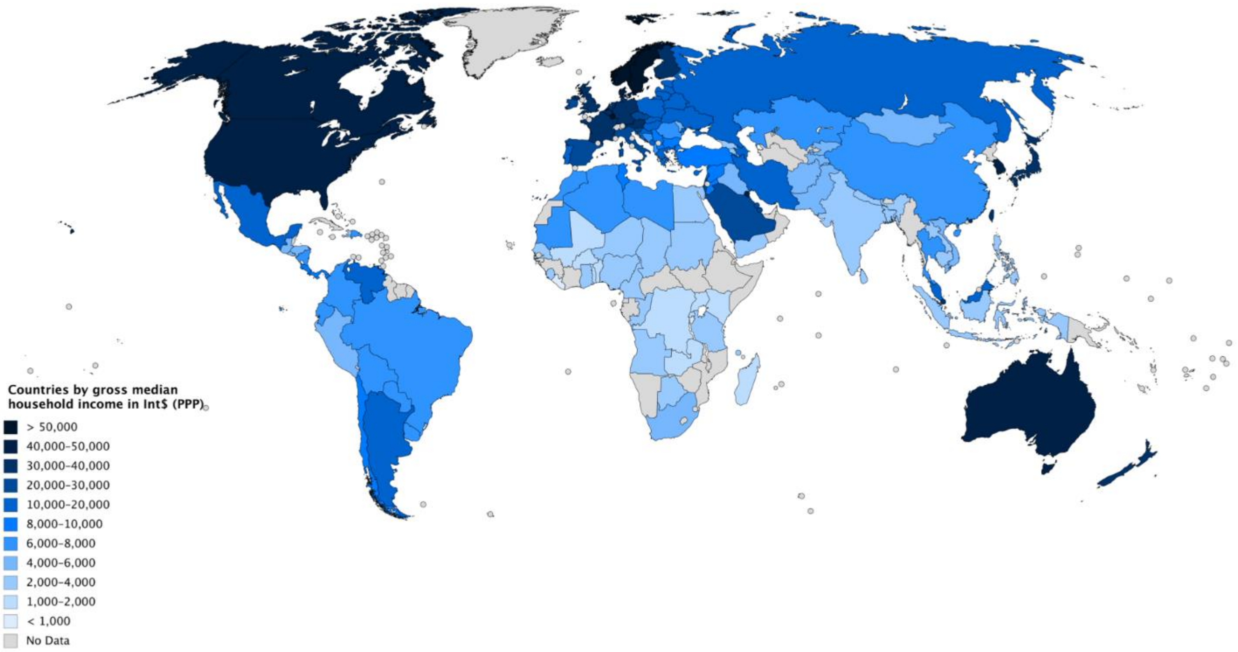
Lucio Tassone – ETH Zurich

Is income a necessary and sufficient condition for improvements in child health?



ISTP | Institute of Science, Technology and Policy – ETH Zurich – 14/05/2021

Abstract

Idea that economic growth is necessary and sufficient condition for health improvement in a population is widely accepted. Previous analysis on low income countries shows only a minor effect of GDP on child undernutrition. This time effect of per-capita income will be considered for malnutrition e child mortality. A comparison of the factors that could mitigate effectively this phenomenon will be assessed in this studio.

Methods

This analysis will use a data set consistent of a pooled micro data set for nine African countries over a period from 1992 to 2016. This dataset consists in various surveys, not homogeneous by size and across countries and time. Instead of per capita GDP, income at household level will be analysed. Analysis will focus on presence of stunted child (stunting) and child mortality before 5 (dead5) in the household. Comparison between education, sanitary system variables and income will be done, trying to assess whether a policymaker could intervene more effectively to overcome this problem. Analysis will start with simple linear models, comparing whether logarithm of income (log_y), has effect on stunting and dead5 as outcome variables. Adjustment for country and region fixed effects, survey year, clustering, and demographic and socioeconomic covariates for the child and the mother will be taken in consideration. As both outcome variables are binary, logistic regression will better define the models.

Findings

Sample sizes were 157261 for stunting and 216213 for dead5. Overall, 37.5 % of children presented stunting traits and 4.6% died before reaching age of 5. Country with the minor proportion of stunted children, is Morocco with 26.08% and the one with the greatest is Zambia with 44.61%. For child mortality, Morocco is again the one with the least with a proportion of 0.025% and Mozambique is the one with the most, with 0.07%. For stunting outcome variable association with the logarithm of the income has been seen between all 9 countries. Considered child mortality as outcome variable, no association has been noticed across countries, despite results being significant if no sub-dataset would had been regressed. In logistic models adjusted for the country and survey-year fixed effects and socioeconomic covariates still association with stunting has been found (regression coefficient -0.113, significant), while for child mortality association does not hold (regression coefficient -0,029, not significant). Comparing outcome coefficients with other socioeconomical variables, as mother education or health assistance and care, it is evident how, even if a double of the income is registered, that weakly influence both our outcome variables. In particular, secondary education plays a key role to reduce child malnutrition and mortality, with significant coefficients of -0,375 and -0,518 respectively.

Interpretation

A quantitatively small association has been found between per-capita income and child malnutrition and mortality. Findings emphasize the needs for direct investments in healthcare and educational systems.

Introduction

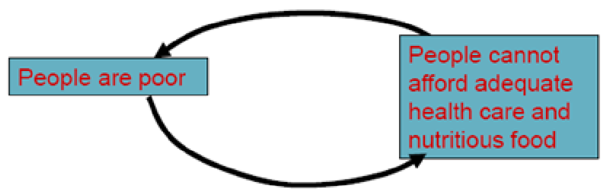
Developing countries are countries with economies that have a low gross domestic product (GDP) per capita and rely heavily on agriculture as the primary industry. In these countries, problems such as poverty, hunger, good health and well-being, and education still affect a high share of the population. This is reflected in first stance to the children, as the weakest in society are the ones more affected. Stunting and child mortality phenomena are a clean mirror that still one country has long way to go to be considered developed. Increasing economic growth, as measured through increases in per-head gross domestic product (GDP), is the cornerstone of development policy for most national governments. Although the empirical evidence to support the strategy of economic development policies remains unclear. Smith and Haddad instead found a strong inverse association between national economic growth and childhood underweight. Headey showed that economic growth leads to a small and significant reduction in stunting. Subramanyam and colleagues reported that there was no consistent evidence that economic growth in various Indian states was associated with a reduction in childhood stunting, underweight, or wasting. Vollmer and Colleagues found very small to null association between increases in per-head GDP and reduction in early childhood undernutrition. Using a pooled micro data set for nine African countries (Ethiopia, Ghana, Kenya, Morocco, Mozambique, Namibia, Tanzania, Uganda, Zambia) over a period from 1992 to 2016 this analysis will further assess impact of economic growth on child malnutrition and mortality. A comparison with other socioeconomical variables will be present, to assess impact of income in a relative context and not in an absolute one.

Methods

Data sources and procedures

Data are from the Demographic and Health Surveys (DHS) Data, which are nationally representative cross-sectional surveys that have been done by ICF International in more than 82 low-income and middle-income countries at varying intervals since 1985. These surveys are designed to collect nationally representative health and welfare data for women of reproductive age, their children, and their households. Surveys done between 1992 and 2016 has been included in the analysis. Description on the sampling design will be cited from the original paper: “The DHS used a multistage stratified sampling design. In the first stage of sampling, each country was divided into regions, which are either political regions such as states or provinces, or geographical areas divided and labelled north, south, east, and west. Within these subnational regions, populations were stratified by urban and rural area of residence. Within these stratified areas, a random selection. These primary sampling units (clusters) were selected such that the probability of each cluster being selected was equal to the proportion that specific cluster’s population contributed to the total population. In the second stage of sampling, all households within the cluster were listed and an average of 25 houses within a cluster were randomly selected for an interview by equal-probability systematic sampling. Detailed sampling plans are available from the final survey reports. For each sampled household, members were listed and women eligible for a child health interview were identified.”

Women interviewed are aged typically from 15 to 49. Mother’s weight and children age and sex are recorded. Other social variables are also included. Children age vary from 0 to 60 months (5 years). In contrast with the paper, which used GDP per capita at country level, income at the household level will be considered. Effect of income on stunting, which is an indicator whether a child below the age of five suffers from chronic undernutrition and on child mortality. To estimate child mortality before reaching age of 5 all age range has been considered. Income measured in natural logarithm units has been used to model a potentially non-linear association with early childhood undernutrition and mortality.



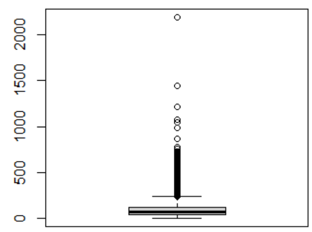


Figure 1- Boxplot Income

	Survey year		Stunting sample		Child mortality Sample	Income	log_income
		N	Proportion stunted (95% CI)	N	Proportion child mortality (95% CI)		
Ethiopia	2005	3906	47.286% (47.271 - 47.302)	9500	5.411% (5.406 - 5.415)	79.183	4.244
Ethiopia	2011	9446	42.42% (42.41 - 42.43)	11070	3.839% (3.836 - 3.843)	85.658	4.285
Ethiopia	2016	8758	34.471% (34.461 - 34.481)	10201	3.019% (3.016 - 3.023)	92.435	4.338
Ghana	2008	2325	28.215% (28.197 - 28.233)	2797	3.575% (3.568 - 3.582)	190.488	4.946
Ghana	2014	2616	19.19% (19.175 - 19.205)	5562	2.122% (2.118 - 2.125)	199.591	4.975
Kenya	2014	18279	27.108% (27.101 - 27.114)	20207	2.083% (2.081 - 2.085)	99.685	4.319
Morocco	2004	5008	23.922% (23.91 - 23.934)	5509	1.561% (1.558 - 1.564)	236.240	5.202
Mozambique	2011	8982	40.525% (40.515 - 40.536)	10294	4.401% (4.397 - 4.405)	77.572	3.829
Namibia	2007	3221	29.246% (29.23 - 29.261)	4364	3.781% (3.775 - 3.787)	217.034	4.708
Namibia	2013	1579	22.609% (22.589 - 22.63)	4299	2.582% (2.577 - 2.587)	316.196	5.132
Tanzania	2005	6652	42.949% (42.938 - 42.961)	7731	5.407% (5.402 - 5.412)	66.627	3.923
Tanzania	2010	6360	40.755% (40.743 - 40.767)	7307	3.558% (3.554 - 3.562)	77.982	4.118
Tanzania	2015	8246	30.269% (30.259 - 30.279)	9169	2.65% (2.647 - 2.654)	82.246	4.135
Uganda	2006	2269	38.519% (38.499 - 38.539)	7848	6.855% (6.85 - 6.861)	75.615	4.009
Uganda	2011	1988	32.394% (32.374 - 32.415)	7412	4.115% (4.11 - 4.119)	100.933	4.329
Uganda	2016	4208	25.618% (25.605 - 25.631)	14513	2.722% (2.719 - 2.724)	96.762	4.260
Zambia	2007	4962	44.7% (44.686 - 44.714)	5941	5.706% (5.7 - 5.712)	76.300	3.791
Zambia	2014	10915	40.229% (40.22 - 40.238)	12564	3.231% (3.228 - 3.235)	84.644	3.841

* Data are from surveys after 2003. N is the sample size. Income measured in USD.

Figure 2 Surveys from 2003 - Descriptive

The DHS data does not provide information in income or expenditure. The household income per capita variable is based on a simulation using the approach by Harttgen and Vollmer (2013). DHS data and income simulation has been merged in the analysed dataset. Survey respondents provided oral informed consent. This study will be assessed by Dr. Harttgen, Dr. Durizzo, Dr. Kudrzycki, Dr. Meili, part of ETH NADEL (Zurich, Switzerland), lecturers of Statistic 2 at ISTP ETH.

Outcomes

DHS data has been analysed for two outcomes: stunting and if a child died before reaching the age of 5 (dead5), in children aged 0-60 months (5 years) at the time of the interview. The dataset has calculated already, as defined by WHO standards and classifications, whether a child was stunted. It has been used age, sex of the child, whether it was the firstborn; mother weight, current age total children ever born, births in the last 5 years, if currently pregnant and if currently breastfeeding; if water and sanitation conditions were improved, education level of the mother and if tetanus injection, prenatal care or assistance by doctor or nurse has been received; also number of household members, how many children aged 5_18 are present in the household and the type of place of residence as covariates for the analysis. Although several of these factors could be mediators of the association between economic growth and early childhood undernutrition, they are also modifiable by direct investment in social programmes. Therefore, the association with and without adjustment for these factors has been examined.

Statistical analysis

A series of linear and logistic regression models for stunting and dead5 as outcome variables. For each outcome, models have been adjusted for survey-year fixed effects, country fixed effects and region fixed effects. Regression models for different countries have been analysed. To allow interpretation, logit regression coefficients have been taken in consideration, following the hypothesis of a doubling in income to compare the effects with socioeconomic variables, education and health care related. For all analyses, associations with a p value of less than 0.05 were regarded as significant. All statistical analyses were done with R-studio.

Table 1:

	Dependent variable:			
	stunting			
	OLS		*logistic*	
	(1)	(2)	(3)	(4)
log_y	−0.096***	−0.058***	−0.425***	−0.184***
	(0.001)	(0.002)	(0.004)	(0.006)
mo_pregnantyes		0.052***		0.181***
		(0.004)		(0.012)
mo_breastfeeedingyes		0.024***		0.006
		(0.003)		(0.009)
water_improved_total		−0.017***		−0.063***
		(0.003)		(0.008)
sani_improved_total		−0.026***		−0.112***
		(0.003)		(0.010)
mo_noedu		0.022***		0.079***
		(0.004)		(0.014)
mo_primary		−0.021***		−0.152***
		(0.003)		(0.011)
mo_secondary		−0.045***		−0.375***
		(0.005)		(0.019)
mo_tetanus		0.006**		−0.008
		(0.003)		(0.010)
mo_care		−0.018***		−0.013
		(0.003)		(0.009)
mo_assistance		−0.040***		−0.144***
		(0.003)		(0.009)
deadsibling		0.028***		0.077***
		(0.004)		(0.011)
Constant	0.776***	10.442***	1.246***	116.230***
	(0.006)	(0.397)	(0.015)	(23.458)
Observations	157,261	157,261	157,261	157,261
R^2	0.032	0.069		
Adjusted R^2	0.032	0.069		
Log Likelihood			−101,374.100	−96,795.200
Akaike Inf. Crit.			202,752.100	193,850.400
Residual Std. Error	0.476	0.467		
F Statistic	5,280.090***	414.547***		
Note:				*p<0.1; **p<0.05; ***p<0.01

	Dependent variable:			
	dead5			
	OLS		*logistic*	
	(1)	(2)	(3)	(4)
log_y	−0.014***	−0.010***	−0.310***	−0.029
	(0.0005)	(0.001)	(0.011)	(0.023)
mo_pregnantyes		0.004**		0.146***
		(0.002)		(0.043)
mo_breastfeeedingyes		−0.099***		−2.712***
		(0.001)		(0.042)
water_improved_total		0.007***		0.190***
		(0.001)		(0.032)
sani_improved_total		−0.001		0.095**
		(0.001)		(0.044)
mo_noedu		0.003**		0.179***
		(0.001)		(0.062)
mo_primary		−0.002*		−0.165***
		(0.001)		(0.048)
mo_secondary		−0.012***		−0.518***
		(0.002)		(0.090)
mo_tetanus		−0.025***		−0.724***
		(0.001)		(0.041)
mo_care		−0.077***		−2.231***
		(0.001)		(0.036)
mo_assistance		0.009***		−0.004
		(0.001)		(0.039)
deadsibling		0.005***		−0.459***
		(0.002)		(0.042)
Constant	0.103***	4.770***	−1.768***	558.014***
	(0.002)	(0.141)	(0.043)	(91.651)
Observations	216,213	216,213	216,213	216,213
R^2	0.004	0.188		
Adjusted R^2	0.004	0.188		
Log Likelihood			−39,887.980	−19,244.410
Akaike Inf. Crit.			79,779.960	38,750.820
Residual Std. Error	0.209	0.189		
F Statistic	764.247***	1,728.576***		
Note:				*p<0.1; **p<0.05; ***p<0.01

Figure 3 Stunting and Dead 5 OLS and Logistic Regression -with covariates

Results

28 surveys done between 1992 and 2016 in 9 African countries had recorded anthropometric data for 206383 children born up to 5 years before the time of interview. Data, as prepared to be analysed in a learning context, included at least two years to a maximum of four for each country. No year had a survey in each country resulting in a data time series, but not a panel. Exclusions resulted from missing data, resulted in a sample of 157261 for stunting and 216213 for dead5. Income, as simulated, is present in every observation. In the 9 countries

included in the study, 37.5 % of children presented stunting traits and 4.6% died before reaching age of 5. That means that of 157261 children 58187 were stunted and that on 216213 children 9922 died before reaching age of 5. Also, analysing income variable, huge inequalities are found. A minimum of 2.017 $/month and a maximum of 2190.888 $/month a mean of 101.957 $/month indicates that income vary considerably across households, but that except for some outliers, more than half of the households analysed (median 66.434) received less than 100 $/month. Data frequencies are children and there is a negative correlation between number of children in the household and income of the household. Therefore, correlation biases could be present, but still income estimate is relevant to our analysis. Of the 9 countries included in the study, 7 had their last survey after 2013. Namibia is the country with less surveys across the years, 8663, while Ethiopia with 40982 is the one with the most. Kenya and Uganda with 30712 and 36308 are also the countries analysed with the greatest number of surveys. Country with less stunted children, in proportion to the number of surveys, is Morocco with 26.08% and the one with the most is Zambia with 44.61%. For child mortality, Morocco is again the one with the less with a proportion of 0.025% and Mozambique is the one with the most, with 0.07%. Across years, income overall increased and stunting and mortality decreased for every country. Tables shows impact of the various regressors on stunting and child mortality. To compare the regressor effects, the effect of doubling the income has been simulated. In stunting case, doubling the income corresponded to a decrease of 12.75% in the probability that the child is stunted. In child mortality case, doubling the income correspond to a decrease of 2,01% in the probability that the child is stunted. To notice that correlation between the logarithm of income and the outcome variables remains significant for stunting even if analysing by country. Instead analysing child mortality, no association has been noticed in the logistic model, and neither analysing by country. Most important, comparing effects of income to the woman education related variables and to the assistance and healthcare received, it is evident how little the first influence the outcomes compared to other socioeconomical variables. Not to forget the vicious correlation that exist between poverty and health conditions. For stunting secondary education has been revealed to be the strongest covariable, with a coefficient value of -0.375. The same variable regressed for child mortality has a value of -0,518. For the last regression instead, breastfeeding variable has been revealed to be the more influent, together with mo_care, a variable that indicates whether the mother received pre-natal care. The values are respectively -2.712 and -2.231, and compared with the logarithm of the income coefficient of 0.029, not significant for this regression, it can be argued that the most effective policies measures to mitigate and make disappear those phenomenon will not be monetary, but health an educational ones.

var	coeff	q0	q1	deltaq	effect	var	coeff	q0	q1	deltaq	effect
stunting						dead5					
Y		x	2x			Y		x	2x		
log_y	-0,184	log (x)	log(x) + lo	0,693147	-0,12754	log_y	-0,029	log (x)	log(x) + lo	0,693147	-0,0201
breastfeed	0,006	1			0,006	breastfeed	-2,712	1			-2,712
wat	-0,063	1			-0,063	wat	0,19	1			0,19
san	-0,112	1			-0,112	san	0,095	1			0,095
noedu	0,079	1			0,079	noedu	0,179	1			0,179
primary	-0,152	1			-0,152	primary	-0,165	1			-0,165
secondary	-0,375	1			-0,375	secondary	-0,518	1			-0,518
care	-0,013	1			-0,013	care	-2,231	1			-2,231
assistance	-0,144	1			-0,144	assistance	0,004	1			0,004

Figure 4- Effects comparing a hypotetic income doubling

Table 1:

	Dependent variable: stunting										
	OLS	logistic									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
log_y	−0.058*	−0.184***	−0.191***	−0.232***	−0.302***	−0.533***	−0.186***	−0.283***	−0.188***	−0.191***	−0.139***
	(0.034)	(0.046)	(0.027)	(0.059)	(0.023)	(0.052)	(0.028)	(0.031)	(0.021)	(0.010)	(0.010)
mo_pregnantyes	0.052	0.181**	0.282***	0.222**	0.238***	0.099	0.122**	0.216***	0.098*	0.247	0.087***
	(0.045)	(0.082)	(0.049)	(0.086)	(0.056)	(0.134)	(0.053)	(0.062)	(0.052)		(0.020)
mo_breastfeeedingyes	0.024	0.006	0.280***	−0.073	0.033	−0.147	0.004	−0.153***	−0.217***	0.042***	−0.169***
	(0.036)	(0.067)	(0.034)	(0.065)	(0.044)	(0.090)	(0.042)	(0.056)	(0.041)	(0.013)	(0.015)
water_improved_total	−0.017	−0.063	−0.033	0.049	−0.025	0.040	−0.088***	0.149***	−0.065*	−0.112***	−0.072***
	(0.029)	(0.052)	(0.032)	(0.066)	(0.036)	(0.104)	(0.033)	(0.043)	(0.034)	(0.013)	(0.013)
sani_improved_total	−0.026***	−0.112*	−0.204***	0.016	−0.136**	−0.281***	−0.058	−0.125**	−0.161***	−0.099***	0.039**
	(0.050)	(0.062)	(0.038)	(0.087)	(0.058)	(0.106)	(0.044)	(0.061)	(0.039)	(0.017)	(0.017)
mo_noedu	0.022***	0.079	0.314***	−0.018	0.102	−0.305**	0.158**	0.335***	0.040	−0.052**	0.074***
	(0.117)	(0.111)	(0.055)	(0.227)	(0.099)	(0.131)	(0.067)	(0.083)	(0.048)	(0.023)	(0.024)
mo_primary	−0.021**	−0.152	−0.099***	−0.161	−0.052	−0.663***	−0.212***	−0.011	−0.161***	−0.307***	−0.082***
	(0.099)	(0.109)	(0.035)	(0.207)	(0.078)	(0.134)	(0.034)	(0.064)	(0.040)	(0.018)	(0.018)
mo_secondary	−0.045	−0.375***	−0.526***	−0.426**	−0.259	0.028	−0.507***	−0.715***	−0.414***	−0.448***	−0.304***
	(0.123)	(0.144)	(0.065)	(0.200)	(0.203)	(0.137)	(0.109)	(0.138)	(0.073)	(0.033)	(0.033)
mo_tetanus	0.006	−0.008	0.075*	−0.057	−0.015	−0.033	0.097**	0.063	−0.048	−0.083***	−0.052***
	(0.048)	(0.056)	(0.040)	(0.087)	(0.047)	(0.095)	(0.041)	(0.055)	(0.034)	(0.016)	(0.016)
mo_care	−0.018	−0.013	−0.042	−0.193***	0.087**	0.135	0.048	−0.230***	−0.048	0.012	−0.138***
	(0.042)	(0.057)	(0.043)	(0.062)	(0.039)	(0.119)	(0.042)	(0.063)	(0.046)	(0.014)	(0.016)
mo_assistance	−0.040	−0.144***	−0.097***	−0.057	−0.141***	−0.153*	−0.118***	−0.189***	−0.142***	−0.179***	−0.077***
	(0.056)	(0.055)	(0.033)	(0.066)	(0.040)	(0.093)	(0.038)	(0.045)	(0.041)	(0.015)	(0.015)
deadsibling	0.028	0.077	0.122**	0.097	0.059	0.288*	0.026	−0.062	0.119***	−0.028	0.080***
	(0.039)	(0.078)	(0.056)	(0.094)	(0.045)	(0.158)	(0.051)	(0.054)	(0.045)		(0.018)
Constant	10.442	116.230	132.181	124.061	36.716	266.559	−112.039	125.383	305.646***	143.664***	201.043***
	(86.250)	(154.813)	(95.939)	(173.403)	(104.580)	(240.328)	(104.959)	(132.937)	(99.862)	(0.092)	(38.559)
Observations	157,261	157,261	30,727	10,562	27,042	9,273	19,281	4,800	21,258	13,333	20,985
R^2	0.069										
Adjusted R^2	0.069										
Log Likelihood		−96,795.200	−19,300.690	−5,893.763	−15,729.180	−4,988.680	−12,423.850	−2,617.293	−13,103.400	−8,101.574	−13,841.040
Akaike Inf. Crit.		193,850.400	38,681.380	11,861.530	31,530.350	10,045.360	24,925.710	5,312.586	26,314.800	16,269.150	27,756.080
Residual Std. Error	0.467										
F Statistic	414.547***										

Note: *p<0.1; **p<0.05; ***p<0.01

	Dependent variable: dead5										
	OLS	logistic									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
log_y	−0.010	−0.029	0.036	−0.194	0.068	−0.572***	−0.001	−0.223***	−0.095	−0.011	−0.113***
	(0.085)	(0.114)	(0.082)	(0.178)	(0.053)	(0.121)	(0.074)	(0.058)	(0.058)	(0.011)	(0.023)
mo_pregnantyes	0.004	0.146	−0.105	−0.055	0.993***	0.358	0.046	0.230**	−0.015	0.109	0.200***
	(0.095)	(0.203)	(0.148)	(0.234)	(0.106)	(0.304)	(0.127)	(0.105)	(0.121)		(0.043)
mo_breastfeeedingyes	−0.099	−2.711***	−2.416***	−3.282***	−1.967***	−2.586***	−3.245***	−3.055***	−2.779***	−2.897	−3.225***
	(0.089)	(0.202)	(0.132)	(0.244)	(0.111)	(0.229)	(0.130)	(0.106)	(0.132)		(0.042)
water_improved_total	0.007***	0.190	0.134	0.079	0.323***	0.444*	0.068	0.454***	0.108	0.066	0.385***
	(0.073)	(0.137)	(0.112)	(0.217)	(0.086)	(0.248)	(0.096)	(0.083)	(0.095)		(0.032)
sani_improved_total	−0.001	0.095	0.082	0.009	0.302*	0.088	0.012	0.036	0.064	0.007	0.115***
	(0.125)	(0.156)	(0.128)	(0.261)	(0.157)	(0.260)	(0.130)	(0.108)	(0.111)		(0.044)
mo_noedu	0.003	0.179	0.086	0.162	−0.396	−2.165***	0.474**	0.317**	0.656***	0.142	−0.011
	(0.310)	(0.319)	(0.172)	(1.112)	(0.267)	(0.335)	(0.187)	(0.153)	(0.132)		(0.062)
mo_primary	−0.002	−0.165	−0.529***	−0.582	0.034	−2.091***	−0.325***	0.027	−0.046	−0.203	−0.238***
	(0.270)	(0.317)	(0.124)	(1.075)	(0.203)	(0.338)	(0.094)	(0.119)	(0.113)		(0.048)
mo_secondary	−0.012	−0.518	−1.602***	−0.483	−0.718	−14.512***	−0.292	−0.245	−0.451**	−0.565	−0.680***
	(0.461)	(0.349)	(0.198)	(0.404)	(0.511)	(0.265)	(0.312)	(0.265)	(0.213)		(0.090)
mo_tetanus	−0.025	−0.724***	−1.001***	−0.568	0.400***	−1.139***	−0.932***	−0.339***	−1.326***	−0.424	−1.070***
	(0.142)	(0.138)	(0.136)	(0.395)	(0.125)	(0.232)	(0.137)	(0.099)	(0.080)		(0.041)
mo_care	−0.077	−2.231***	−1.337***	−1.749***	−2.928***	−1.395***	−1.926***	−2.793***	−2.000***	−3.360	−2.469***
	(0.138)	(0.132)	(0.118)	(0.220)	(0.087)	(0.216)	(0.104)	(0.078)	(0.109)		(0.036)
mo_assistance	0.009	−0.004	0.163	−0.216	−0.365***	−0.472*	−0.134	0.241***	0.140	0.033	0.126***
	(0.160)	(0.157)	(0.116)	(0.248)	(0.104)	(0.257)	(0.103)	(0.082)	(0.113)		(0.039)
deadsibling	0.005	−0.459**	−0.591***	−0.915***	−0.393***	−0.803**	−0.545***	−0.369***	−0.068	−0.615	−0.705***
	(0.091)	(0.227)	(0.152)	(0.313)	(0.102)	(0.376)	(0.131)	(0.101)	(0.126)		(0.042)
Constant	4.770	558.040	398.981	1,301.647**	951.812***	−14.999	157.008	1,013.870***	578.891**	480.357***	839.587***
	(202.695)	(378.077)	(317.771)	(577.320)	(235.145)	(482.265)	(279.215)	(226.949)	(256.314)	(0.043)	(91.651)
Observations	216,213	216,213	40,982	14,944	30,712	10,263	25,395	8,663	24,207	36,308	24,739
R^2	0.188										
Adjusted R^2	0.188										
Log Likelihood		−19,244.430	−3,952.217	−1,090.218	−1,796.644	−558.891	−2,844.639	−622.032	−2,142.571	−3,018.624	−2,292.660
Akaike Inf. Crit.		38,748.860	7,988.433	2,256.436	3,667.288	1,187.782	5,771.278	1,324.065	4,395.143	6,105.248	4,661.321
Residual Std. Error	0.189										
F Statistic	1,728.576***										

Note: *p<0.1; **p<0.05; ***p<0.01

Figure 5 - Regression clustered for countries

Discussion

Using data from DHS from 28 surveys done between 1992 and 2016 in 9 African countries, joined with a simulation of income per household it has been shown that income has a quantitatively significant but small association with reductions in early childhood stunting. For child mortality even weaker level of significate and association has been found. This finding is robust for a variety of covariate adjustments, modelling approaches (linear and logistic regressions) and subsample analysis, per country and survey year.

Some plausible explanations could account for this result.

First, main difference between GDP and income as General National Income will be explained: main difference is that income, instead of GDP, includes earning gained outside the country, so income of families with people that migrated will have domestic and foreign income. This is expected to lead to a stronger association between the income and the outcome variables. Results shows that huge income inequalities are present in the countries analysed. Second, even if a doubling of all incomes would be registered, poverty line would probably still be above most of the incomes. Third, an increase of the incomes would not necessary being used to increase major public interventions as education and healthcare. Still, the need of specific policies in those sectors is underlined. This is because public goods as knowledge and health have to receive subventions directly by the state to result equally and effectively spreaded across all population bands.

This study present different limitations, which are tried to be assessed below. First, association between socioeconomical variables and income has not been estimated in this study, so association biases are likely to be present in the analysis. Second, it is missing the data of the cost of improvement education and heal care services. Effect of those variables have been estimated but it is hard to compare which policies could be more effective without costs data. This make the study reasonable from a qualitative point of view. It has been tried to remove ethnical difference adjusting the models for country and region fixed effects. Still income-based subsets could be analysed, that would allow a more precise estimate in lowest population's band.

In summary, income mitigation on malnutrition and child mortality has been found weak and sometimes (for child mortality) not significant. Other socioeconomical factors could improve life situation of development countries' people in a more significant and strong way. In particular, woman education and heal care have been shown to be the greatest mitigators of those effects.

References

This studio has been inspired by VOLLMER, Sebastian, et al. Association between economic growth and early childhood undernutrition: evidence from 121 Demographic and Health Surveys from 36 low-income and middle-income countries. *The lancet global health*, 2014, 2.4: e225-e234.