Sibut and seized Damara. The Seleka were then 55km from Bangui. On 23 March, the fighting continued on the Bangui-Damara-Sibut road axis, at PK 55, 55 kilometers from the capital. Further west, a second rebel column seized Bossembélé and Boali. On the evening of 23 March 2013, the Seleka took up position 12km from Bangui. During the night, the rebels cut off electricity in the city. On Sunday 24 March 2013, the Seleka rebels announced the capture of the presidential palace. The same day, President Bozizé fled to Cameroon (International Peace Information Service, 2018).

On 10 January 2014, the President of the Central African Transition Michel Djotodia and his Prime Minister Nicolas Tiangaye announced their resignation during an extraordinary summit of the Economic Community of Central African States (ECCAS). On 15 January 2014, the Special Forces for Justice Revolution (SF-JR), led by Commander Sayo, attacked the Seleka in the north-west of the country. The movement published several statements in which it claimed to have won several fights against the Seleka. According to them, on 17 January 2014, they overpowered the Seleka between Boguila and Goré. On the 19 January 2014, a new clash took place in Sido, between Markounda and Bossangoa. On 20 January 2014, the National Transitional Council elected Catherine Samba-Panza as Head of the Transitional State of the Central African Republic. On the 22 January 2014, the SF-JR declared that they had killed 22 Seleka fighters in Boguila after fighting for two days with no loss in their ranks, from which they then seized Bodjomo (Marchal, 2015).

According to Amnesty International report published on 12 February 2014, massacres committed by Anti-Balaka against Muslims claimed around 30 lives in Boyali on 8 January 2014, five in Boali on 17 January, at least 43 in Bossemptélé from 16 to 18 January, and more than 100 in Bossembélé on 18 January. For their part, the Selekas killed 24 Christians in Bata on 31 December 2013, then more than 100 others in Baoro on 22 January 2014. In February 2014, Anti-Balaka assassinated 72 men in Guen, not far in another village, the Seleka killed 19 people. On 10 April 2014, clashes in Dekoa between Seleka and Anti-Balaka left at least 37 dead. From 13 to 16 April 2014, fighting in Grimari between Seleka and Anti-Balaka left several dead (Marchal, 2015).

On 26 April 2014, the Seleka attacked Boguila after having murdered several people on the way. The rebels kill 16 people in hospital, including three employees of Doctors without Borders. On 1 May 2014, Markounda was attacked by Fulani rebels who killed 20 to 30 people, 15,000 inhabitants then fled and took refuge in Komba, in Chad. At the start of the month, further violence in Paoua left at least 55 dead. Between 1 and 5 May, clashes also took place in Mala between Seleka and Anti-Balaka, leaving at least 30 dead and around 10 injured. After this violence, the French forces of Operation Sangaris launched a reconnaissance mission between Bossangoa and Paoua. But on 5 May 2014, in Boguila, the French were attacked by a group of around 40 armed men who may have been part of the Seleka from Bémal. The attack was repulsed after three hours of fighting and between 10 and 15 attackers were killed. On 6 May 2014, fighting between Seleka and Anti-Balaka left 13 dead in Kaga Bandoro, including two civilians. On 10 May 2014, the insurgent Seleka and Peuls attacked the village of Dissikou, near Kaga Bandoro, and killed several residents, 13 people were burnt alive in a house (Carayannis and Lombard, 2015).

On 11 May 2014, in Gallo, in a village located on the Cameroonian border, between Bouar and Garoua-Boulaï, the Anti-Balaka fell into an ambush set up by the Seleka and the insurgent Peuls. The confrontation left at least four dead on the side of the Anti-Balaka and six among the Seleka and the Peuls. On 5 June 2014, fighting took place in Boyo, according to a Seleka officer, a man from his movement was killed, along with 18 Anti-Balaka. On 9 and 10 June 2014, fighting between Seleka and Anti-Balaka left at least 22 dead in the village of Liwa, near the town of Bambari, where after the clash, the Seleka publicly executed two prisoners. On 19 une 2014, in Sabanga, Seleka men killed five people from a family, including two children. On 30 June 2014, in the village of Kono, in the region of Nzako in the southeastern part of the Central African Republic, the Ugandan army attacked Seleka soldiers, mistaking them for men of the Lord's Resistance Army. The fight left at least 15 dead among the Seleka and several killed on the side of the Ugandans. Towards the end of June, fighting between Seleka and Anti-Balaka in the centre of the city of Bambari left around 100 dead. Two weeks later, on 7 July 2014, Seleka attacked the Catholic Cathedral of Saint Joseph, 26 people, including 11 women, were killed and 35 others were injured according to the Red Cross (MINUSCA, 2015).

Cessation of hostilities and peace agreements

On 23 July 2014, a cessation of hostilities agreement was signed in Brazzaville after three days of negotiations. The agreement was signed by Mohamed Moussa Dhaffane for the Seleka, by Patrice-Edouard Ngaissona for the Anti-Balaka and by 40 other delegates, including Denis Sassou-Nguesso, President of the Republic of Congo, the Archbishop of Bangui Dieudonné Nzapalainga, and Imam Layama Kobine, President of the Islamic community of the Central African Republic (African Union, 2014).

Statement of the problem

More than 25% of the world's population live in countries affected by conflicts (Avis, 2019). In Sub-Saharan Africa, armed conflicts have affected almost 60% of countries for more than 30 years (Palik et al, 2020). The deterioration of human development indicators in Sub-Saharan Africa is one of the consequences of multiple armed conflicts that affected the region, with the average value of the Human Development Index (HDI) of 0.423 in 2018. Most of the countries with low HDI and high infant mortality rate came out of a long period of armed conflict with the example of Angola, which recorded an average HDI of 0.581 in 2018 and an infant mortality rate of 180%, Burundi whose HDI in 2014 was 0.417 with an infant mortality rate of 142%, the Democratic Republic of Congo which registered an HDI of 0.457 and an infant mortality rate of 170%, and the CAR which over the same period recorded a HDI of 0.35, thus occupying the penultimate position of the ranking of 188 countries (PNUD, 2019).

Specifically in Central Africa, the Central African Republic (CAR) had a history marked by numerous sociopolitical and military crises characterized by multiple coups since its independence. Over the 10 presidents who have so far ruled the country between 1958 and 2016, five came to power via a coup accompanied by rioting and the formation of rebel groups. Over the past 16 years, recurrent military and political crises have led perpetual armed conflicts. This has accentuated the status of the fragility of the country and the level of vulnerability of groups such as farmers, women and children whose access to basic infrastructure has been greatly reduced, which led to the degradation of the level of socioeconomic and health indicators of the country, which remain among the lowest in the world (OCHA, 2022).

In general, populations affected by armed conflict experience severe public health consequences worsened by population displacement, food scarcity, and the collapse of basic health services, which together often give rise to complex humanitarian emergencies (Toole and Waldman, 1997; Vass, 2001). Conflict has both direct and indirect effects on people's health and on the overall health system (Vass, 2001). Armed conflicts can cause the displacement of people and an increase in infectious diseases (Mcdonnell et al, 2004). From its consequences, it is recognized that armed conflict is an important driver of acute malnutrition (Brück and d'Errico, 2019; Loewenberg, 2015). An estimated 124 million people are exposed to crisis-level food insecurity, a direct contributor to acute malnutrition, and, at present, all countries at risk of crisis levels of food insecurity experience significant armed conflict (Food Security Information Network, 2018). While acute malnutrition is damaging to individual's health all along the life course, it is particularly harmful for young children. Worldwide, almost 51 million children under-five are affected by acute malnutrition which is one of the greatest contributors to mortality within this age range (UNICEF et al, 2019; Ahmed et al, 2013).

In the CAR, 40% of children under-five are already chronically malnourished (MICS 2018-2019), a rate above the emergency threshold of 30%. Due to the combined impact of violence, insecurity, population displacements, limited access to food, health, water and sanitation services, rising food prices, and the socioeconomic repercussions of the COVID-19 pandemic, 27 localities[4] distributed in 14 health districts of the country currently show alarming levels of severe malnutrition among children under five years old (UNICEF, 2021). On average, more than 2% of children in these areas are at risk of severe malnutrition, and these exceed more than 3% in the numbers of displaced people around Bouar, near the border with Cameroon.

Therefore, from what preceding section, the nutritional health of children is a call for concern in the CAR. The persistence of armed conflicts could be one of the main causes attributed to this concern. Regarding the frequency and destructiveness of armed conflict, previous studies (Akresh et al, 2012; Arcand and Wouabe, 2009; Kreif et al, 2022; Minoiu and Shemyakina, 2014; Ricci et al, 2018; Shemyakina, 2011; Singhal, 2019) have spent efforts to analyse the effects of conflict on human capital, especially on health, even if most of these works neglect the idea that the effect of the conflicts on a child's health could depend on the duration of its exposure to the war. But in the context of the CAR, no similar study has been done in this country before. To the authors' knowledge, most of the works have instead been focusing on the links with the socioeconomic status of household (Iwanaga et al, 2009; Ricci et al, 2018; Vonaesch et al, 2021).

Statistics on children's health from MICS reports show that between 2006 and 2010, and 2010 and 2018, indicators of child's health, in particular their nutritional health have deteriorated, highlighting the 2003-2008 and 2012-2014 armed conflicts as the potential cause of this situation. Thus, armed conflicts are expected to have an impairing effect on children's health in CAR. Accordingly, it would be relevant to answer the question: What are the effects of 2003-2008 and 2012-2014 armed conflicts on children's health in the Central African Republic?

There is a growing interest in microeconomic research to examine the impact of conflicts on children's health in developing countries (Akresh et al, 2012; Arcand and Wouabe, 2009; Kreif et al, 2022; Minoiu and Shemyakina, 2014; Singhal, 2019), particularly in CAR for three main reasons. First, the country is still recovering from a deep political crisis that has accounted for its weakness, and at the same time, for its vulnerable groups. Access to health care is compromised because of the destruction and looting of health facilities and infrastructure. Then, the challenges on child health are enormous both nationally and internationally with the Sustainable Development Goals (SDGs) adopted in September 2015. Finally, from the local literature on the subject, studies on the relationship between armed conflicts and children's health are few and far bbetween.

Objectives of the study

The main objective of this work is to evaluate the impact of the 2003-2008 and 2012-2014 armed conflicts on children's health in CAR. Specifically, this paper is designed to:

- Measure the impact of armed conflicts on the nutritional status of children under the age of five years born during the conflicts;
- Measure the impact of the total duration of exposure to the conflicts on the nutritional status of children.

Hypotheses of the study

- Exposure to armed conflicts of children under age of five years born during the war negatively affect their nutritional status;
- The more the total duration of exposure to the conflicts increase, the more the negative impact of conflict on child's nutritional health increase.

2. Literature review

This study contributes to the literature by stressing the importance of early childhood conditions for human capital accumulation, in CAR. More recently, Kreif et al (2022) estimated the effect of different levels of internal conflict intensity on height-for-age, weight-for-age, and weight-for-height z-scores among children under five years old in Colombia. They used individual and municipality-level data for the period 2000–2010 and concluded that there is a harmful effect linked to the exposure related to conflict in utero and in early childhood for HAZ and WAZ. Moreover, the underlying pathways appear to operate during the period of the pregnancy and birth (in the form of maternal alcohol use, use of antenatal health care and skilled birth attendance), rather than during the post-birth period (via breastfeeding or vaccination).

Kaila et al (2021) analysed the immediate impact of Boko Haram attacks in the far-North of Cameroon on child welfare. Using data collected from the 2014 Multiple Indicator Cluster Surveys (MICS) and Demographic and Health Surveys (DHS) from 2004 to 2011, they found that Boko Haram attacks led to an immediate decrease in weight-for-height for children under five and a reduction in the use of health care services.

Singhal (2019) on his part analysed the causal evidence on early-life exposure to war on mental health status during adulthood in Vietnam. Using an instrumental variable strategy, the author found that early-life exposure to bombing during the American war in Vietnam had long-term effects that correspond to a one percent increase in bombing intensity during the period 1965–1975 which increased the likelihood of severe mental distress in adulthood by 16%. Akbulut-Yuksel (2017) estimated the causal long-term consequences of an exposure to war in utero and during childhood on the risk of obesity and the probability of having a chronic health condition in adulthood. The paper used the city-by-cohort variation in the German destruction that arose from the extensive Allied Air Forces aerial attacks during the Second World War (WWII) in a unique quasi-experiment. From the estimates of a difference-in-differences-type strategy, Akbulut-Yuksel (2017) argued that individuals who were exposed to WWII destruction, during the prenatal and early postnatal periods had higher BMIs and were more likely to be obese in their adulthood.

A seminal work on the relationship between armed conflicts and child health was carried out by Akresh et al (2012). They used household survey data from Eritrea to investigate the effect of exposure to the 1998–2000 Eritrea–Ethiopian war on children's health. They found that the HAZ z-scores were 0.45 standard deviation less for children living in war zones and the effects of the war were similar with or without the characteristics of the mother and the household. They also found that children born during the war in such areas were 0.42 standard deviation lower in terms of HAZ z-score, while children born before the war were 0.34 standard deviation lower in terms of HAZ z-score. Finally, Akresh et al (2012) proved that each additional month of exposure to war significantly reduced the z-score by 0.04. A similar study was conducted by Minoiu and Shemyakina (2014). The analysis involved the causal impact on children's health over the 2002–2007 civil war or conflict in Côte d'Ivoire; with the difference from the latter being rather the consideration of utero exposure of children to the conflict. Using household surveys collected before, during, and after the conflict, and information on the exact location and date of conflict events, Minoiu and Shemyakina (2014) argued that children from regions more affected by the conflict suffered significant health setbacks compared to children from less affected regions. The authors also documented possible war impact mechanisms and suggested that conflict-related household victimization is an important channel through which armed conflicts produce negative effects or impact on children's health.

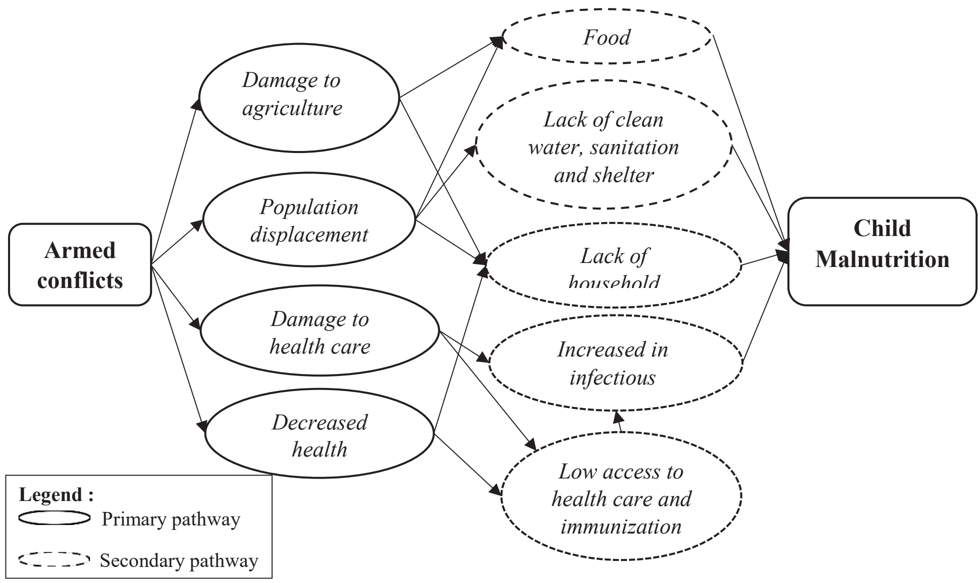
Using variation for the Nigerian civil war 1967-70 generated by secession of the Igbo-dominated south-eastern region, Akresh et al (2011) investigated long-run impact on human health capital using variation across ethnicity and cohort in Nigeria. They found that individuals exposed to the war at all ages between birth and adolescence exhibited reduced adult stature and the impact in each case became more pronounced in the adolescence age. Analyzing the effects of crop failures and civil conflict on the health of Rwandan children born between 1987 and 1991, Akresh et al (2011) proved that children affected by this shock have 0.390 standard deviation lower in terms of HAZ z-score. Furthermore, children born after the civil war in these regions had a 0.623 standard deviation lower in terms of HAZ z-score. Elsewhere, Bundervoet et al (2009)) focused on the effect of the duration of the civil war in Burundi on child health. In this war, every additional month of war exposure decreased the HAZ of children by a standard deviation of 0.47. By using the same type of anthropometric indicators, Arcand and Wouabe (2009) found similar results in the case of the civil war in Angola.

3. Methodology

Conceptual framework

The conceptual framework used in this research is adopted from Guha-Sapir and D'Aoust (2011) on the demographic and health consequences of civil conflict. The framework sketches the main pathways by which conflict can affect the lives (killed, injured and disabled) and health (abused mental damage, malnutrition and starvation, increased in infectious diseases) of civilians. According to this framework, the primary pathways are damage to agriculture, population displacement, damage to health care infrastructure and decreased health expenditure; while the secondary pathways are comprised of food shortage, lack of clean water, sanitation and shelter, low immunization coverage, low access to health care and lack of resources.

In our conceptual framework, child malnutrition is considered as the only outcome. All primary pathways remain unchanged. The outcome *Increase in infectious diseases* is rather considered as a secondary pathway since it contributes to the aggravation of the harmful effects of child malnutrition (Kaila et al, 2021). *Increase in infectious diseases* is impacted by *Low access to health care and immunization* (and the primary pathway *Damage to health care infrastructure*) which are merged into a single secondary pathway as they are both inputs in children health. We assimilate *lack of resources* here as *lack of household economic resources* since it is the unit within which the allocation and distribution of food resources to its members, in particular children, takes place. Since most households in CAR derive their income from agricultural activities (Gaskell et al, 2019), we add to the conceptual framework a link between the primary channel and the secondary channel. Thus, conflict-induced migrations will contribute to loss of income for these households, which justifies the theoretical link between the primary pathway *Population displacement* and the secondary pathway *Lack of household economic resources*.



Source: Adopted from Guha-Sapir and D'Aoust's (2011) conceptual framework

Data

The data used in this study comes from the fifth and sixth edition of the Multiple Indicator Cluster Survey (MICS) conducted, respectively, in 2010 and 2018 in the Central African Republic (CAR). These surveys were conducted by the Central African Institute of Statistics, Economic and Social Studies (ICASEES) with financial and technical support of the United Nations Children's Fund (UNICEF), the United Nations Population Fund (UNFPA), World Food Programme (WFP), the World Health Organization (WHO) and the World Bank. The datasets are a nationally representative cross-sectional survey that provides information and socioeconomic conditions of households and demographic topics such as fertility, child mortality, health service utilization, and nutritional status of mothers and young children.

The sample of the MICS database has been chosen to provide estimates for a large number of indicators on the situation of children and women at national level, by area of residence, and for all 17 prefectures covered by the survey, and structured into seven regions: region 1 (Ombella-Mpoko, Lobaye), region 2 (Mambéré-Kadéï, Sangha-Mbaéré, Nana-Mambéré), region 3 (Ouham, Ouham-Péndé), region 4 (Kémo, Nana-Grébizi, Ouaka) , region 5 (Bamingui-Bangoran, Haute-Kotto, Vakaga), region 6 (Basse-Kotto, Mbomou, Haut-Mbomou) and region 7 (Bangui). Urban and rural areas of these prefectures were identified as the main sampling strata. In each stratum, a number of enumeration areas (EAs) were selected systematically with a probability proportional to its size. After the list of households were established in selected enumerated areas, a systematic sample of 28 clusters (households) was chosen from each. A representative sample of 10,474 and 9,037children aged 0–59 months could be drawn at the end of 2010 MICS5 and 2018 MICS6, respectively, and information on children were obtained from women between the ages of 15 and 49. However, the study does not consider children whose information on anthropometric indicators were not reported or flagged (305 in 2010 and 116 in 2018). Finally, empirical investigations will focus on samples of 10,169 and 8,921 children under age five, respectively, in 2010 and 2018.

Armed Conflict Location and Event Data Project (ACLED) dataset will also be used to illustrate the spatial and temporal intensity of these conflicts, and more specifically, to identify conflict-affected prefectures, the exact dates and locations of violent incidents during the conflict, including riots, protests, armed battles, and violence against civilians.

Measurement of variables

Outcomes

The outcome of this study is the child' health, measured by the nutritional status. Two indicators of child's nutritional status are used: height-for-age Z-score (HAZ) and weight-for-age Z-score (WAZ). Z-score is defined as the difference between the child's height and the median height of the same-aged international reference population, divided by the standard deviation of the reference population (WHO, 2006). However, if height-for-age, weight-for-age and height-for-weight Z-score are the main anthropometric indicators of child nutritional health, this study does not consider height-for-weight Z-score because it is a combined indicator of height-for-age and weight-for-age Z-score (Amare et al, 2019; McKenna et al, 2019).

Measurement of armed conflict

The variable used to measure the effect on children's health is armed conflict. Indeed, this appears difficult to measure since it is basically not observable. To overcome this obstacle, we use the armed conflict by a child's exposure to 2005-2008 and 2012-2013 armed conflicts. Three measures of a child's exposure to conflict are used in this study, where all are related to region-birth and cohort level. The first measure is the interaction of a binary indicator of residence in a conflict prefecture (at the time of the conflict) with a binary variable indicating whether the child was alive during the conflict (i.e. born during the conflict). This measure is denoted *conflict prefecture*Bornduringconflict*.

The second measure of a child's exposure to conflicts accounts for the total duration of exposure, since we assume that the impact on child's health of conflicts could depend on the length of exposure. In other words, we assume that the impact of the war could not be the same on children born at the beginning of war and children born at the end of the conflicts (if they were living in a conflict prefecture). We consider the duration in months and setting it equal to zero if the child lived in a non-affected prefecture or if the child was born after the war had ended.[6] This measure of armed conflicts is denoted *conflict prefecture*Durationofexposure*.

Control variables

The control variables are divided into three categories: child characteristics, mother characteristics and household characteristics. Child characteristics include child sex and child age, mother characteristics include marital status, level of education, religion and body mass index (BMI), while household characteristics is comprised of sex and education of household head, number of living children and wealth index.

Empirical identification strategy

It is worth recalling that the main objective of this study is to evaluate the general impact of armed conflicts on children's nutritional status, measured by the anthropometric variables (HAZ and WAZ). The difference-in-differences method is used to evaluate this impact since from the data, it could be possible to compare change in children health over time. More precisely, by using MICS 2010 and MICS 2018, the difference-in-differences method helps to compare the nutritional status of children exposed to conflicts before the conflict starts and after the conflict ends with the situation of non-exposed children.

Like most impact evaluation methods, the difference-in-differences method assumes the construction of two groups, notably a treatment group and a control group (the counterfactual), and two periods: a pre-conflict period and a post-conflict period. Then, the first difference between the two groups is assessed before the conflict and the second difference is assessed after the conflict, and the difference of the differences is therefore evaluated. This process is depicted in Table 1, where *H* represents child's heath outcome (height-for-age Z-score or weight-for-age Z-score):

Table 1: Difference-in-differences non-parametric process

	Before conflicts	After conflicts	Change over time
Treatment group (TG)	H_{10}	H_{11}	$\Delta H_{TG} = H_{11} - H_{10}$
Control group (CG)	H_{20}	H_{21}	$\Delta H_{CG} = H_{21} - H_{20}$
Difference in Differences (DD)	$DD = \Delta H_{TG} - \Delta H_{CG}$		

Source: Constructed by authors.

The construction of the treatment and control groups is based on the spatial and temporal intensity of the armed conflicts in CAR reported by the ACLED dataset synthesized by Table 3. In fact, from Table 2 it comes out that treatment group is comprised of children living in conflict-affected prefecture and born during the conflict

(2005-June 2008 for the first round of conflict and the 2010 data, and 2013-July 2014 for the second round of conflict and the 2018 data).[7] The control group is comprised of children born after the peace agreements, that is children born July 2008-2010 (for the first round of conflict and the 2010 data) and August 2014–2018 (for the second round of conflict and the 2018 data).

Table 2: Construction of treatment and control groups

Prefecture / Birth cohort	Conflict-affected prefectures[8]: Bangui; Mbomou; Kemo; Ouaka; Basse-Kotto; Ombella Mpoko; Nana-Mamberé Nana-Gribizi; Vakaga	Non-conflict prefectures : Haut-Mbomou ; Haute-Kotto ; Bamingui-Bangoron Lobaye ; Sangha-Mbaéré Mambéré-Kadéï ; Ouham ; Ouham-Péndé
Children born July 2008-2010 and August 2014–2018 (after peace agreements)	Non-exposed children: control group	Non-exposed children: control group
Children born 2005-June 2008 and 2013-July 2014[9] (during the conflicts)	Exposed children: treatment group	Non-exposed children: control group

Source: Constructed by authors

However, to better understand the effect on child's health of armed conflicts by controlling region-fixed effect and birth cohort-fixed effects, the difference in differences estimator will be estimated through a parametric model. Since the dependent variables (height for age z-scores and weight for age z-score) are quantitative and continuous, a linear regression model will be estimated for each anthropometric measure.

We follow Akresh et al (2012) in estimating the following empirical specifications with prefecture and birth-cohort fixed effects:

(i.) Empirical specification 1: Considering children born during the conflict

$$CH_{ipt} = \alpha_p + \delta_t + \rho_t + \beta_1(ConflictZone_p * BornDuringConflict_t) + \varphi X_{ipt} + \varepsilon_{ipt} \quad (1)$$

Where CH_{ipt} represents child's health and measured by HAZ_{ipt} and WAZ_{ipt}, respectively, for child i born in time period t in prefecture p. α_p are prefecture fixed effects, δ_t are year of birth cohort fixed effects and ρ_t are survey year fixed effects (given the two rounds of data). Controlling for prefecture fixed effects allows us to account for prefecture-specific unobserved characteristics, and thus removes any bias caused by the correlation between these characteristics and exposure to the conflicts. Birth cohort-fixed effects control for global factors that simultaneously affect the health of each cohort. β_2 measures the conflict's impact on children's height-for-age Z-scores and weight-for-age Z-scores for children who were born during the conflict in conflict-affected prefectures.[10] X_{ipt} are parental and household characteristics, and ε is a random, idiosyncratic error term. The coefficient β_1 measures the conflict's impact on children's height-for-age Z-scores for children who were alive during the war in war-affected prefectures.

(ii.) Empirical specification 2: Considering the total exposure duration to the conflicts

Elsewhere, we conceive in this study the fact that the effect of war on the health of children born in 2005 could not be the same on the health of children born several months/years later (in the interval between 2005-2008). In other words, we assume in this study that the effect of armed conflict could also depend on the exposure duration of children, since they were not born at the same time. Thus, it would be interesting to take into account the total exposure duration of children when analysing the effects of armed conflicts. Consequently, in addition to estimating the effect based on whether a child was born during the war, we also estimate fixed effects regressions with a continuous measure of conflicts exposure:

$$CH_{ipt} = \alpha_p + \delta_t + \rho_t + \beta_2\left(ConflictZone_p * DurationofExposure_t\right) + \varphi X_{ipt} + \tau_{ipt} \quad (2)$$

$DurationofExposure_t$ refers to the months of exposure to the war for a child living in a conflict prefecture p. The coefficient $\beta_2\beta_2$ measures the effect of an additional month of war exposure on children's height-for-age and weight-for-age Z-scores.

(iii.) Identification Assumption

As in the study of Shemyakina (2011) and Minoiu and Shemyakina (2014), the correct estimation of Difference-in-Difference regressions is based on a key assumption. Correct identification of $\beta_1\beta_1$ (respectively $\beta_2\beta_2$) relied on the implicit assumption that differences across birth cohorts (cohort of children born during the conflicts and cohort of children born after the war) in average height-for-age Z-scores and weight-for-age Z-score would be similar across conflicts and non-conflicts regions in the absence of the conflict. The probability that in CAR there could have been other events affecting women's and children's health during the period of the conflict is low. The economic recession observed in the country between 2005 and 2010 and between 2013 and 2015 is partly due to armed conflicts mostly located in the mining areas.

In fact, mineral resources and agriculture production are the main sources of the CAR's economic growth. However, the war has negatively affected the exploitation of raw materials from the mining sector and agricultural activities, which plunged the country into a severe economic recession and a decline in living standards of households. Thus, we may be correctly attributing the decline in the nutritional health indicators of exposed children cohort to the war.

This assumption can be illustrated by the figures below: *(i)* Figures 1 and 2 which show, respectively, the kernel density of HAZ and WAZ in war prefecture and non-war prefectures in 2010 (uniquely for children born after June 2008), and *(ii)* Figures 3 and 4, which show the kernel density of HAZ and WAZ in war prefecture and non-war prefectures in 2018 (for children born after July 2014). These figures revealed that in the absence of conflict, that is after June 2008 (for the 2003-2008 armed conflict) and after July 2014 (for the 2012-2014 armed conflict), children of the treatment group and those of the control group have similar characteristics in terms of nutritional health indicators. Therefore, the impact on the health of children that will be found has a high probability to be attributable to the conflicts.

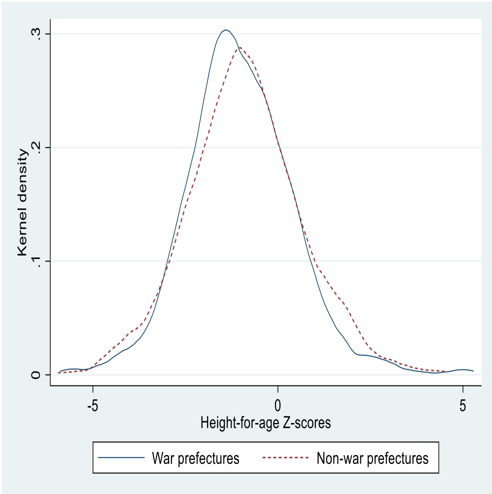


Figure 1: Kernel density of height-for-age Z-scores in CAR in 2010 (War and Non-War prefectures).

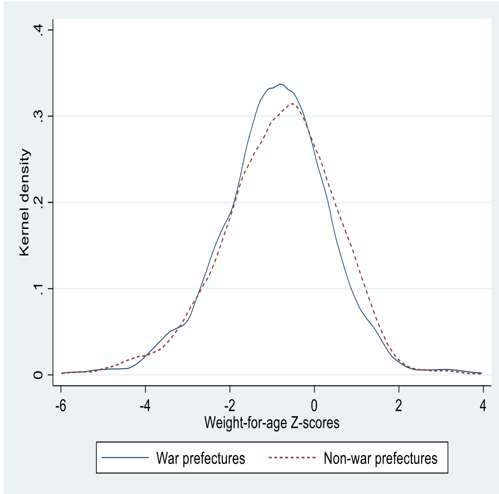


Figure 2: Kernel density of weight-for-age Z-scores in CAR in 2010 (War and Non-War prefectures).

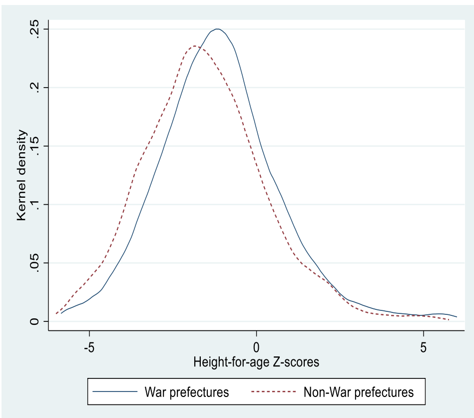


Figure 3: Kernel density of height-for-age Z-scores in CAR in 2018 (War and Non-War prefectures).

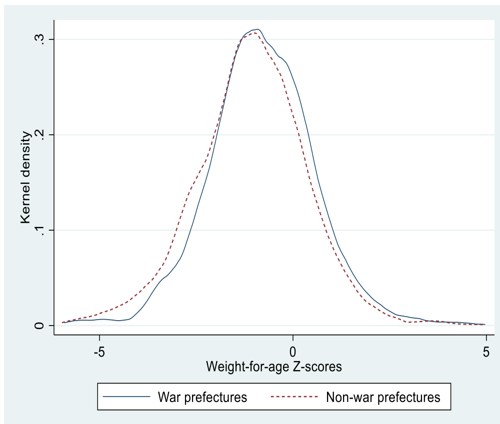


Figure 4: Kernel density of weight-for-age Z-scores in CAR in 2018 (War and Non-War prefectures

Notes: Kernel local polynomial regression (using Epanechnikov kernel) of HAZ and WAZ

4. Empirical results and discussion

Results of descriptive statistics

Table 3 gives the descriptive statistics of variables, and it comes out that in 2010, on average, across households in all regions of CAR, children were 1.61 and 1.16 standard deviations below the average height-for-age and weight-for-age of a reference child. In 2018, children were 1.47 and 1.026 standard deviations below the average height-for-age and weight-for-age of a reference child. Average height-for-age z-scores ad weight-for-age z-scores were also higher in conflict regions no matter the year. The mean-comparison test illustrates that the differences in average height-for-age z-scores and weight-for-age z-scores between conflicts and non-conflicts prefectures, respectively, are statistically significant. By composition, 50.46% of children are girls, and 21.75% are aged 0-11 months, 19.52% are aged 12-23, 20.06% aged 24-35 months, 20.32% aged 36-47 months and 18.35% are aged 48-59 months.

Concerning the characteristics of mothers, their average age is 28 years, 81.88% are married and most of them are Christian (85.53%), followed by Muslim (11.00%) and other religions (2.31%). Moreover, 41.26% of mothers are uneducated, 49.89% have primary level of education, 8.85% have secondary level (or more), and a high proportion of them are thin (92.51%). Regarding the characteristic of household, 22.46% of household heads are women, and 22% of them are uneducated, 55.79% have primary level of education and 22.21% have secondary level (or more). Most of households are located in rural areas (65.84%). The average number of living children is three. Regarding household wealth, 22.94% are poorest, 22.16% are poor, 21.81% have an average wealth, 19.03% were rich and 14.06% were richest. Finally, the composition of birth cohort shows that in 2010, 69.78% of children were born during war (that is between 2005 and June 2008) and 68.75% of them were born inside conflict zones. In 2018, 30.43% of children were born during war (that is between 2013 and July 2014) and 30.71% of them were born inside conflict zones.

Table 3: Descriptive statistics of variables

	Prefecture cohort		Total	Difference (1)-(2) (*p-value* of mean-comparison test)
	Non-affected prefectures (1)	Conflict-affected prefectures (2)		
Outcomes (mean)				
Height-for-age z-score (2010)	-1.639	-1.586	-1.610	-0.053 (0.047)
Height-for-age z-score (2018)	-1.732	-1.290	-1.474	-0.442 (0.000)
Height-for-age z-score (pooled)	-1.681	-1.441	-1.545	-0.240 (0.000)
Weight-for-age z-score (2010)	-1.187	-1.145	-1.164	-0.041 (0.051)
Weight-for-age z-score (2018)	-1.1867	-0.911	-1.026	-0.276 (0.000)
Weight-for-age z-score (pooled)	-1.187	-1.029	-1.097	-0.157 (0.000)
Child characteristics (%)				
Child is female	50.99	50.06	50.46	
Child age: 0-11 months	21.56	21.89	21.75	
Child age: 12-23 months	19.22	19.75	19.52	
Child age: 24-35 months	20.11	20.02	20.06	
Child age: 36-47 months	20.83	19.93	20.32	
Child age: 48-59 months	18.28	18.40	18.35	
Mother characteristics (%)				
Mother age (in years) (mean)	28.287	27.972	28.108	
Marital status: not married	18.00	18.21	18.12	
Marital status: married	82.00	81.79	81.88	
Education : uneducated	42.26	40.50	41.26	
Education : primary	51.80	48.43	49.89	
Education : ≥ secondary	5.94	11.08	8.85	
Religion : other	2.53	2.88	2.73	
Religion : Christian	87.83	83.76	85.53	
Religion : Muslim	9.64	13.35	11.74	
BMI : thin	92.15	92.79	92.51	
BMI : normal	4.51	4.35	4.42	
BMI : overweight	3.35	2.85	3.07	
Household characteristics (in %)				
Household head is female	23.72	21.53	22.46	
Education : uneducated	21.51	22.36	22	
Education : primary	57.30	54.65	55.79	
Education : ≥ secondary	21.19	22.98	22.21	
Number of living children (mean)	2.823602	2.738627	2.775534	
Wealth index : poorest	21.79	23.82	22.94	
Wealth index : poor	22.82	21.65	22.16	
Wealth index : average	24.78	19.52	21.81	
Wealth index : rich	20.79	17.69	19.03	
Wealth index : richer	9.81	17.32	14.06	
Place of residence: rural	72.06	61.06	65.84	
Birth cohort (2010) (%)				
2005-06/2008	71.02	68.75	69.78	
07/2008-2010	28.98	31.25	30.22	
Birth cohort (2018) (%)				
2013-07/2014	30.03	30.71	30.43	

Source: Author's calculations, from CAR MICS 2010 and 2018

Notes: the mean-comparison test is specified as follow :

H_0: $\overline{difference} = 0$; H_0: $\overline{difference} < 0$. *t*-

Difference-in-differences estimation

Columns 1 and 3 of Tables 4 and 5 presents results from our baseline specifications for estimating the impact of armed conflicts on height-for-age Z-scores and weight-for-age Z-scores, respectively, as specified in Equation 1and Equation 2, and includes year of birth cohort-fixed effects, and prefecture and survey year-fixed effects. Regressions in columns 2 and 4 also include controls for child's characteristic, and mother and household characteristics. Thus, the empirical results of the difference-in-differences estimation will be presented in two ways: (i) the impact of armed conflict by considering children born during the war and the total exposure duration; (ii) the impact of armed conflict by considering the total exposure duration; (iii) the other determinants of child health.

Impact of armed conflict on the nutritional health of children born during the conflicts

We first examine the effect of exposure to the war on the pooled group of children born during the war, without control variables. As expected, we find that the impact of armed conflicts on child health is negative and significant (at 1% for HAZ and 5% for WAZ). More specifically, height-for-age Z-scores and weight-for-age Z-scores are, respectively, 0.518 and 0.242 standard deviations lower for children residing in conflict regions and born during the war, and that the negative impact of the war is almost similar (-0.549 and -0.201, respectively) with child, mother and household characteristics (columns 2 and 4). This relationship is obvious and can be explained by the fact that conflicts can lead to displacement, a decrease in food availability, social disruption, destruction of agricultural crop, higher food prices, hunger, and then malnutrition (Bendavid et al, 2021).

Akresh et al (2012), Kaila et al (2021), Kreif et al (2022) and Minoiu and Shemyakina (2014) found identical results. Similarly, Le and Nguyen (2022) argued that children exposed to armed conflicts have lower height-for-age, weight-for-height, and weight-for-age z-scores compared to the average corresponding z-scores of children unexposed to armed conflicts in 56 developing countries. Other studies found the negative effect of the war in the long run. For example, Akbulut-Yuksel (2017) found that individuals who were exposed to WWII destruction during the prenatal and early postnatal periods have higher BMIs and are more likely to be obese as adults. Singhal (2019) also found a negative impact of war in Vietnam.

Impact of the total duration of exposure to the conflicts on child nutritional health

By focusing on the impact of the total duration of exposure (column 1 and 3 of Table 6), we find that an additional month of exposure significantly reduces height-for-age z-scores and weight-for-age z-scores, respectively, by 0.00561 and 0.00215 standard deviations on average (significant at the 5% and 10%, respectively). When we control for child, mother and household characteristics, the negative impact of an additional month of exposure on HAZ is significant and almost similar (evaluated at -0.00546) while the negative impact on WAZ (estimated at -0.00105) is no longer significant. Minoiu and Shemyakina (2014) also find that an additional month of exposure reduces height-forage z-scores with or without control for province-specific trends. For Akresh et al (2012), each additional month of exposure also results in a significant reduction (of 0.04) in the height-for-age z-scores.

Other determinants of children's health

Tables 5 and 6 also show other determinants of child health. In fact, results in columns 2 and 4 include controls for child's characteristic, and mother and household characteristics. It comes out that child sex, education, marital status and BMI of the mother, education (secondary or higher) are other determinants of child nutritional health. Specifically, there is a positive relationship between child sex and HAZ and WAZ, which suggest that girls were less likely to be malnourished than boys.

Table 4: Difference-in-differences estimates for impact of armed conflicts on child health

Variables	*Height-for-age z-score*		*Weight-for-age z-score*	
	(1)	(2)	(1)	(2)
Conflict prefecture*Born during war	-0.518***	-0.549***	-0.242**	-0.201**
	(0.0781)	(0.0753)	(0.0674)	(0.0611)
Child is female		0.225***		0.170***
		(0.0289)		(0.0165)
Age of mother		-0.00243		-0.00175
		(0.00234)		(0.00126)
Mother's marital status (*Ref=not married*)		-0.0472**		-0.0193
		(0.0149)		(0.0162)
Mother's education (*Ref=uneducated*)				
Primary		0.103**		0.105***
		(0.0319)		(0.0145)
Secondary or higher		0.390***		0.328***
		(0.0511)		(0.0451)
Mother's religion (*Ref=other religion*)				
Christian		-0.0800		-0.0827
		(0.108)		(0.0758)
Muslim		0.00968		-0.145*
		(0.0828)		(0.0692)
Body Mass Index (*Ref=thin*)				
Normal		-0.289***		1.503***
		(0.0779)		(0.0736)
Overweight		-1.644**		1.288***
		(0.528)		(0.165)
Household head is female		0.0498		0.0251
		(0.0318)		(0.0290)
Education of household head (R*ef=uneducated*)				
Primary		0.0480		0.0584
		(0.0630)		(0.0390)
Secondary or higher		0.0697		0.0739
		(0.0986)		(0.0643)
Number of living children		0.00135		-0.000870
		(0.00730)		(0.00377)
Rural		-0.0661		-0.0310
		(0.0639)		(0.0382)
Year of birth cohort fixed effects	Yes	Yes	Yes	Yes
Prefecture fixed effects	Yes	Yes	Yes	Yes
Prefecture-specific time trends	Yes	Yes	Yes	Yes
Survey year fixed effects	Yes	Yes	Yes	Yes
Constant	-1.635***	-1.675***	-1.238***	-1.373***
	(0.0408)	(0.143)	(0.0285)	(0.0796)
Observations	18,135	16,091	18,295	16,227
R-squared	0.047	0.059	0.024	0.095

Source: Calculated by authors using 2010 and 2018 MICS data

Notes: Robust standard errors in parentheses, clustered at the prefecture level. The dependent variable is the height-for-age z-score (column 1 and 2) and the weight-for-age z-score (column 3 and 4). *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Difference-in-differences estimates for impact of the total duration of armed conflicts on child health

Variables	*Height-for-age z-score*		*Weight-for-age z-score*	
	(1)	(2)	(3)	(4)
Conflict prefecture*Exposure duration	-0.00561***	-0.00546***	-0.00215*	-0.00105
	(0.00135)	(0.00146)	(0.00106)	(0.00118)
Child is female		0.227***		0.172***
		(0.0384)		(0.0380)
Age of mother		-0.000752		-0.000165
		(0.00229)		(0.00157)
Mother's marital status (*Ref=not married*)		-0.0970*		-0.0644*
		(0.0437)		(0.0302)
Mother's education (*Ref=uneducated*)				
Primary		0.0629*		0.0645*
		(0.0286)		(0.0287)
Secondary or higher		0.405***		0.317***
		(0.0796)		(0.0683)
Mother's religion (*Ref=other religion*)				
Christian		-0.0585		-0.108
		(0.160)		(0.180)
Muslim		0.175		-0.0363
		(0.137)		(0.169)
Body Mass Index (*Ref=thin*)				
Normal		-0.677***		1.304***
		(0.142)		(0.124)
Overweight		-0.620		1.234**
		(1.538)		(0.353)
Household head is female		0.00281		0.00335
		(0.0252)		(0.0170)
Education of household head (*Ref=uneducated*)				
Primary		0.0503		0.0743
		(0.0371)		(0.0395)
Secondary or higher		0.168*		0.168*
		(0.0698)		(0.0844)
Number of living children		-0.00959		-0.0101
		(0.0154)		(0.0115)
Rural		0.130*		0.112**
		(0.0546)		(0.0370)
Year of birth cohort fixed effects	Yes	Yes	Yes	Yes
Prefecture fixed effects	Yes	Yes	Yes	Yes
Survey year fixed effects	Yes	Yes	Yes	Yes
Constant	-2.073***	-2.281***	-1.469***	-1.701***
	(0.0267)	(0.147)	(0.0209)	(0.146)
Observations	6,512	5,980	6,538	6,003
R-squared	0.053	0.075	0.035	0.080

Source: Calculated by authors using 2010 and 2018 MICS data

Notes: Robust standard errors in parentheses, clustered at the prefecture level. The dependent variable is the height-for-age z-score (column 1 and 2) and the weight-for-age z-score (column 3 and 4). *** p<0.01, ** p<0.05, * p<0.1.

Primary education and secondary (or above) education of women are positively related to child health. Indeed, relative to uneducated women, women with primary, secondary or higher education have higher chances to have children with a good nutritional status since educated parents recognize the importance of the investment in the quality of their children's nutrition. The same explanation can be provided to the positive effect of education of household heads (in particular the secondary or higher level). A previous study in the Central African Republic (Iwanaga et al, 2009) found no association between mother's years of school attendance and stunting and wasting.

A mother's BMI is an important factor in children weight-for-age z-scores. Indeed, compared to thin women, women with a normal BMI or overweight have lower likelihood of having wasted children. This result could, therefore, suggest that women with a normal or high BMI (overweight or obesity) live in a household or an environment with an excessive availability of food which also benefits children (Rahman et al, 2016). Conversely, we find a negative effect of normal or overweight BMI of women on children's height-for-age z-scores. This last finding supports the growing body of evidence showing that the coexistence of high maternal overweight and child stunting has linked root causes to early life undernutrition that are exacerbated by the nutrition transition (Blankenship et al, 2020).

Robustness checks

In addition to the previous approaches using a difference-in-differences method, robustness analyses are performed by taking into account migration and specific sub-samples among children exposed to conflicts.

Taking into account migration

Equation 1 and Equation 2 ignore migrations that could have occurred during conflicts. Migration could affect the analysis of the results by changing the size and composition of the sample (Singhal, 2019). In fact, due to the conflicts, many people were displaced within or outside the country. As suggested by the United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA), in February 2014, there was a mass departure of Muslim civilians from the West to the North of the country and neighbouring Chad. Table 6 shows the distribution of IDPs by prefecture and it comes out that the conflicts provoked the mass flight of civilians, causing internal displacement of 838,000 persons, including 413,000 in the capital Bangui (almost 50% of IDP) and 268,000 refugees in neighbouring countries. According to the United Nations High Commissioner for Refugees (UNHCR), the IDPs were made up of 49% men and 51% women. However, 65% of the displaced population are minors aged 0 to 18 while 6% over 60.

Thus, migrations, related to the fact that people (in particular children) moved across prefectures, would bias our estimates because we would incorrectly evaluate a child's conflict exposure based on the child's current region of residence. As postulated by Akresh et al (2012), if, for example, well-off households with healthier children migrated from conflict to non-conflict prefectures, results would overestimate the impact of the conflict. Alternatively, if children from poorer areas and poorer households fled the conflict and moved from war to non-war prefectures, our results would underestimate the war's impact. Unfortunately, in the MICS data, information on migration/displacement of households during years prior to the survey are not available.

Yet, we attempt to correct the bias induced by this geographical displacement, using information from Table 6 related to the distribution of IDPs by prefectures to construct two sub-samples: the sub-sample of immigrant affected-prefectures and the sub-sample of non-immigrant-affected prefectures. We consider immigrant prefectures as prefectures where the quota of internal displacement were high, that is higher than the median of the distribution of IDP (Lobaye, Ouham Pende, Ouham, Nana Grebizi, Ouaka, Haute-Kotto, Basse-Kotto, Mboumou and Bangui). Non-immigrant prefectures are comprised of prefectures where the quota of internal displacement were low, that is lower than the median of the distribution of IDPs (Ombella-M'poko, Mambere Kadei, Nana Mambere, Sangha Mbaere, Mbomou, Kémo, Baminigui bangoran, Mbomou and Vakaga).[11] Thus, estimates of Equation 1 and Equation 2 have been performed by sub-sample to show how the incidence on child’s health due to armed conflict changes with internal displacement.

Table 6: Distribution of internally displaced persons (IDPs) by prefectures

Préfectures	*Number of IDPs*	*Proportion (%) of IDPs*
Bangui	413,000	49.28
Ouham-Péndé	31,960	3.81
Nana-Mambéré	11,164	1.33
Mambéré-Kadéï	17,140	2.05
Sangha-Mbaéré	2,857	0.34
Lobaye	32,480	3.88
Ombélla-Mpoko	17,939	2.14
Kémo	4,621	0.55
Nana-Gribizi	40,686	4.86
Bamingui-Bangoron	3,737	0.45
Ouaka	96,873	11.56
Basse-Kotto	22,289	2.66
Haute-Kotto	76,735	9.16
Mbomou	25,579	3.05
Haut-Mbomou	15,122	1.80
Ouham	24,292	2.90
Vakaga	1,526	0.18

Source: Authors, from data of UNOCHA and UNHCR, 2014

Based on results presented in Tables A1 and A2 (column 1) in the Appendix, we find a negative and significant impact on child's HAZ of exposure to conflict estimated at -0.656 in prefectures with high IDP and -0,646 in prefectures with low IDP. These negative impacts on child's WAZ are estimated at -0.183 and -0.275, respectively, in prefectures with high IDP and in prefectures with low IDP, respectively. These results suggest that when migrations that could have occurred during the war are not considered, the impact of armed conflicts on child's HAZ and WAZ are overestimated. Akresh et al (2012) also found that the estimated negative impact of exposure to conflict are 13% larger when they used the child's location at the time of the war than they would be if they used the child's location at the time of the survey. However, our results (column 2 of Tables A1 and A2) show that the negative impact of the duration of exposure is only significant on child's HAZ in areas with low IDP.

Analysis across sub-samples

Estimates have also been performed by separating children from different types of households: poor household vs non-poor households. Results are presented in Tables A3 and A4 in the Appendix and indicate that children born during the war in poor households or non-poor households have lower height-for-age Z-scores and weight-for-age Z-scores, and results are statistically significant. But an additional month of exposure significantly reduces child's height-for-age Z-scores only in poor households, and there is not a significant impact on child's weight-for-age Z-scores either in poor households nor non-poor households. The results found by Akresh et al (2012) also suggested the negative impact of the war among children born during the conflicts in poor and non-poor households.

5. Identifying contextual mechanisms

From the results obtained above, we have documented a negative impact on child nutritional health due to exposure to armed conflict in the Central African Republic. However, it would be relevant, to enrich the empirical analysis produced, by illustrating the plausible contextual mechanisms through which such an impact is possible, given that each country has its own socioeconomic, demographic and geopolitic specificities. Our analysis will focus on two mechanisms in particular:

The first mechanism is based on the economic consequences of conflicts. Indeed, during the conflict, the economic infrastructure of the CAR completely collapsed. According to the World Bank dataset, the country's growth rate was -5.4% in 2003 (compared to 2% in 2008), and this rate reached the critical level of -36.4% in 2013 (against 0.1% in 2014). In a country where agriculture and livestock are the key sectors of growth[12], the economic depression during war could probably have resulted from dissolution of all possibilities of agro-pastoral production, which caused the deterioration of food livelihoods of the populations and considerable losses of household income.

In addition, the logistic and transportation means of food resources from neighbouring countries, in particular Cameroon, which constitute the main food supply route for the CAR (World Food Programme, 2014), became extremely difficult to envisage. The direct consequence of such a situation is the increase in food prices and, therefore, the loss of household purchasing power. It inevitably follows a strong exposure to food insecurity (lack of dietary diversity, failure to respect the minimum meal frequency and the minimum acceptable diet) due to the inability to purchase food, which of course had a negative impact on the nutritional health of household members, and that of children.

The second mechanism is related to the prevalence of illnesses among children combined with poor access to adequate health care. Indeed, the decrease of HAZ and WAZ Z-scores could have resulted from illnesses (Kaila, Nawo and Son, 2021). Our analysis focuses on diarrhoea and malaria since these diseases are the deadliest among children under five in CAR (MICS, 2010, 2018-2019). Unfortunately, the destruction of health infrastructure (hospitals, pharmacies, etc.) which generally characterizes the scale of armed conflicts leading to a reduction in the use of health care services which can prolong and aggravate these diseases. Through illustration, the MICS 2010 report[13] argues that among 24% of children under 5 who suffered from diarrhoeal diseases, barely 16% were able to receive advice or treatment from a health centre or a health care agent, and only 34% of children under 5 who had fever in the previous two weeks prior to the survey were treated with antimalarial drugs.

It is well documented that fever and cough, being the major symptoms of malaria, could be dangerous in a short-term and ultimately lead to long-term adverse outcomes. Severe diarrhoea could be associated for example, with the consumption of dirty water, and it can affect a child's weight within a short period of time. Thus, the aggravation of these diseases inevitably leads to the low values of HAZ and WAZ Z-scores.

6. Conclusion and policy implications

In this study, we examined the impact of the 2003-2008 and 2012-2014 armed conflicts in the Central African Republic on children's weight-for-age and height-for-age through Z-scores using data from the fifth and the sixth edition of the Multiple Indicator Cluster Survey conducted, respectively, in 2010 and 2018. Our identification strategy relies on exploiting both temporal and spatial variation across birth and prefectures cohorts to measure children's exposure to these conflicts. The results show that height-for-age Z-scores and weight-for-age Z-scores are, respectively, 0.518 and 0.242 standard deviations, lower for children residing in conflicts regions who were born during the war. Moreover, we found that an additional month of exposure significantly reduced height-for-age z-scores and weight-for-age z-scores, respectively, by 0.00561 and 0.00215 standard deviations on average. We also performed robustness analysis by considering migrations and the sub-sample poor household vs non-poor households, and our results are robust in considering the level of internally displaced persons, and the impact of conflicts are of similar magnitude for poor households or non-poor households.

This study contributes to a growing literature that estimates the welfare impact of wars. It is the first study to be carried out in the CAR, a country affected for several years by successive waves of coups and conflicts between armed groups. It also proposes an innovative approach to address migrations in its robustness analysis. Its findings help improve our understanding of broader issues, which are the long-term growth and development consequences of wars. Investigating the impact on WHZ and HAZ in the CAR is important from a policy perspective, as the negative effects can be reversed with timely interventions to prevent stunting and wasting of children during conflicts. During conflicts in the CAR, the areas affected by the conflict are sometimes less accessible to the Central African government than humanitarian organizations and programmes, which justifies the importance of taking these latter into account when formulating recommendations. Thus, we suggest two main policies that could mitigate the adverse effects of armed conflict.

During the conflict, the Central African government, in collaboration with the United Nations Multidimensional Integrated Stabilization Mission in the Central African Republic (MINUSCA), should set up humanitarian corridors allowing the movement of populations from affected areas to secure sites. The exploitation of these humanitarian corridors will make it possible, with the participation of international programmes and organizations (World Food Programme, Food and Agriculture Organization of the United Nations, UNICEF) and civil societies, to transport and supply the displaced populations with necessities and foodstuffs, especially children who are most at risk of malnutrition in times of conflict (FAO, 2016). The involvement of the Ministry of Health with international humanitarian medical organizations (Médecins sans Frontières, International Committee of the Red Cross) cannot be ruled out in the management of diseases that degrade the nutritional status of children. Regarding areas unaffected or little affected by the conflicts, the Central African Republic government should define a security plan by strengthening the defense forces around and inside these areas so that its inhabitants are not affected by the conflicts.

After the conflict, policy makers should facilitate the return of the displaced persons to restore their economic well-being. As economic losses appear to be the most relevant mechanism paired with the decline in child nutritional health in the CAR, interventions must promote agricultural empowerment of internally displaced persons, initiate cash transfers and employment programmes aimed at rebuilding household assets in the absence of agricultural income. Moreover, rehabilitating basic social services, especially health infrastructure, can help alleviate the negative effects of conflicts on child health through access to adequate health care during illness.

However, this study has a number of limitations. Firstly, it is very difficult to absolutely distinguish the treatment group from the control group. Indeed, the cartography of armed conflicts in the CAR suggests a strong geographical extent of these conflicts, in particular the 2012-2014 armed conflict, so that almost all the prefectures had been directly or indirectly affected. As a result, the comparison group may also be affected by war, and therefore its cohorts of children affected by the negative effect on nutritional health through the loss of household's income, rising prices of food stuffs and reduction in the use of health care services. Secondly, the results obtained underestimate the "true impact" of the conflicts since they do not include deceased children in the analysis. Thirdly, the cross-sectional nature of the data used limits the ability to determine causal effects of conflict exposure on children health. The last limitation of this study concerns the absence in the MICS database of information on the location of households (or children) during the conflicts, which could have permitted us to capture more effectively migrations.

Notes

1 The concept of "health for all" means that governments should adopt national policies that can promote primary health care for all members of the community by bringing closer the health workforce to the population.

2 The health-related objectives include: Objective 4: Reduce by two-thirds the mortality rate of infant less than 5 years, between 1990 and 2015. Target 5: Reduce by 75%, between 1990 and 2015, the maternal mortality rate. Goal 6: Fight against HIV/AIDS, malaria and other diseases.

3 Period during which Bozizé was in rebellion and this area served as their rear base.

4 Dekoa, Kaga-Bandoro, Bambari, Grimari, Bouca, Koui, Bocaranga, Paoua, Markounda, Bouar, Gamboula, Amadagaza, Nola, Carnot, Gadzi, Mingala, Alindao, Nzangba, Mobaye, Kembe, Satema, Gambo, Pombolo, Ouango, Bakouma, Rafai, Bangassou.

5 This framework is the same as the one proposed by Guha-Sapir and van Panhuis (2002).

6 For example, for children born in 2013, the total duration exposure to the conflict is 17 months.

7 The choice of June 2008 and July 2014, respectively, rely on the fact that ceasefire agreements between government and Central African politico-military movements was signed on these dates.

8 We define conflict-affected prefectures and non-conflictaffected prefectures as those regions for which ACLED dataset reports at least one conflict event from December 2012 to July 2014.

9 Children aged two and five in 2010 were born, respectively, in 2008 and 2005. Similarly, children aged five in 2018 were born in 2013, and children aged four in 2018 were born in 2014. This specification is useful to explain how children of every cohort are identified in the MICS dataset.

10 Note that it would also have been possible to introduce the variable BornDuringConflict into the equation without interaction with the prefecture of residence to capture the full impact of the conflict, and taking into account its externalities on the health of children from other localities. This was not done since the paper measures the impact of armed conflicts on the health of children born during conflicts and exposed to these conflicts. Thus, the coefficient β_1 (and β_2 in Equation 2 are not the overall impact of conflicts, but rather their net causal impact.

11 Bangui and Ouaka concentrated 49.3% and 12% of the total of internally displaced persons, respectively, while every prefecture considered as non-immigrant concentrated less than 5%.

12 Agriculture and livestock employ more than 75% of the active population and contribute to 55% of GDP (Gaskell et al, 2019).

13 The choice of the 2010 MICS survey, and not necessarily of 2018, stems from the fact that part of the conduct of this survey took place during the conflicts, which brings our reasoning closer to reality

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Appendix

Table A1: Impact of armed conflict on child health (measured by height-for-age Z-score):

	Regions with high IDPs		Regions with low IDPs	
	(1)	(2)	(1)	(2)
Conflict prefecture*Born during war	-0.656***		-0.646***	
	(0.0936)		(0.0717)	
Conflict prefecture*Exposure duration		-0.00361		-0.00699***
		(0.00206)		(0.000974)
Child is female	0.236***	0.200**	0.217***	0.282***
	(0.0394)	(0.0604)	(0.0336)	(0.0179)
Age of mother	-0.000746	0.00129	-0.00395	-0.00390
	(0.00341)	(0.00210)	(0.00247)	(0.00204)
Mother's marital status (Ref=not married)	-0.0498	-0.127**	-0.0610***	-0.0685
	(0.0336)	(0.0463)	(0.0130)	(0.0783)
Mother's Education (Ref=uneducated)				
Primary	0.145***	0.0692*	0.0756*	0.0323
	(0.0370)	(0.0326)	(0.0352)	(0.0523)
Secondary or higher	0.379**	0.425**	0.386***	0.339***
	(0.110)	(0.146)	(0.0882)	(0.0661)
Mother's religion (Ref=other religion)				
Christian	-0.207*	-0.316*	0.105	0.341
	(0.0977)	(0.146)	(0.0648)	(0.203)
Muslim	-0.0219	0.0524	0.155***	0.424**
	(0.125)	(0.147)	(0.0278)	(0.138)
Body Mass Index (Ref=thin)				
Normal	-0.423**	-0.824***	-0.214	-0.554***
	(0.124)	(0.186)	(0.112)	(0.0949)
Overweight	-2.830***	-2.525**	-1.013	1.768***
	(0.429)	(0.871)	(0.600)	(0.0562)
Household head is female	0.0270	-0.0655*	0.0854**	0.0653**
	(0.0503)	(0.0291)	(0.0301)	(0.0143)
Education of Household head (Ref=uneducated)				
Primary	0.0220	0.0478	0.0758	0.0588
	(0.0513)	(0.0648)	(0.0716)	(0.0369)
Secondary or higher	0.00214	0.143*	0.170**	0.200
	(0.0976)	(0.0659)	(0.0600)	(0.108)
Number of living children	-0.000349	-0.00538	0.00492	-0.0101
	(0.0121)	(0.0199)	(0.00841)	(0.0112)
Rural	0.0480	0.287**	-0.0838	0.0550
	(0.106)	(0.0729)	(0.0540)	(0.0624)
Year of birth cohort fixed effects	Yes	Yes	Yes	Yes
Prefecture fixed effects	Yes	Yes	Yes	Yes
Survey year fixed effects	Yes	Yes	Yes	Yes
Constant	-2.004***	-2.335***	-1.675***	-2.452***
	(0.120)	(0.123)	(0.157)	(0.160)
Observations	7,431	3,362	8,660	2,618
R-squared	0.065	0.061	0.071	0.104

Source: Calculated by authors using 2010 and 2018 MICS data

Notes: Robust standard errors in parentheses, clustered at the prefecture level. The dependent variable is the weight-for-age z-score (HAZ) for all the regressions. *** p<0.01, ** p<0.05, * p<0.1.

Table A2: Impact of armed conflict on child health (measured by weight-for-age Z-score):

	Areas with high IDPs		*Areas with low IDPs*	
	(1)	(2)	(1)	(2)
Conflict prefecture*Born during war	-0.183***		-0.275***	
	(0.0481)		(0.0492)	
Conflict prefecture*Exposure duration		-0.000332		-0.00146
		(0.00102)		(0.00201)
Child is female	0.191***	0.151**	0.153***	0.205***
	(0.0220)	(0.0533)	(0.0216)	(0.0195)
Age of mother	-0.000660	0.000794	-0.00273*	-0.00159
	(0.00209)	(0.00202)	(0.00134)	(0.00221)
Mother's marital status (Ref=not married)	-0.0153	-0.0727*	-0.0299*	-0.0607
	(0.0294)	(0.0339)	(0.0135)	(0.0505)
Mother's Education (Ref=uneducated)				
Primary	0.141***	0.0960**	0.0831**	0.0138
	(0.0315)	(0.0253)	(0.0303)	(0.0299)
Secondary or higher	0.330***	0.353**	0.322**	0.236**
	(0.0770)	(0.108)	(0.0831)	(0.0717)
Mother's religion (Ref=other religion)				
Christian	-0.165**	-0.248	0.0262	0.118
	(0.0621)	(0.252)	(0.0754)	(0.184)
Muslim	-0.117	-0.0845	-0.0827*	0.104
	(0.133)	(0.283)	(0.0341)	(0.154)
Body Mass Index (Ref=thin)				
Normal	1.479***	1.171***	1.505***	1.416***
	(0.0681)	(0.158)	(0.0868)	(0.0342)
Overweight	1.126***	1.589**	1.418***	0.865*
	(0.195)	(0.595)	(0.204)	(0.329)
Household head is female	-0.000861	-0.0317	0.0592*	0.0419
	(0.0444)	(0.0234)	(0.0245)	(0.0259)
Education of Household head (Ref=uneducated)				
Primary	-0.00634	0.0322	0.111*	0.133**
	(0.0425)	(0.0510)	(0.0480)	(0.0376)
Secondary or higher	0.00751	0.111**	0.151	0.242
	(0.0581)	(0.0408)	(0.0805)	(0.145)
Number of living children	-0.00146	-0.00551	0.00168	-0.0116
	(0.00778)	(0.0152)	(0.00540)	(0.0109)
Rural	0.0790	0.211***	-0.0598	0.0843
	(0.0485)	(0.0468)	(0.0468)	(0.0453)
Year of birth cohort fixed effects	Yes	Yes	Yes	Yes
Prefecture fixed effects	Yes	Yes	Yes	Yes
Survey year fixed effects	Yes	Yes	Yes	Yes
Constant	-1.664***	-1.817***	-1.361***	-1.752***
	(0.0776)	(0.221)	(0.0592)	(0.165)
Observations	7,482	3,375	8,745	2,628
R-squared	0.094	0.071	0.108	0.102

Source: Calculated by authors using 2010 and 2018 MICS data

Notes: Robust standard errors in parentheses, clustered at the prefecture level. The dependent variable is the weight-for-age z-score (WAZ) for all the regressions. *** p<0.01, ** p<0.05, * p<0.1.

Table A3: Impact of armed conflict on child health (measured by height-for-age Z-score):

	Poor households		*Non-poor households*	
	(1)	(2)	(1)	(2)
Conflict prefecture*Born during war	-0.574***		-0.522***	
	(0.132)		(0.0465)	
Conflict prefecture*Exposure duration		-0.0112***		-0.000799
		(0.000715)		(0.00301)
Child is female	0.222***	0.238**	0.227***	0.216***
	(0.0375)	(0.0876)	(0.0337)	(0.0502)
Age of mother	-0.00465	0.00410	-0.000324	-0.00507
	(0.00267)	(0.00223)	(0.00339)	(0.00291)
Mother's marital status (Ref=not married)	-0.0266	-0.0336	-0.0600*	-0.150*
	(0.0392)	(0.0624)	(0.0281)	(0.0764)
Mother's Education (Ref=uneducated)				
Primary	0.0750	0.0613	0.109**	0.0431
	(0.0597)	(0.0331)	(0.0410)	(0.0445)
Secondary or higher	0.136	0.175*	0.406***	0.391***
	(0.143)	(0.0725)	(0.0608)	(0.0839)
Mother's religion (Ref=other religion)				
Christian	0.148	0.166	-0.215**	-0.255
	(0.175)	(0.278)	(0.0734)	(0.151)
Muslim	0.101	0.215	-0.0775	0.00863
	(0.128)	(0.291)	(0.0723)	(0.147)
Body Mass Index (Ref=thin)				
Normal	-0.367**	-0.758***	-0.236**	-0.584**
	(0.110)	(0.0750)	(0.0853)	(0.233)
Overweight	-2.503***	-3.339***	-0.319	1.428
	(0.442)	(0.0601)	(0.879)	(1.049)
Household head is female	0.0944	-0.00660	0.0121	0.00677
	(0.0570)	(0.0231)	(0.0387)	(0.0339)
Education of Household head (Ref=uneducated)				
Primary	0.0492	0.0331	0.0484	0.0249
	(0.0838)	(0.0539)	(0.0514)	(0.0493)
Secondary or higher	0.00935	0.0421	0.105	0.172**
	(0.133)	(0.0890)	(0.0697)	(0.0643)
Number of living children	0.0107	-0.0152	-0.00592	-0.00399
	(0.00664)	(0.0200)	(0.00920)	(0.0144)
Rural	0.0308	0.142	-0.0578	0.188**
	(0.0986)	(0.0988)	(0.0740)	(0.0763)
Year of birth cohort fixed effects	Yes	Yes	Yes	Yes
Prefecture fixed effects	Yes	Yes	Yes	Yes
Survey year fixed effects	Yes	Yes	Yes	Yes
Constant	-2.076***	-2.683***	-1.531***	-1.933***
	(0.275)	(0.390)	(0.0712)	(0.247)
Observations	7,092	2,762	8,999	3,218
R-squared	0.059	0.087	0.061	0.082

Source: Calculated by authors using 2010 and 2018 MICS data

Notes: Robust standard errors in parentheses, clustered at the prefecture level. The dependent variable is the weight-for-age z-score (HAZ) for all the regressions. *** p<0.01, ** p<0.05, * p<0.1.

Table A4: Impact of armed conflict on child health (measured by weight-for-age Z-score): *Poor households Vs non-poor households*

	Poor households		*Non-poor households*	
VARIABLES	(1)	(2)	(1)	(2)
Conflict prefecture*Born during war	-0.206*		-0.190***	
	(0.100)		(0.0441)	
Conflict prefecture*Exposure duration		-0.00290		0.000101
		(0.00170)		(0.00235)
Child is female	0.153***	0.171*	0.184***	0.172***
	(0.0229)	(0.0765)	(0.0183)	(0.0359)
Age of mother	-0.000107	0.00352	-0.00274	-0.00337
	(0.00192)	(0.00222)	(0.00166)	(0.00314)
Mother's marital status (Ref=not married)	0.00101	-0.00874	-0.0331	-0.118**
	(0.0324)	(0.0322)	(0.0270)	(0.0359)
Mother's Education (Ref=uneducated)				
Primary	0.0918**	0.0624	0.0917**	0.0419
	(0.0360)	(0.0486)	(0.0249)	(0.0375)
Secondary or higher	0.116	0.148***	0.316***	0.283**
	(0.0900)	(0.0391)	(0.0415)	(0.0816)
Mother's religion (Ref=other religion)				
Christian	0.0829	-0.0756	-0.179**	-0.159
	(0.118)	(0.271)	(0.0632)	(0.189)
Muslim	-0.0615	-0.117	-0.233**	-0.103
	(0.0764)	(0.234)	(0.0832)	(0.172)
Body Mass Index (Ref=thin)				
Normal	1.505***	1.290***	1.494***	1.319***
	(0.112)	(0.0962)	(0.0816)	(0.175)
Overweight	1.542***	1.354***	1.026***	1.084
	(0.254)	(0.186)	(0.214)	(0.821)
Household head is female	0.0579	0.0461**	-0.00491	-0.0364
	(0.0390)	(0.0186)	(0.0299)	(0.0329)
Education of Household head (Ref=uneducated)				
Primary	0.0510	0.0311	0.0582	0.0680
	(0.0445)	(0.0458)	(0.0329)	(0.0456)
Secondary or higher	0.00708	0.0449	0.0955	0.166*
	(0.0815)	(0.0797)	(0.0497)	(0.0830)
Number of living children	0.000130	-0.0130	-0.00134	-0.00600
	(0.00414)	(0.0143)	(0.00612)	(0.0148)
Rural	0.0951	0.224**	-0.0302	0.116
	(0.0633)	(0.0733)	(0.0571)	(0.0601)
Year of birth cohort fixed effects	Yes	Yes	Yes	Yes
Prefecture fixed effects	Yes	Yes	Yes	Yes
Survey year fixed effects	Yes	Yes	Yes	Yes
Constant	-1.825***	-2.029***	-1.165***	-1.429***
	(0.200)	(0.388)	(0.0604)	(0.146)
Observations	7,152	2,772	9,075	3,231
R-squared	0.097	0.101	0.098	0.078

Source: Calculated by authors using 2010 and 2018 MICS data

Notes: Robust standard errors in parentheses, clustered at the prefecture level. The dependent variable is the weight-for-age z-score (WAZ) for all the regressions. *** p<0.01, ** p<0.05, * p<0.1.

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Consortium pour la Recherche Economique en Afrique

Middle East Bank Towers,

3rd Floor, Jakaya Kikwete Road

Nairobi 00200, Kenya

Tel: +254 (0) 20 273 4150

communications@aercafrica.org