





# Does economic growth reduce childhood stunting? A multicountry analysis of 89 Demographic and Health Surveys in sub-Saharan Africa

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## ABSTRACT

**Background** There is mixed evidence and lack of consensus on the impact of economic development on stunting, and likewise there is a dearth of empirical studies on this relationship in the case of sub-Saharan Africa. Thus, this paper examines whether economic growth is associated with childhood stunting in low-income and middle-income sub-Saharan African countries.

**Methods** We analysed data from 89 Demographic and Health Surveys conducted between 1987 and 2016 available as of October 2018 using multivariable multilevel logistic regression models to show the association between gross domestic product (GDP) per capita and stunting. We adjusted the models for child's age, survey year, child's sex, birth order and country random effect, and presented adjusted and unadjusted ORs.

**Results** We included data from 490 526 children. We found that the prevalence of stunting decreased with increasing GDP per capita (correlation coefficient=-0.606,  $p<0.0001$ ). In the unadjusted model for full sample, for every US\$1000 increase in GDP per capita, the odds of stunting decreased by 23% (OR=0.77, 95% CI 0.76 to 0.78). The magnitude of the association between GDP per capita and stunting was stronger among children in the richest quintile. After adjustment was made, the association was not significant among children from the poorest quintile. However, the magnitude of the association was more pronounced among children from low-income countries, such that, in the model adjusted for child's age, survey year, child's sex, birth order and country random effect, the association between GDP per capita and stunting remained statistically significant; for every US\$1000 increase in GDP per capita, the odds of stunting decreased by 12% (OR=0.88, 95% CI 0.87 to 0.90).

**Conclusion** There was no significant association between economic growth and child nutritional status. The prevalence of stunting decreased with increasing GDP per capita. This was more pronounced among children from the richest quintile. The magnitude of the association was higher among children from low-income countries, suggesting that households in the poorest quintile were typically the least likely to benefit from economic gains. The findings could serve as a building block needed

## Key questions

### What is already known?

- ▶ Child health goals remain far from being met in most parts of sub-Saharan Africa.
- ▶ Policymakers expect economic growth to influence child well-being positively.

### What are the new findings?

- ▶ The prevalence of stunting decreases with increasing gross domestic product (GDP) per capita.
- ▶ There is no significant association between GDP growth per capita and child stunting across sub-Saharan Africa.
- ▶ Improved economic growth may positively affect the lives of children in wealthy households, but not of those from poor households.

### What do the new findings imply?

- ▶ Improving child well-being requires clear policies that will ensure the most affected children have access to the resources needed.

to modify current policy as per child nutrition-related programmes in Africa.

## BACKGROUND

High rates of child mortality and undernutrition remain a persistent barrier to economic and human development goals in sub-Saharan African countries.<sup>1-8</sup> Chronic undernutrition is a key predictor of child mortality and morbidity, both of which exert long-term consequences on cognitive development, as well as educational and professional outcomes, and lower the opportunities for upward mobility.<sup>9-12</sup> As such, addressing child stunting is a critical aspect of Africa's human development efforts in the post-millennium development goals (MDGs) era.<sup>13 14</sup>

Researchers have shown that in many countries child mortality MDGs remain far from being met in sub-Saharan Africa, and risk factors such as inadequate healthcare infrastructure, lack of skilled human resources for healthcare and low use of reproductive and child health services are still widespread.<sup>5 15–19</sup> Signs of great achievements are reported in the areas of fighting subsistence poverty, and improving access to better water and sanitation facilities, electricity, high school enrolment, and national and household food security, which are important preconditions for better child nutrition outcomes.<sup>15 20–23</sup> Notwithstanding these achievements, sub-Saharan Africa and South Asian countries continue to account for most of the undernourished children worldwide, which in turn is contributing to the poor economic and human development outcomes.<sup>8 22</sup>

During the last two decades, the relationship between economic growth and child nutrition has attracted noteworthy research and donor attention.<sup>24–30</sup> Using a data set of 74 developing countries observed between 1984 and 2014, many concluded that economic growth is not a sufficient condition for child undernutrition reductions,<sup>31</sup> while others suggested that factors that contributed the most to the decrease in child stunting are full immunisation, iron supplements and deworming medication.<sup>32</sup> Economic growth can lead to widening inequalities in a variety of ways, such as access to education, health and technology, and growth represents an important means to reduce poverty only if income distribution remains constant over time.<sup>29</sup> A most recent review of evidence on the association between stunting and undernutrition in childhood and economic outcomes in adulthood indicated that economic growth is effective at reducing stunting when ‘increases in national income are directed at improving the diets of children, addressing gender inequalities and strengthening the status of women, improving sanitation and reducing poverty and inequities’.<sup>33</sup>

In the context of some developing countries, political reforms, influx of foreign aid and foreign direct investments are bringing unprecedented opportunities for growth, employment, education and improvement in public health indices.<sup>34–38</sup> At the same time, significant challenges remain in an effort to sustain the growth trajectories, reduce the prevalence of extreme poverty, and cut child stunting and mortality rates. For sustaining the economic growth, challenges arise most notably from ineffective governance, endemic corruption, internal conflicts, high debt levels and poor resource management, which altogether downsize the impact of inadequate investment and intervention efforts to fight low child survival and anthropometric outcomes.<sup>39–42</sup>

The challenges for improving child health are more pronounced in the resource-limited countries with chronic fiscal deficits, high dependence on foreign donors and low-performing agriculture sector. Poor agricultural resources with chronic water and energy crisis generally result in higher dependency on imported

food and inflation in consumer prices, with diminishing food security among the poor households.<sup>13 43–47</sup> The burden of stunting gets further compounded by the fast-changing demography, labour market and socio-cultural environment. An increasing number of people are leaving the agricultural sector as they struggle for a better life and migrate to urban areas for better job and livelihood prospects.<sup>48–51</sup> This increasing trend of rural-to-urban migration is causing serious imbalances in the labour force, increasing urban poverty and mounting pressure on the fragile healthcare infrastructure, exacerbating the situation of health and nutritional status of the urban population.<sup>52–55</sup>

African age structure is predominantly young, meaning that each year an increasing number of people are enrolling in higher education and entering the job market without enough employment opportunities being created. Poor access to credit, market and technology also hinders the transition to high productivity jobs, and consequently a larger proportion of the youth remains stuck in low-productivity jobs.<sup>56–58</sup> Low-income families face competing challenges between meeting basic needs such as food and housing and less immediate needs such as education and healthcare. This perpetuating cycle of poverty and stunting has been a key barrier to meeting most of the MDGs, and is most likely to remain so for the sustainable development goals as well, unless effective interventions (increased coverage of iron supplementation, immunisation, water, sanitation and hygiene, and social safety nets) are formulated and implemented.

There is mixed evidence and lack of consensus on the impact of economic development on nutrition improvement, and there is a dearth of empirical studies on this relationship in the case of sub-Saharan Africa. In the present study, we used data from 89 Demographic and Health Surveys (DHS) in sub-Saharan Africa to assess the relationship between child nutritional status and economic development. The main rationale was to contribute to the current evidence base and assist in policymaking for child nutrition-related programmes in Africa.

## METHODS

### Study design

We used cross-sectional data from the DHS, which are nationally representative household surveys conducted in sub-Saharan Africa. This study used data from 89 DHS surveys conducted between 1987 and 2016 available as of October 2018. The DHS uses a multistage, stratified sampling design with households as the sampling unit.<sup>59</sup> Eligible women and men living in households were interviewed. The survey data were comparable across countries as all survey instruments and procedures were implemented similarly.

### Outcome variable

Childhood stunting and chronic childhood malnutrition were assessed using height-for-age according to WHO

recommendations. We defined stunting as less than  $-2$  SD for height-for-age z score (haz) according to the WHO international reference. The outliers were removed in line with the exclusion ranges recommended by WHO.<sup>60</sup> Hence,  $\text{haz} < -6.0$  and  $> +6$  are excluded from the analysis.

### Main explanatory variable

We used national aggregate data for gross domestic product (GDP) per capita from World Bank's World Development Indicators (WDI). WDI provided data for GDP per capita, adjusted for purchasing power parity exchange rates. This adjustment makes the GDP per capita comparable across countries. Data from each respondent were merged with GDP per capita by country and survey year.

### Covariates

The following covariates were included in the study: survey year, child's age (0–11 months, 12–23 months, 24–48 months), child's sex (male vs female), child's birth order, household wealth index (poorest vs richest quintile),<sup>61 62</sup> maternal educational attainment (no formal education vs secondary or higher education) and country income category (low-income vs lower-middle-income).

### Statistical analyses

We used multivariable multilevel logistic regression models to analyse the association between stunting and GDP per capita. We specified a three-level model for binary response (stunted child or not), for a child (level 1), in a neighbourhood (level 2) living in a country (level 3). Two models were developed. First, the unadjusted model was with only GDP per capita as the only explanatory variable. The second model was adjusted for child's age, survey year, child's sex, birth order and country random effect.

In addition to the analyses of the full sample, we also developed regression models for various subsamples: the poorest and richest wealth quintiles; children aged 0–11, 12–23 and 24–48 months; no formal education and secondary or higher education; and low-income and lower-middle-income. We reported the measures of association and ORs with their 95% CIs. Finally, Pearson correlation analysis was performed to examine the association of (1) a country's prevalence of stunting and GDP per capita and (2) the average annual change in the prevalence of stunting and the average annual change in GDP per capita. For correlation analysis, a country's GDP per capita was log-transformed. Multilevel analysis was performed with the MLwiN V.3.02 software<sup>63</sup> using Stata's 'runmlwin'.<sup>64</sup> For all analyses, associations with a p value of less than 0.05 were considered significant.

### Patient and public involvement

Patients and the public were not involved in the design and conduct of this research.

## RESULTS

### Characteristics of the included surveys

We included data from 89 surveys conducted between 1987 and 2016 in 20 sub-Saharan African countries with

anthropometric data for 490 526 children. The characteristics of the included surveys are summarised in [table 1](#). The total sample size ranged from 8065 in Cote D'Ivoire to 54880 in Kenya. In recent surveys, the prevalence of stunting ranged from 19.2% in Ghana to 48.4% in Madagascar, and recent GDP per capita ranged from US\$300 in Malawi to US\$2997 in Nigeria. Of the 20 countries, 14 experienced decline in the average annual change in the prevalence of stunting, from as much as  $-12.1\%$  in Ethiopia to as little as  $-0.3\%$  in Cote D'Ivoire. Meanwhile, the remaining six countries experienced an increase in the average annual change in the prevalence of stunting, ranging from as much as 10.2% in Mali to as little as 0.1% in Burkina Faso. Nigeria and Ethiopia experienced the strongest economic growth with an average annual growth rate of GDP per capita of 87.6% and 83.6%, respectively, while Zimbabwe and Uganda experienced the weakest economic growth with an average annual growth rate of GDP per capita of 10.3% and 13.8%, respectively.

### Association between economic growth and chronic childhood stunting

The ecological association between GDP per capita and the prevalence of stunting is shown in [figure 1](#). There was a strong statistically significantly negative correlation between GDP per capita and stunting rate, such that the prevalence of stunting decreased with increasing GDP per capita (correlation coefficient= $-0.606$ ,  $p < 0.0001$ ) ([figure 1](#)). There was a negative correlation between the average annual economic growth and the average annual change in the prevalence of stunting, although not statistically significant (correlation coefficient= $-0.291$ ,  $p = 0.214$ ) ([figure 2](#)).

[Figure 3](#) shows the adjusted and unadjusted associations (ORs) between GDP per capita and stunting for the full sample and the different subsamples. In the unadjusted model for full sample, for every US\$1000 increase in GDP per capita, the odds of stunting decreased by 23% (OR=0.77, 95% CI 0.76 to 0.78). In the model adjusted for child's age, survey year, child's sex, birth order and country random effect, the association between GDP per capita and stunting remained statistically significant; for every US\$1000 increase in GDP per capita, the odds of stunting decreased by 12% (OR=0.88, 95% CI 0.87 to 0.90).

The magnitude of the association between GDP per capital and stunting was stronger among children in the richest quintile. After an adjustment was made, the association was not significant among children from the poorest quintile. The pattern of the associations across different age groups of children was similar to the full sample, and similarly for the different maternal educational groups. However, the magnitude of the association was more pronounced among children from low-income countries, such that, in the model adjusted for child's age, survey year, child's sex, birth order and country random effect, the association between GDP per capita and stunting remained statistically significant; for every

**Table 1** Summary characteristics of the surveys

Country	Surveys			Recent survey		Average annual change	
	n	Years	Sample	% stunting	GDP per capita	Stunting	Economic growth
Benin	4	1996, 2001, 2006, 2011	26084	44	825.9	10.1	31.7
Burkina Faso	4	1993, 1998, 2003, 2010	22319	34.2	575.4	0.1	36
Cameroon	4	1991, 1998, 2004, 2011	12343	31.6	1429.6	5.4	16.9
Congo Democratic Republic	2	2007, 2013	11324	44.1	458.1	-2	59.9
Cote d'Ivoire	3	1994, 1998, 2011	8065	29.8	1214.7	-0.3	43.7
Ethiopia	4	2000, 2005, 2011, 2016	30890	36.4	712.9	-12.1	83.6
Ghana	6	1988, 1993, 1998, 2003, 2008, 2014	14476	19.2	1449.7	-9.3	49.4
Guinea	3	1999, 2005, 2012	8645	30.8	665.2	3.7	47.6
Kenya	5	1993, 1998, 2003, 2008, 2014	54880	27.1	1335.1	-8.4	65
Madagascar	4	1992, 1997, 2003, 2008	16181	48.4	470.7	-6.3	25.8
Malawi	5	1992, 2000, 2004, 2010, 2016	30188	35.2	300.3	-8.7	23.6
Mali	5	1987, 1995, 2001, 2006, 2012	30082	37.7	777.3	10.2	34.2
Mozambique	3	1997, 2003, 2011	20468	39.3	526.5	-4.4	48.8
Niger	4	1992, 1998, 2006, 2012	16459	41.9	391.5	1.6	18.2
Nigeria	5	1990, 1999, 2003, 2008, 2013	54730	36.1	2997	-5.3	87.5
Rwanda	5	1992, 2000, 2005, 2010, 2014	21587	37.4	706.6	-8.9	31.5
Tanzania	6	1991, 1996, 1999, 2004, 2010, 2015	36853	33.6	872.3	-7.8	38.6
Uganda	6	1988, 1995, 2001, 2006, 2011, 2016	22207	28.4	580.4	-9.1	13.8
Zambia	5	1992, 1996, 2001, 2007, 2013	32389	39.6	1850.8	-3.9	65
Zimbabwe	6	1988, 1994, 1999, 2005, 2010, 2015	20356	25.6	1033.4	-3.3	10.3

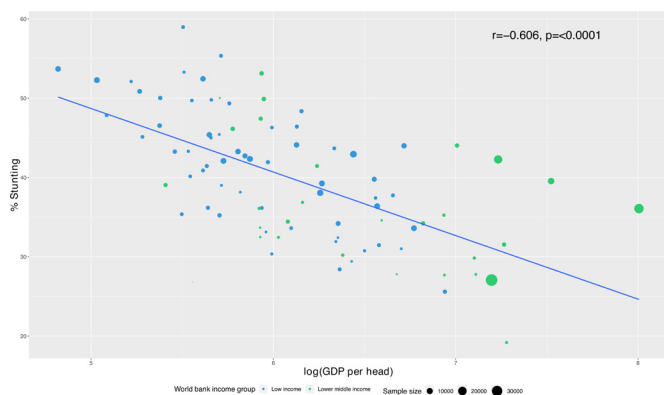
GDP, gross domestic product.

US\$1000 increase in GDP per capita, the odds of stunting decreased by 12% (OR=0.88, 95% CI 0.87 to 0.90).

**DISCUSSION**

The study explored the association between economic growth and childhood stunting in 20 sub-Saharan African countries. Secondary data from DHS conducted

between 1987 and 2016 were considered and used. The study involved 490 526 children who had anthropometric data. This multicountry analysis provided evidence for the complex association between economic growth and childhood stunting,<sup>65-67</sup> and suggested that economic

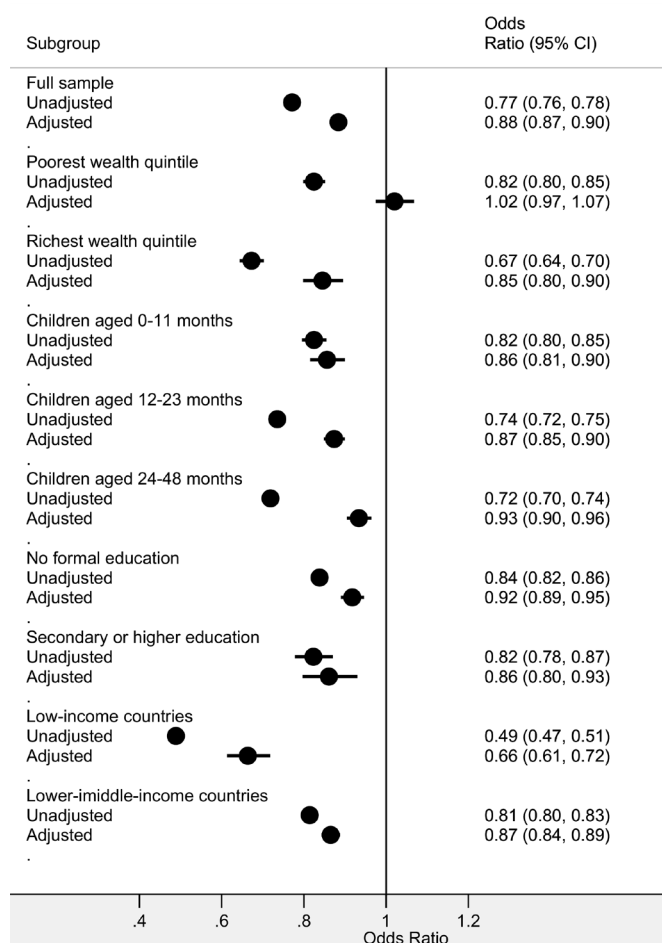


**Figure 1** Association between gross domestic product (GDP) per capita and prevalence of stunting.



**Figure 2** Association between average annual change in gross domestic product (GDP) per capita and prevalence of stunting.





**Figure 3** Unadjusted and adjusted associations between gross domestic product per capita and stunting.

growth does not necessarily translate or lead to higher nutritional status of children in Africa. To make sense of this observation, we considered the argument that economic gains in many parts of Africa accrue disproportionately to the richest quintile.<sup>68 69</sup> For this subpopulation, economic growth may have the desired effect of improving the welfare of children and other household members. Households in the poorest quintile are typically the least likely to benefit from economic gains, and are thus the least affected. In a sense, the study aligns with explanations from a few earlier studies.<sup>65–67 70–72</sup>

For policy implementation and evaluation, a major implication is that macro-level economic growth indicators offer very little information about childhood stunting and general well-being, especially among the poorest, who also happen to be the most affected by negative health outcomes.<sup>73–75</sup> Interventions designed with the assumption that economic growth translates to improved child well-being also run a high risk of being ineffective. Achieving the sustainable development goals depends on getting governments to address the gap between the rich and the poor, which is still at its highest level in decades.<sup>76</sup>

The findings of this study will serve as a building block needed to modify current policy as per child nutrition-related programmes in Africa. Perhaps, the economic

gains achieved accrue disproportionately to the rich, who are less affected by the problems of poor child well-being and health outcomes. Improving child well-being requires clear policies that will ensure the most affected children have access to the resources needed. At present, those benefiting from the economic gains are those with higher order needs. We recommend that low-income and middle-income countries of the world are encouraged to commit more to equitable distribution through social investment programmes that alleviate the poorest of the poor so that the poor–rich gap in childhood stunting can be bridged.

### Strengths and limitations

The study involved a large sample from 89 surveys conducted in 20 countries to measure the association between economic growth and child nutritional status. The data were nationally representative; therefore, the findings were generalisable in the study area. There are various ways of assessing the nutritional status of children aged under 5 years, such as using clinical signs, biochemical indicators or anthropometry.<sup>77</sup> The anthropometric approach is the most commonly used method/approach<sup>78</sup> and is more advantageous when compared with the other two because it has the benefit of ease of interpretation, rapidity and objectivity. Stunting is regarded as an indicator of long-standing dietary inadequacy and can also be due to chronic infections. The height-for-age measure is less sensitive to temporary food shortages and thus is the most reliable indicator of long-standing malnutrition in childhood.<sup>79</sup> Furthermore, the WHO recommended stunting as a reliable measure of overall social deprivation.<sup>78</sup> However, DHS data have limitations. The surveys were cross-sectional and therefore associations but no causalities could be established. In addition, the surveys were conducted in different years. Therefore, results from different surveys should be compared with caution.

### CONCLUSIONS

Economic growth does not necessarily improve the well-being of children in Africa. Perhaps, the economic gains achieved accrue disproportionately to the rich, who are less affected by problems of poor child well-being and health outcomes. Improving child well-being requires clear policies that will ensure the most affected children have access to the resources needed. At present, those benefiting from the economic gains are those with higher order needs.

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**Data availability statement** Data are available in a public, open access repository. Data for this study were sourced from Demographic and Health Surveys (DHS) and available at <http://dhsprogram.com/data/available-datasets.cfm>.

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