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Determinants of Child Undernutrition in Sub-saharan Africa: Empirical Evidence from Cross-country Analysis

Gafar T. Ijaiya, Abdulrazaq. A. Yahaya & Usman. A. Raheem

Child undernutrition is one of the key features of an underdeveloped economy, with its causes linked to three distinct factors classified as immediate, underlying and basic determinants. Using a cross-country data drawn from 48 countries in Sub-Saharan Africa and a multiple regression analysis, this paper examines the validity of these determinants. The results obtained indicates that factors like the lack of access to health care services, the lack of democratic values and the existence of civil conflicts did not impact much on child undernutrition, while factors like low calories, protein and fat intakes, lack of access to safe water, lack of access to sanitation facilities, food insecurity, high rate of inflation, high rate of poverty, huge debt servicing have impacts on child undernutrition. Given these results measures such as the reduction in income poverty, increase in food production and its efficient distribution, stable macroeconomic policies and good governance are suggested as possible solutions to child undernutrition.

Key words: Sub-Saharan Africa, Child undernutrition, Cross-country Analysis

INTRODUCTION

The prevailing cases of undernutrition in less developed countries have in recent times become alarming, given its consequences on most children that have either died or become physically or mentally disabled. For instance, in the year 2001 close to 26 percent of the children in Africa are under weight with an estimated figure of 131 per 1000 under-5 mortality rate recorded in the same year (ADB, 2003).

Reasons deduced for these situation include among others; increased food insecurity that has led to insufficient nutritional intakes, the lack of care for mothers and children, improper healthy environment drawn from the lack of access to safe water, lack of access to health care

Gafar T. Ijaiya, is a Poverty Analyst and a Lecturer in the Department of Economics, University of Ilorin, Ilorin, Nigeria, E-mail: gtijaiya@yahoo.com.

Abdulrazaq. A. Yahaya, is a Food Security Analyst and a Lecturer in the Department of Liberal Studies, Kwara State Polytechnic, Ilorin, Nigeria.

Usman A. Raheem, is a Medical Geographer and a Lecturer in the Department of Geography, University of Ilorin, Ilorin, Nigeria.

services and sanitation facilities, low education of parents, high rate of poverty, macro economic instability (e.g. increase in inflation, and exchange rate instability) and socio-political instability (e.g. ethnic/religion and civil conflicts (see World Bank 1990, 2001).

Drawing from the above, the aim of this paper therefore is to examine the validity of some of these factors in Sub-Saharan Africa, using a set of data drawn from some countries in the sub-region and a multiple regression analysis.

The next section that follows provides a conceptual overview of child undernutrition and its determinants. Section three provides the data source and methodology. Section four analyses the data and discusses the results. Conclusion and recommendations are contained in the last section.

CONCEPTUAL CLARIFICATION: CHILD AND CHILD UNDERNUTRITION

A child is a person between about 1 month to 13 years of age. In other words, it is someone who is not yet an adult. According to this definition, childhood extends from birth until sometimes past the age of 13—the age at which most people reach their full adult physical growth. In most developing countries, it is regarded as one of three stages that people pass through from birth to adulthood. The other stages are infancy and adolescence. Infancy extends from birth to about 13 months of age. Adolescence begins between the ages of about 10 and 13 years and lasts to adulthood. Childhood therefore is the period between infancy and adolescence (World Book 2001a).

On the other hand, undernutrition is a situation of incomplete or imperfect nutrition that is necessary for growth and maintenance of vigour or health (World Book 2001b). The situation of child undernutrition is best understood from the three commonly used anthropometrics measures that offers a comprehensive profile of undernutrition: stunting, underweight and wasting. The term stunting is used to describe a condition in which children fail to gain sufficient height, given their age. Stunting is therefore an extremely low “height-for-age” (H/A) score, and often associated with long-term factors such as chronic malnutrition, especially protein – energy malnutrition and sustained and frequent illness. The term underweight is used to describe a situation where a child weight is less than expected, given his or her age. Underweight is thus an extremely low weight-for-age (W/A) score. Unlike height, weight fluctuates over time and therefore reflects current and acute, as well as, chronic malnutrition. The term wasting refers to a situation where a child has failed to achieve sufficient weight for height (W/H). Wasting often results from recent and continuing severe weight loss due to inadequate energy intake, recent and continuing poor health or a combination of both. (Wagstaff and Watanabe 2000; Glewwe, et. al 2002).

Determinants of Undernutrition

Drawing from the United Nations Children’s Fund’s Framework on the causes of child undernutrition, Smith and Haddad (2000) break the determinants of child under nutrition into three levels of causality: immediate determinants, underlying determinants and basic determinants. The immediate determinants of child undernutrition manifest at the level of the individual human being. They are inadequate dietary intakes (energy, protein, fat and

micronutrients) and poor health status. These factors themselves are interdependent. A child with inadequate dietary intake is more susceptible to disease. In turn, disease depresses appetite, inhibits the absorption of nutrients in food and competes for a child's energy. The immediate determinants of child undernutrition are in turn, influenced by the underlying determinants manifesting themselves at the household level. These are food insecurity, inadequate care for mothers and children and improper health environment that include poor access to health care services, water and sanitation facilities. Food insecurity is when a person has no access to enough food for an active and healthy life. The resources necessary for gaining access to food are food production, income for food purchases or in-kind transfers of foods. Inadequate care for mother and children has to do with lack of provision in household and communities of time, attention and support to meet the physical, mental and social needs of the growing child and other household members. Examples of caring practice are child-feeding, health seeking behaviour, support and cognitive stimulation for children, care and support for mothers during pregnancy, educational and socio-political opportunities for women. The improper health environment and services are limited to availability of safe water, sanitation, and health care services and environmental safety including shelter. Another key factor that is related to this is poverty. A person is considered to be in absolute poverty when he or she is unable to satisfy his/her basic needs (adequate food, health care, safe water, shelter, primary education and community participation). The effects of poverty in this regard are reflected on individuals' inability to achieve food security, have adequate resources for care, and inability to use or contribute to the creation of resources for health on a sustainable basis. Finally, the underlying determinants of child undernutrition are in turn influenced by basic determinants, which include inadequate potential resources available to a country or community usually limited by the natural environment, lack of access to technology and the poor quality of human resources. Political, economic, cultural and social instability that affect the utilization of these resources and how they are translated into resources for food security, care and healthy environment are also considered here. Prominent among them are the absence of democratic principles, civil conflicts/wars, inflation and increase in debt servicing.

Scholars like Schiff and Valdes (1990), Abosede and McGuire (1991), Ali and Pitkin (1991), Musgrove (1993), World Bank (1993), World Bank (1994), Binswanger and Landell-Mills (1995), Psacharopoulos (1995), Del Roso and Maerk (1996), Young (1996), Haddad, et.al (2003), also provided other determinants of undernutrition to include the people's lack of means to obtain enough of their accustomed diet because of the rate of poverty, which is limited to income drops or stagnation, seasonal fluctuation in availability of food due either to natural disasters (e.g. flood or drought) or distortions in the distribution and flow of foods items; persistent increase in the prices of food, lack of balance diet, poor feeding practices and excessive disease; lack of education and information (thus, leading to ignorance about micronutrients, especially vitamins); ignorance about diseases that are caused by inadequate feeding and ignorance about how to care for every young child. For instance, the famine due to drought that occurred in 1974 in Ethiopia, China and Nigeria between 1973-74, and in Somalia and Sudan in the 1990s had its toll on the people and livestock. During these periods as many as 30 million people most of them children were said to have died in the Chinese famine and hundreds of thousand in the recent famines in Sub-Sahara Africa. A relatively small member of children died from out right starvation and many died of infectious diseases. In Ethiopia and Sudan, most of the victims

were children of nomadic and semi-nomadic herders who saw their income plummeted when livestock prices fell and they could not afford to buy food.

DATA SOURCE AND METHODOLOGY

A cross-country data drawn from 48 countries in Sub-Sahara Africa for the period 2001 were used (see Appendix 1). The variables considered for the study were the nutritional status of children (proxied by the percentage of under weight children that are less than five years old) and the key determinants of child undernutrition grouped into three: the immediate determinants, the underlying determinants and the basic determinants. The immediate determinants comprises of low nutritional intakes (calorie, protein and fat), which in turn are influence by the underlying determinants comprising food insecurity, inadequate care for mothers and children and improper health environment that include the lack of access to health care service, the lack of access to safe water and the lack of access to sanitation facilities. The underlying determinants are in turn influenced by the basic determinants which include the lack of economic resources (that are limited by the natural environment, poor technology and lack of quality human resources), the absence of democratic values and socio-cultural problems e.g. tribal/civil conflicts (see Smith and Haddad, 2000).

The data were obtained from the African Development Bank Selected Statistics on African Countries for the year 2002 and African Development Bank Gender, Poverty and Environmental Indicators on African Countries for the year 2003.

THE MODELS

Drawing from the studies by Schiff and Valdes (1990) and Glewwe, et. al (2002) (that uses household data and health production function in determining child nutritional status), sets of models were formulated. The main model (Model A) is a disaggregated model that investigates the validity of the three key determinants of child undernutrition in Sub-Saharan Africa. Model A is thus represented as:

$$CUN_A = f(ID, UD, BD) \quad \dots(1)$$

Where: CUN_A = Child undernutrition

ID = Immediate determinants

UD = Underlying determinants

BD = Basic determinants

When treated separately, three different models were arrived at: (Models 1, 2 and 3)

Model 1 is the immediate determinants of child undernutrition represented as:

$$CUN_1 = f(ID) \quad \dots(1.1)$$

$$\text{With ID} = (LCI, LPI, IFI) \quad \dots(1.2)$$

When equation (1.2) is substituted into equation (1.1) it then becomes:

$$CUN_1 = f(LCI, LPI, IFI) \quad \dots(1.3)$$

When transformed into a multiple linear equation, Model 1 then becomes:

$$CUN_1 = \beta_0 + \beta_1 LCI + \beta_2 LPI + \beta_3 LFI + U \quad \dots(1.4)$$

Model 2 represents the underlying determinants of child undernutrition and is written as:

$$CUN_2 = f(UD) \quad \dots(2.1)$$

With $UD = (FOI, Lcare, Lwostatus, LacchH, LaccSW, LaccSF) \quad \dots(2.2)$

When equation (2.2) is substituted into equation (2.1) it then becomes:

$$CUN_2 = f(FOI, Lcare, Lwostatus, LacchH, LaccSW, LaccSF) \quad \dots(2.3)$$

When transformed into a multiple linear regression equation, Model 2 becomes:

$$CUN_2 = \alpha_0 + \alpha_1 FOI + \alpha_2 Lcare + \alpha_3 Lwostatus + \alpha_4 LacchH + \alpha_5 LaccSW + \alpha_6 LaccSF + E \quad \dots(2.4)$$

Model 3 represents the basic determinants of child undernutrition which is written as:

$$CUN_3 = f(BD) \quad \dots(3.1)$$

With $BD = (PCI, DemoV, Exdebts, Infla, Ecconflict) \quad \dots(3.2)$

When equation (3.2) is substituted into equation (3.1) it then becomes:

$$CUN_3 = f(PCI, DemoV, Exdebts, Infla, Ecconflict) \quad \dots(3.3)$$

When transformed into a multiple linear regression equation, Model 3 then becomes:

$$CUN_3 = z_0 + z_1 PCI + z_2 LDemoV + z_3 Ex\ debts + z_4 Infla + z_5 Ecconflict + Q \quad \dots(3.4)$$

Where:

- LCI = low daily calorie intake per capita
- LPI = low daily protein intake per capita
- LFI = low daily fat intake per capita
- FOI = food insecurity proxied by the availability of food (output per capita)
- Lcare = low women and child care (proxied by women gross secondary school enrolment ratio)
- Lwostatus = low women status relative to men (proxied by ratio of female life expectancy at birth to men)
- LacchH = percentage number people that lack access to health care
- LaccSW = percentage number of people that lack access to safe water
- LaccSF = percentage number of people that lack access to sanitation facilities
- PCI = low level of economic resources (proxied by per capita income)
- LDemoV = lack of democratic values e.g. the presence of military/dictatorial rule. Dummy 1 was used for the presence of democratic values-civilian government; and dummy 0 for military/dictatorial rule (see Appendix 2).
- ExDebts = external debt servicing in US dollars (\$)
- Infla = the rate of inflation (in percentage)
- Ecconflict = ethnic/civil conflicts e.g. wars. Dummy 1 for absence of wars; and dummy 0 for war torn countries (see Appendix 3).
- β_0, α_0 , and z_0 = the intercepts

$\beta_1, \dots, \beta_3, \alpha_1, \dots, \alpha_6$ and z_1, z_2, z_3 = parameter estimates associated with the influence of the independent variables on the dependent variable.

U, E and Q = the disturbance terms

To estimate the model, a multiple regression analysis is used in order to reflect the explanatory nature of the variables. To verify the validity of the models, two major evaluation criteria were used: the *a-priori* expectation criteria which is based on the signs and magnitudes of the coefficients of the variables under investigation; and (ii) statistical criteria which is based on statistical theory, which in other words is referred to as the First Order Least Square (OLS) consisting of R-square (R^2), F-statistic and t-test. The R-square (R^2) is concerned with the overall explanatory power of the regression analysis, the F-statistic is used to test the overall significance of the regression analysis and the t-test is used to test the significant contribution of the independent variables on the dependent variable (Oyeniyi 1997).

Drawn for the models our *a-priori* expectations or the expected behaviour of the independent variables on the dependent variable are: LCI < 0; LPI < 0; LFI < 0; FOI > 0; Lcare < 0; Lwostatus < 0; Lacc H < 0; LaccSW < 0; LaccSF < 0; PCI < 0; LDemoV < 0; ExDebts > 0; Infla > 0; Ecconflict > 0. An indication that all the independent variables are inversely related to the dependent variable except food insecurity, external debt servicing, inflation and ethnic/civil conflicts that are directly related to the dependent variable.

RESULTS AND DISCUSSION

The results of the multiple regression analysis of the models conducted at 5 percent level of significance are presented in Table 1. The regression results of Model 1 representing the immediate determinants of child undernutrition show that the R^2 is 45 percent which is the variations by which the dependent variable is explained by the explanatory variables, while the error term take care of the remaining 65 percent, which are variables in the study that can not be included in the model because of certain qualitative features.

At 5 per cent level of significance, the F-statistic show that the model is useful in determining if the explanatory variables have any significant influence on the dependent variable, as the computed F-statistic which is 8.16 is greater than the tabulated F-statistic ($_{3,48}$ degree of freedom) valued at 2.84.

In terms of the individual independent variables, the co-efficient estimates and the associated t-statistics of calorie, protein and fat intakes have the expected signs, thus fulfilling our *a-priori* expectations. But when viewed statistically, only protein and fat intakes having significant effect on child undernutrition with calorie intake having little or no effect since it is statistically insignificant at 5 percent level of significance. The negative signs of these variables are indications that the less the calorie, protein and fat intakes, the more the level of child undernutrition in Sub-Sahara Africa. A situation that can be linked to the decline in food production and the high rate of poverty that have deprived a lot of people access to quality food.

The regression results of Model 2, representing the underlying determinants of child undernutrition also show the R^2 at 43 percent, with the F-statistic at 2.41, thus indicating that the model is useful in determining if the explanatory variables have any significant influence on the dependent variable, since the value of the F-statistic is greater than the tabulated F-statistic values at 2.33.

Table 1 Regression Results of the Determinants of Child Undernutrition in Sub-Saharan Africa

Variable	Model 1 Immediate Determinants	Model 2 Underlying Determinants	Model 3 Basic Determinants
Intercept	44.0	59.9	23.9
(t)	(5.75)	(1.62)	(5.32)*
LCI	-3.64		
(t)	(-0.87)		
LPI	-3.85		
(t)	(-1.72)*		
LFI	-1.23		
(t)	(-2.92)*		
FOI		2.65	
(t)		(0.35)	
Lcare		-0.21	
(t)		(-2.65)*	
Lwostatus		-23.6	
(t)		(-0.66)	
LaccH		1.74	
(t)		(0.26)	
LaccSW		-9.04	
(t)		(-1.30)**	
LaccSF		-3.51	
(t)		(-0.09)	
PCI			-3.71
(t)			(3.76)*
LDemoV			11.40
(t)			(2.15)*
ExDebts			5.46
(t)			(0.14)
Infla			1.98
(t)			(1.23)**
Ecconflict			-6.78
(t)			(-2.05)*
R ²	0.45	0.43	0.52
Adjusted R ²	0.31	0.41	0.51
F	8.16*	2.71*	4.83*

t-statistics in parenthesis

* Significant at 5 percent

** Significant at 10 percent

The co-efficient estimates and the associated t-statistics of food insecurity, the lack of care for woman and children, low women status relative to men, lack of access to safe water and lack of access to sanitation facilities have the expected signs, thus fulfilling our a-priori expectations. Of all these variables only the lack of care for woman and children and the lack of access to safe water are statistically significant at 5 percent and 10 percent levels respectively, while the other variables are not. The results of the a-priori expectations indicates that as food insecurity increases child undernutrition also increases and as less attention is given to woman and their children the more is child undernutrition. Same it is for when the status of women is low relative to men, and when the people lack access to safe water and sanitation facilities.

The outcomes of these variables can be linked to the poor state of the nations' agricultural sector and its total neglect for other sectors by the governments and policy makers, the poor state of women education and the high rate of men's discrimination against women that are seen as lesser sex in Africa. That the lack of access to health care services is not a significant factor to child undernutrition and that it falls short of our a-priori expectation can be linked to the individual's perception of health care needs and choice that usually occurs when they are ill. Thus with the presence of traditional health care services that usually serve as alternative, the people in the sub-region need not bother much with modern health care services.

The regression results of Model 3, representing the basic determinants of child undernutrition show the R^2 at 52 percent and the F-statistic at 4.83. An indication that the model is useful in determining if the explanatory variables are significant to the dependent variable, since the value of the F-statistic is greater than the tabulated F-statistic valued at 2.33.

The co-efficient estimates and the associated t-statistics of inadequate economic resources and those of external debt servicing and inflation have the expected signs, thus fulfilling our a-priori expectations. These results notwithstanding only inadequate economic resources and the rate of inflation are statistically significant at 5 percent and 10 percent levels respectively, while external debt servicing is statistically insignificant. The results of the a-priori expectations indicate that as the nations' economic resources continue to deteriorate and as external debt servicing and the rate of inflation continue to increase so would the rate of child undernutrition. Reasons deduced for these situations can be linked to the effects of the global economic crisis that has been there since the 1980s and the negative effects of structural adjustment programme that came with it.

The co-efficient estimates and the associated t-statistics of the absence of democratic values and ethnic/religious/civil conflicts in the sub-region, though statistically significant at 5 percent level of significance, the two variables are inversely related to child undernutrition, thus contradicting our a-priori expectations. That the absence of democratic values and conflicts did not impact much on child undernutrition could be linked to the recent emergence of democracy in most countries in the sub-region and for ethnic/religious/civil conflicts e.g. wars, the sub-region has in recent time also experienced relative peace, except for few countries like Liberia, Sierra Leone, Democratic Republic of Congo and Sudan.

A general look at some of the results seems to conform with the views of scholars like Pacay and Payne 1985; World Bank 1990; Behrman 1996; Narayan et. al 2000a 2000b; Shi 2000; Flores 2001; Fritschel 2001; Hazell and Haddad 2001; World Bank 2001; Pattillo, et. al 2002; who in their various studies established reasons like the high rate of poverty, discrimination against woman, macroeconomic instability, food insecurity, the increases in the price of food, the increase in debt servicing and the lack of infrastructural facilities (e.g. safe water and sanitation facilities) as some of the causes of child undernutrition. Stressing specifically on poverty, Hazell and Haddad (2001), sees it as consisting of two interacting deprivations- physiological and social, with physiological deprivation laying emphasis on the inability of individuals to meet or achieve basic material needs that can be measured either as a lack of income which limits access to food and to education, health, housing, safe water and sanitation services or the failure to achieve desired outcomes such as a high quality diet rich in micronutrients, health status, educational attainment and the quality of health, water and sanitation services received, while

social deprivation refers to the absence of elements that are empowering, such as, autonomy, time, information, dignity and self-esteem. Lack of empowerment is reflected in exclusion from important decision making processes that affect the life of the people most of them poor. Even when the outcomes are of considerable important to them, for example, decisions about public investment in the local community, management of common properties and priorities for agricultural production, research and extension.

CONCLUSION AND RECOMMENDATIONS

An empirical study of the determinants of child undernutrition in Sub-Saharan Africa was carried out using a cross-country data and a multiple regression analysis. The determinants viewed from three perspectives (immediate, underlying and basic determinants) provided some interesting results that fulfilled some of our a-priori expectations. For instance, insufficient calorie, protein and fats, lack of care for mothers and children, lack of access to safe water and sanitation facilities, low status of women relative to men, poor economic performance, external debt burdens, high rate of inflation, inadequate supply of food have to some extent impacted on child undernutrition in Sub-Saharan Africa.

Addressing these situations would require intense comprehensive solutions that would include a reduction in income poverty, because greater income at the household and community levels would enable families to invest more in food consumption, have more access to safe water and good hygiene and have better child and mother care arrangements; and direct investment by all and sundry in nutrition programmes like micronutrients supplementation and fortification, given their importance to child growth and development.

In addition to the above is the recognition of the role of biodiversity in food and livelihood security, which emphasizes on the diversification of food production from carbohydrate staples (e.g. rice, maize and wheat) to the use of culturally appropriate, traditional and underutilized food crops like *roselle*, *canahua* and *quinua* that are valuable sources of micronutrients and vitamins needed to overcome the problem of hidden hunger.

Equally important are stable macro-economic policies to take care of some of the basic problems that usually deprive people access to food, like inflation, external debt overhang and exchange rate volatility. The stability of these variables at appropriate rates would facilitate domestic and foreign investment in food production and related food processing industries.

Enhancing good governance at all levels of government (national, state/regional and local levels) is paramount, since good governance would be able to take care of sharp practice among the people that are put in charge of responsibilities, especially in the area of food production and distribution, safe water supply and sanitation and in the management of the economy in general.

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Appendix 1: The Number of Countries Selected for the Study in Sub-Saharan Africa

Angola	Benin	Botswana	Burkina Faso	Burundi	Cameroon
Cape Verde	Central African Republic	Chad	Comoros	Congo	Democratic Republic of Congo
Cote D'ivoire	Djibouti	Equat. Guinea	Eritrea	Ethiopia	Gabon
Gambia	Ghana	Guinea	Guinea Bissau	Kenya	Lesotho
Liberia	Madagascar	Malawi	Mali	Mauritania	Mauritius
Mozambique	Namibia	Niger	Nigeria	Rwanda	Sao Tome & Principe
Senegal	Seychelles	Sierra Leone	Somalia	South Africa	Sudan
Swaziland	Tanzania	Togo	Uganda	Zambia	Zimbabwe

Appendix 2: The Number of Countries in Sub-Saharan Africa with the Presence of Military/Dictatorial Rule and Democratic Values-Civilian Government Before 2002

Angola	Benin	Botswana	Burkina Faso	Burundi*	Cameroon
Cape Verde	Central African Republic*	Chad	Comoros	Congo	Democratic Republic of Congo*
Cote D'ivoire	Djibouti	Equat. Guinea	Eritrea	Ethiopia	Gabon
Gambia*	Ghana	Guinea*	Guinea Bissau	Kenya	Lesotho
Liberia*	Madagascar	Malawi	Mali	Mauritania	Mauritius
Mozambique	Namibia	Niger	Nigeria	Rwanda*	Sao Tome & Principe
Senegal	Seychelles	Sierra Leone	Somalia*	South Africa	Sudan*
Swaziland	Tanzania	Togo*	Uganda*	Zambia	Zimbabwe*

* Countries in Sub-Saharan Africa with the presence of military/dictatorial rule

Appendix 3: The Number of Countries in Sub-Saharan Africa with Relative Peace and at War before 2002

Angola*	Benin	Botswana	Burkina Faso	Burundi*	Cameroon
Cape Verde	Central African Republic*	Chad	Comoros	Congo	Democratic Republic of Congo*
Cote D'ivoire*	Djibouti	Equat. Guinea	Eritrea	Ethiopia	Gabon
Gambia	Ghana	Guinea	Guinea Bissau	Kenya	Lesotho
Liberia*	Madagascar	Malawi	Mali	Mauritania	Mauritius
Mozambique	Namibia	Niger	Nigeria	Rwanda*	Sao Tome & Principe
Senegal*	Seychelles	Sierra Leone*	Somalia*	South Africa	Sudan*
Swaziland	Tanzania	Togo	Uganda*	Zambia	Zimbabwe

* Countries in Sub-Saharan Africa that are still at war