

Armed Conflicts and Children's Health in Central African Republic

African Economic Research Consortium (AERC) Proposal

Submitted by

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1. Introduction

Since its independence, the Central African Republic (CAR) had a history marked by numerous socio-political and military crisis characterized by multiple coups. Of the ten presidents who have so far ruled the country between 1958 and 2016, five came to power by coup accompanied by rioting and the formation of rebel groups. Over the past sixteen years, recurrent military and political crises have led to the destruction of several basic social infrastructures and massive impoverishment of the population with a poverty rate of 72% (UNDP, 2012). 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. This has led to the degradation of the level of socio-economic indicators of the country, which are now among the lowest in the world (UNDP, 2012).

Specifically, for children, investigations from Multiple Indicator Cluster Survey (MICS) and the National Survey of Nutritional Status and Mortality (SMART) made respectively in 2010 and 2014, have shown that the health indicators are very alarming. Indeed, these results indicate that among children under age five, 40.7% are suffering from stunting, 7.4% are wasted, 23.5% are underweight, 24%, 48% suffering from diarrhea, 7% with pneumonia, 32% suffering from malaria, which heavily reduces the human development potential. Such a situation is especially due to food insecurity, limited access to adequate health care, inadequate feeding practices of infants and young children; but mostly, rampant poverty aggravated by the continuous military and socio-political unrest that the country has witnessed.

However, despite these results, efforts have been made in order to improve on child health indicators. 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) rehabilitate and develop health infrastructures, (ii) increase the availability and quality of essential health care, (iii) reduce infant and maternal mortality, (iv) stop the spread of endemic diseases, including HIV/AIDS, (vi) strengthen the health system, (vii) promote a favorable environment for health, including sustainable development, preparation and response to emergencies, etc. Internationally, the country is firmly committed to take action to achieve the Sustainable Development Goals (SDGs) following a recent analysis of some health indicators suggesting that the CAR is far from reaching the targets set under the SDGs.

Indeed, it may be noted in particular in 2015 the infant mortality rate is 180 deaths per 1,000 live births; this gap is considerable as compared to 84 deaths for the African average and 63

deaths for the target of the SDGs. The maternal mortality rate also increased over the 1988-2015 period from 683 to 984 deaths per 100 000 live births, while the target set by the MDGs was 215 deaths in 2015. Similarly, only 22% of the population had access to quality health care compared to the average of 38% for Africa. HIV prevalence was 6.8% among pregnant women, while the MDGs were designed to stop its spread. To this end, the SDG is part of a continuation of the efforts initiated in the framework of the SDGs, including reducing maternal mortality to more than 70 deaths per 100 000 live births and the mortality of children under 5 years to 25 deaths per 1000 live births. This is to ensure universal access to sexual and reproductive health services, for the purpose of family planning, information and education, and the integration of reproductive health into national strategies and programs 2030. It is clear that achieving these challenges for CAR is based on lasting security and political stability.

Hence, from what precedes, it appears that the health of children, as well as maternal health, is a call for concern in CAR. Resolutely, one of the main causes attributed to this finding is the persistence of armed conflicts resulting from repeated coups for over 30 years. However, even if the war undermines much of the territory and the capital in particular, it should be noted that some areas are very often saved. Therefore, we can postulate that a position relatively far from the conflicts zones implies very good health for children as compare to zones closer. This hypothesis thus leads us to look with a certain sharpness of the effect that can have armed conflict on children's health.

2. Statement of problem

According to the World Health Organization (WHO), 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, etc. (Labourdette, 1988). 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, in 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

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.

MDGs², which were reaffirmed with acuity in the context of Sustainable Development goals (SDGs) as four goals on seventeen are directly related to health.

After all these initiatives, even if there is a clear reduction in child mortality rates in Sub-Saharan Africa over a long period of years³; these rates remain high and are outstanding features of countries of this sub-region. Moreover, among the 26 countries with highest infant mortality rates, 24 countries come from this region of the world (UNICEF, 2014). Thus, the search of the factors contributing to the improvement of children's health is a priority for developing countries. As highlighted by Audibert et al. (2004), although the health policies of African countries south of the Sahara have known many reforms in recent decades, including strengthening public health care supply, many encountered barriers to access to health care services in these countries.

In the literature concerning the determinants of children health, many works were rather focused on the links with the socio-economic status of household. According to Scott (2002), this factor plays an important role in health. Similarly, Choi (2003) found a strong correlation between the level of household life and health of the child. Using data from a cross-section, Fay et al (2005) found that children from low-income household have more health problems than children from rich household. Korenman et al. (1992) found a positive and robust relationship between income level and nutritional status of children in Zimbabwe.

Other studies have investigated the relationship between individual characteristics of the mother and child health, including her education. Girma (2007) found a strong influence of maternal education on child health. For Rutstein (2000) and Wang (2003), the infant mortality rate decreases with age and weight of the mother.

Guth (1990) and Wright (1997) point out that the social environment is also a determinant of child health. It can not only take the child to its full potential, but it can also prevent it from developing its potential. For UNICEF (2012), the environment determines the ease of access to social services databases, and this facility is strongly and negatively affected by endogenous or exogenous shocks. In this regard, armed conflict is a type of negative shock affecting the components of social environment. The health outcomes of people living in countries inflicted

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 $\frac{3}{4}$, between 1990 and 2015, the maternal mortality rate. Goal 6: fight against HIV/AIDS, malaria and other diseases.

³ Over the period 1990-2015, there have been a significant drop in the infant mortality rate which have decreased from 88 deaths to 57 deaths per 1,000 births.

by conflict are worse than those of people living in countries that have remained in peace (the number of deaths were twice as high in the affected countries than non-war affected countries).

By definition, armed conflict is "a prolonged struggle between the military forces of two or more governments, or between one government and at least one organized army group, during which the number of deaths exceeds one thousand." It is considered as a dominant feature of the recent global landscape, particularly in disadvantaged countries and regions that are poor, with weak institutions and low levels of human development. It exposes households to violence and massacres, limited access to health care, unstable electricity supply, the deterioration of drinking water and sewage systems and lack of adequate food supply (UNICEF, 2003).

Armed conflicts have affected almost 60% of sub-Saharan Africa for more than 30 years. 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 0.475 in 2014. The majority of countries with low HDI and high infant mortality rate came out of a long period of armed conflict or in conflict with the example of Angola, which recorded an average HDI of 0.532 in 2014 and a mortality rate infant 180‰, Burundi whose HDI in 2014 was 0.4 with an infant mortality rate of 142‰, the Democratic Republic of Congo which registered an HDI 0.433 and an infant mortality rate of 170‰ and CAR which over the same period recorded a HDI of 0.35 and occupying the penultimate position of the ranking of 188 countries (UNDP, 2015).

Unfortunately, the literature on children's health focus primarily on the endogenous factors to households forgetting the influence of exogenous factors including the social environment of the child. Armed conflict is an exogenous factor to household related to the child's environment that could significantly affect his health. In different parts of the world, children are paying the price of armed conflict and other violent situations. They do not only suffer the direct consequences of war and armed conflicts (recruitment into armed forces or armed groups, physical injury, death), but they are also indirectly affected by displacement, loss of loved ones and the trauma they suffer by being witnesses of acts of violence. Regarding the frequency and destructiveness of armed conflict, recent literature (Akresh et al, 2012; Guerrero-Serdan, 2009; Boulada, 2009, Baez, 2011) spent efforts to analyze the effects of conflict on human capital particularly on health.

If the findings of the studies that have been mentioned above suggest that the determinants of health are endogenous and exogenous to households, they do not provide information on

exogenous factors to households linked to the social environment of the child, especially on armed conflict. In CAR specifically, successive armed conflicts that have chained up one after the other to the point of being considered one of the main characteristics of the country, even if they do not affect all the divisions of the country. Accordingly, it would be relevant to ask the question:

What are the effects of armed conflict on children's health in the Central African Republic?

Specifically, this work aims to answer the following questions:

- *What is the effect of the exposure of children under age five to armed conflict on their nutritional status?*
- *What is the association of the location of the child in relation to conflict zones with their nutritional status?*

There is a growing interest in microeconomic research to examine the impact of conflicts on children's health in developing countries (Arcand et al, 2010), particularly in CAR for three main reasons. Firstly, 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. Then, the challenges on child health are enormous both nationally and internationally with the Sustainable Development Goals (SDGs). Finally, from the local literature on the subject, it is clear that studies of the relationship between armed conflicts and children's health are virtually inexistent in CAR to the best of authors' knowledge.

3. Spatial and temporal evolution of armed conflict in CAR from 2002 to 2014

In the analysis that we are developing, the evolution of conflict in time and in space has a key role. Thus, between 2002 and 2014, the events that have characterized these developments are described in the following lines.

On the 25th October 2002, the civil war in CAR started with a coup attempt by General Bozizé which failed in Bangui. This marked the beginning of the war in which a thousand people were killed, including 150 Chadian soldiers causing a crisis between Chad and CAR. Violence has shifted in early 2003 in the prefectures of Ouham, Ouham-Péndé and Vakaga and has led to massacres of civilians in a conflict between the rebels and the government army. On the 15th of

March 2003, while the head of state A.F Patassé was absent to attend a regional summit in Niamey, the general seized power with the help of Chad.

From December 2004, a new constitution fixing the number of presidential terms to five years and strengthening the power of the Prime Minister was approved through a referendum. The last quarter of 2005 was marked by acts of violence in the prefectures of Ouham, Nan-Grébizi and Kemo including the cities of Bouca, Dekoa, Kaga-Bandoro, Tiringulu (in the North-East of the country) between rebels of the Popular Army for the Restoration of Democracy (PARD) and government forces. In autumn 2006 the situation deteriorated with the emergence of a new rebellion called Union of Democratic Forces for Unity (UFDR) with the intention to overthrow the government of Bangui. Following violent clashes, the UFDR rebels seized several cities including Birao, Ndele, Bria respectively in the prefectures of Vakaga, Bamingui-Bangoran and Haute-Kotto on the 22nd of September of the same year. The government then suspected Sudan of supporting the rebels and had sought clarification from the authorities in Khartoum. This attack illustrates the instability in this region, between Chad and Sudan's Darfur.

In February and April 2007, two cease fire agreements were signed between the government and rebels in Sirte and Birao. In early 2008, a process to implement an inclusive political dialogue aimed at reintegration of armed rebellion movements and their transformation into a political party was initiated. Then followed a comprehensive peace agreement signed in Libreville between the government, the PARD and UFDR. December 20th 2008, under the auspices of Gabonese President Omar Bongo; a truth and reconciliation commission was created and the implementation of a demobilization and disarmament reintegration of former rebels began. This process was blocked by economic ethnic rivalries in the tri-border region (CAR, Chad and Sudan).

In December 2012, the country again witnessed an insurrection. A rebel coalition taking the name as Séléka ("Alliance" in Sango language) was formed against the regime of Bozizé. Comprising at least three existing movements, this coalition, had well-armed and disciplined troops. It took control of the diamond town of Bria in December 18th, before quickly moving towards the capital. Bozize hoped to gain military support from France or the US, but both countries choose not to intervene. In March 2013, the rebels of the Seleka coalition resumed hostilities and ended up chasing Bozizé from power on March 24th 2013. The leader of the Seleka Michel Djotodia proclaimed himself president. Unable to restore order, the situation is bogged down and the crisis leads to communal clashes.

Given the risk of genocide, France announced November 26, 2013, sending a thousand troops to restore security in the country. December 5, 2013 by the resolution 2127, the UN Security Council authorized the deployment of the International Support Mission in the Central African Republic (MISCA) for a period of 12 months formally to end the "total bankruptcy in public order, the absence of the rule of law and sectarian tension." The MISCA was supported by French forces (Sangaris operation), authorized to take "all necessary measures".

On the 10th of January 2014 the President of the Central transition government, Michel Djotodia and Prime Minister Nicolas Tiangaye announced their resignation at an extraordinary summit of the Economic Community of Central African States (ECCAS). On January the 20th 2014, the National Transitional Council of the Central African Republic elected Catherine Samba-Panza as head of state to lead a transition government to elections in the CAR.

4. Objectives

The main objective of this work is to evaluate of the effect of armed conflict on children's health in CAR. Specifically, this paper is designed to:

- *Analyze the effect of the exposure of children under age five to armed conflicts on their nutritional status;*
- *Analyze the association of the location of children 0-5 years in relation to conflict zones with their nutritional status.*

5. Hypothesis

The central hypothesis of this study suggests that armed conflicts negatively affects children's health in CAR. Specifically,

- *Exposure of children 0-5 years to armed conflicts negatively affect their nutritional status;*
- *The more the location of a child is close to a conflict zone, the more the negative effect of armed conflict on children's nutritional status is high.*

6. Brief literature on the relationship between armed conflicts and child health

In the empirical part of the analysis on armed conflict and child health, Duque (2013) analyses in Colombia the effects of children exposure to conflicts and the impact of emergency programs on physical, cognitive and emotional development of the child. The results have shown that

exposure to massacres during pregnancy has negative effects on birth weight. More so, prenatal and postnatal exposures have negative impacts on height for age (HAZ), cognitive-test, scores and socio-emotional behavior of the child.

Akresh, Lucchetti and Harsha (2012) estimated the effect of exposure to war on the health of children at birth during the Eritrea-Ethiopia war between 1998-2000. They found that the HAZ z-scores are of 0.45 standard deviation less for children living in war zones and the effects of the war are similar with or without the characteristics of the mother and the household. They also found that children born during the war in war 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, they proved that each additional month of exposure to war significantly reduces the z-score of 0.04. Guerrero-Serdan (2010) examined the causal effect of the Iraq war on the health and nutritional state of children. An analysis of anthropometric indicators allowed him to conclude that the war has affected the physical growth of children or young cohorts born after the war in the conflict of high intensity zones. The effect on young cohorts is between -0.3 to -0.38 standard deviation, which is equivalent to a six-month effect of about 0.76 cm less than its normal size.

Elsewhere, Akresh et al. (2012) have 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 indicator, Arcand et al (2010) found similar results in the case of the civil war in Angola.

Alderman et al. (2006) used the civil war and the impact of drought to identify differences in the preschool nutritional status of children of the same parents. They found that children exposed to these shocks were 3.4 cm shorter and incorporated an instruction status which was 0.85 year lower. Analyzing the effects of crop failures and civil conflict on the health of Rwandan children born between 1987 and 1991, Akresh and Verwimp (2006) 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.

Another study on the effects of the civil war in Burundi rural areas was realised by Bundervoet (2008). They found that children born in the provinces affected by the war had on average 0.5 standard deviations below the HAZ z-score with respect to non-exposed children.

Verpoorten and Serneel (2012), using longitudinal data from rural Zimbabwe, discussed the long-term consequences of malnutrition caused by the armed conflicts on children. According to them, improving the nutritional status of children in kindergarten (as measured by the height for age) is associated with an increased size in adolescence to early schooling and high academic achievement. These improvements are therefore invaluable where there are positive associations between education and productivity, then size and productivity. Finally, they noted that, among the determinants of the size to the mother, malnutrition appears to be as a result of shocks such as war and drought. It follows from the above that there is a correlation between the nutritional status of children in kindergarten and the subsequent results in the formation of human capital. Children's diet of high quality has positive effects on education and normal growth of students. However, conflicts prevent them from reaping these benefits because they undermine food production resources and expose them to malnutrition.

7. Methodology

This section aims to present the methodology that we will use to achieve the goal that we are striving for. It focuses on three main areas: presentation of variables, analytical method and the data.

7.1. Measurement of variables

a) Outcome

The outcome of this study is the child's health, measured by the nutritional status. Two indicators of child's nutritional status are used: stunting and wasting. Indeed, stunting, wasting and underweight are the main anthropometric indicators of child nutritional health. However, this study does not consider underweight because it is a combined indicator of stunting and wasting, and might not clearly delineate potential causal relationships with women's empowerment if an association was observed (Amare, Ahmed, & Mehari, 2019; McKenna et al., 2019).

Stunting, or chronic malnutrition, is measured by the height-for-age (HAZ) Z-score. Children are considered stunted if their HAZ Z-score was more than 2 standard deviations (SDs) below the median of the WHO Child Growth Standards reference population (WHO, 2006). This can be explained by an inadequate diet or by infectious diseases that have occurred over a relatively long period or that have manifested themselves repeatedly. Thus, stunting is a binary variable which is coded as 1 if the HAZ values are less than minus 2 SDs below the median and 0 if not. Wasting, or acute malnutrition, is measured by the weight-for-height (WHZ) Z-score. Children are considered wasted if their WHZ Z-score was more than 2 SDs below the median of the

WHO Child Growth Standards reference population (WHO, 2006). Wasting can be the result of insufficient nutrition during the recent period preceding the survey or of weight loss following an illness (severe diarrhea, measles, anorexia for example). It is therefore a binary variable which is coded 1 if the values of the WHZ are less than minus 2 SDs below the median and 0 otherwise.

b) Measurement of armed conflict

The variable for which we plan to measure the effect on children's health is the armed conflict. Indeed, this appears difficult to measure since it is basically not observable. To overcome this obstacle, we apprehend the said armed conflict in two ways: from the point of view of "children exposure" to the war and from the "location of the child" in relation to war zones.

In the first case, the armed conflict then appears as a binary variable that takes the value 1 if a child was exposed to conflict and 0 if not. Indeed, in the same manner as we use the MICS 2010 data, to characterize the exposure of a child to war we will exploit the spatiotemporal evolution of conflicts for the period from 2003 to 2008. Thus, a child is said to be "exposed to the conflict" when two specific conditions are fulfilled. Concerning the first, the child must have at least three years at the time of the survey (that is to say, in 2010). In other words, the child must belong to the cohort of those whose date of birth coincides with a year of the period of conflict considered, that is to say between 2003 and 2008.⁴ For the second condition, it postulates that at the time of the war, that the child should be within an area affected by this war. Thus, according to the spatial evolution of the conflict, the child should be at this time in one of the prefectures (divisions) below: Ombella-Mpoko, Ouham, Ouham-Péndé, Kemo, Nana-Grébizi, Bangui, Ouaka, Bamingui- Bangora, Haute-Kotto and Vakaga. As indicated by the statistics in Table 1 below, children born alive during the period of conflict (2003-2008), which were present in an area affected by the war correspond to 20.05% of the workforce in our sample. But when we neglect the prefecture of Vakaga which was strongly touched by the instability at the time of investigation, we are left with an adjusted proportion corresponding to 19.98%.

However, our definition of exposure of a child to the conflict is based on a number of assumptions. Firstly, plausible migrations of children between two periods and from one area to another (a prefecture affected by the conflict or not, to another or even outside the country)

⁴ We specify here that instead of 2003-2008, the exact period of exposition to conflict is ought to be 2006-2008 since with the MICS 2010 survey, we are not able to have a cohort of children not exceeding 5 years.

Table 1: Cross distribution of children following the conflicts areas to which they belong and age at the time of the 2010 MICS survey

Age of child at the time of survey MICS 2010	Belonging of children to a conflictual zone			
	Not belonging to		Belong to	
	(N) (%)	(N) (% adjusted ^a)	(N) (%)	(N adjusted ^a) (% adjusted ^a)
Age < 3	2 851 27,22	2 851 27,35	3 826 36,53	3 792 36,38
Age ≥ 3	1 697 16,20	1 697 16,28	2 100 20,05	2 083 19,98

Source: Calculated from MICS, 2010. (a): Adjusted from staff of the prefecture of Vakaga.

that can significantly affect the composition of the children cohort who were exposed to armed conflict, could not be taken into account because they are unobservable. Secondly, we assume that the cohort of children who were exposed was evolving over time. In other words, if we consider a cohort of children aged $[t; t + k]$ at time t , then at time $t + n$, this cohort will correspond to that of older children between $[t + n; t + k + n]$. Thirdly, in areas affected by war, we make a hypothesis that children who lived there were exposed at that same time and space because we do not have any information on whether a particular child has been exposed before or after another. In the fourth place, although it is likely that some prefectures were more affected than others by the war, we assume in our reasoning that children in these conflict zones were affected in the same way.

In the second case, that is to say from the "location of the child " in relation to conflict zones, the armed conflict is measured from three dummies variables. The first one takes the value 1 if child under five years was within a conflict zone and 0 if not. The second dummy variable takes the value 1 if the child was in an area near to the conflict zone and 0 if not,⁵ and the last dummy variable takes the value 1 if the child was in a far by place from the conflict.⁶ Indeed, from the spatial evolution of the areas of armed conflict above, the divisions or prefectures nearest to the conflict include: Haut-Mbomou, Mbomou and Basse-kotto, whereas those in remote war zones are: Nana-Mambéré, Mambéré-Kadéï and Lobaye.

⁵ Only these first two dummies variables will be included in the nutrition regression.

⁶ As before, we also assume that when the MICS 2010 survey, children were aged at least three years, the minimum age required for these children have experienced war.

Table 2: Cross Distribution of children according to position relative to conflict areas and age at the time of the 2010 MICS survey

Age of child at the time of survey MICS 2010	Localization of child relative to conflict zone		
	Far	Near	Inside
	(N) (%)	(N) (%)	(N) (%)
<i>Age < 3</i>	4 269 40,76	1 063 10,15	1 311 12,52
<i>Age ≥ 3</i>	2 391 22,83	558 5,33	831 7,93

Source: Calculated from MICS, 2010. The values of table are adjusted from staff of children of Vakaga region.

As shown in Table 2 above, 23% of children with at least three years at the time of the 2010 MICS survey were in remote conflict zones, only 5% of children of this cohort age were in a remote area and 8% of children in this cohort were located inside the same conflict zones.

7.2. Descriptive and multivariate analysis

Descriptive analysis was performed through univariate and bivariate statistics. Univariate statistics are conducted to explore the distributions of all variables (outcomes, armed conflicts indicators, and control variables). Bivariate statistics are used to evaluate the prevalence of children's nutritional indicators (stunting and wasting) by the explanatory variables and the differences were tested by Pearson's chi-square statistic. The sample weight was used for the estimation of percentage distribution.

Concerning multivariate analysis, a logistic regression model is used to evaluate the association of armed conflicts with childhood stunting and wasting, since these outcomes are qualitative and dichotomous. This model can be formalized as follows:

$$\log\left(\frac{P_i}{1 - P_i}\right) = \beta_0 + \beta_1 AC_i + \beta_2 X_i + \varepsilon_i$$

where $(p/1 - p)$ represents the chances that an indicator of child nutritional health (stunting or wasting) is realized. AC_i represents the armed conflicts. X_i is the matrix of control variables. Estimation of the parameters β_1 and β_2 allow to assess, respectively, the influence of armed conflicts and control variables on childhood stunting and wasting. ε_i is the error term. Note that the robust standard errors are clustered at the household level to take into account the correlation (in terms of nutritional health) between the children of the same household. The regression

results will be presented by the estimated odds ratio (OR) with 95% confidence interval (CI). The software used to carry out the empirical analyzes of this study was STATA, version 15 (StataCorp, 2017).

7.3. Data

The data used in this study comes from the fourth edition of the Multiple Indicator Cluster Survey (MICS4) conducted in 2010 in the Central African Republic (CAR). The survey was 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. This survey provides updated information on the situation of children and women which measures the key indicators that allow countries to monitor the progress towards achieving the Millennium Development Goals (MDGs) and other agreed commitments in international scene.

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. Urban and rural areas of these prefectures were identified as the main sampling strata. In each stratum, a number of enumeration areas (EAs) was 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 total of 10 474 children under age five were registered in the survey. However, twenty-six (26) clusters of twenty-eight (28) in the Vakaga prefecture could not be visited due to the heightened insecurity during the data collection operations in the field, the equivalent of 51 (on 1228 children) children surveyed in this area. Consequently, the information collected from these 51 children are not reliable due to unfavorable environmental parameters of that time and risk of precipitation when the investigators were reporting; for this reason, we neglect the data from this region. Therefore, we would work with a sample of 10,423 children aged from 0 to 59 months instead of 10474.

Also note that this database is the only one available and the most recent in CAR that can enable us to conduct these investigations in the field of health. It allows us to collect information on one hand, from the prefectures affected by the war or not, and on the other hand, it provides information on the socioeconomic and demographic characteristics of the parents and the

household properties. Moreover, it was conducted in 2010, providing an adequate period to assess the spread of the effects of this war. Therefore, this database is suitable not only for measuring the effect of armed conflict on children's health, but also to highlight the effect of other determinants related to socioeconomic and demographic characteristics of the parents and the household.

References

- Akresh, R., & Verwimp, P. (2006).** Civil war, crop failure, and the health status of young children.
- Akresh, R., Bhalotra, S., Leone, M., & Osili, U. O. (2012).** War and stature: growing up during the Nigerian Civil War. *The American Economic Review*, 102(3), 273-277.
- Akresh, R., Lucchetti, L., Harsha, T. (2012).** Wars and child health: Evidence from the Eritrean–Ethiopian conflict, In *Journal of Development Economics*, 99(2), 330-340.
- Amare, Z. Y., Ahmed, M. E., & Mehari, A. B. (2019).** Determinants of nutritional status among children under age 5 in Ethiopia: further analysis of the 2016 Ethiopia demographic and health survey. *Globalization and health*, 15(1), 62. <https://doi.org/10.1186/s12992-019-0505-7>
- Arcand, J. L., & Wouabe, E. D. (2009).** Households in a time of war: Instrumental variables evidence for Angola. The Graduate Institute, Geneva Working Paper.
- Audibert, M., Roodenbeke E., Pavy-Letourmy, A. et Mathonnat, J., 2004,** Utilisation des services de santé en Afrique: l’approche communautaire en termes d’offre de soins est-elle une réponse, communication présentée au développement durable et santé dans les pays du sud. In Colloque développement durable et santé dans les pays du sud, Lyon.
- Baez, J. E. (2011).** Civil wars beyond their borders: The human capital and health consequences of hosting refugees. *Journal of Development Economics*, 96(2), 391-408.
- Bundervoet, T. (2006).** Estimating Poverty in Burundi, Households in Conflict Network.
- Duque, V. (2013).** Violent Conflicts and Child Development: Evidence from Colombia.
- Enquête Nationale sur la Situation Nutritionnelle et la Mortalité en RCA. (2014).** Rapport final.
- Enquête par Grappes à Indicateurs Multiple/ MICS RCA. (2010).** Rapport final.
- Korenman, S., Miller, J. E., & Sjaastad, J. E. (1995).** Long-term poverty and child development in the United States: Results from the NLSY. *Children and Youth Services Review*, 17(1), 127-155.
- Fay, H., Ndoye, D. & Musa, R. (2005).** Les déterminants de la santé des enfants au Sénégal, document de travail n°43, Centre d’Economie de la Sorbonne, Paris, 29-34.
- Girra, H. (2007).** Les déterminants du statut nutritionnel au Matlab : une analyse empirique, document de travail n°39, Centre d’Economie de la Sorbonne, Paris, 1-28.

Guerrero Serdan, G. (2009). The effects of the war in Iraq on nutrition and health: an analysis using anthropometric outcomes of children. *Available at SSRN 1359161.*

Labourdette, A. (1988). *Economie de la santé*, Presses Universitaires de France, Paris.

McKenna, C.G., Bartels S. A., Pablo L. A., & Walker, M. (2019). Women's decision-making power and undernutrition in their children under age five in the Democratic Republic of the Congo: A cross sectional study. *PloS one*, 14(12), e0226041. <https://doi.org/10.1371/journal.pone.0226041>

Richard, A., & Verwimp, P. (2006). Civil War, Crop Failure, and the Health Status of Young Children. HiCN Working Papers 19, Households in Conflict Network (www.hicn.org).

PNUD. (2012), Bilan commun de pays en Centrafrique, Bangui, Document de travail.

PNUD. (2015), Rapport sur le développement humain.

UNICEF. (2012), Rapport national sur la situation des enfants en RCA.

Verpoorten, M., & Serneels, P. (2010). The impact of armed conflict on economic performance: evidence from Rwanda.

World Health Organization. (2006). WHO child growth standards: length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: methods and development. World Health Organization. Available from: https://www.who.int/childgrowth/standards/Technical_report.pdf