Analysis of Microdata: Tanzania
Policy Evaluation and Applied Statistics

ROMAN KÜPPER
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1 Introduction

While stunting and mortality for children under five has declined in most countries over the last decades, it is still an important issue in sub-Saharan Africa [7]. It also is and has been an important topic in development where it has been directly mentioned in Goal 4 of the Millennium Development Goals (MDGs) or in several of the Sustainable Development Goals (SDGs). To successfully solve this issue it is vastly important to understand the underlying causes. The following article will therefore analyse data from the Demographic and Health Survey (DHS) for Tanzania to identify country-specific factors that determine if a child is in risk of being stunted or die before the age of five. The study will focus mainly on the effects of per-household income and examine if income is a necessary and sufficient condition for improvements in child health.

Tanzania

The situation of Tanzanian children in regard to stunting and under-five mortality has improved over the last three decades. The prevalence for stunting could be decreased from 50% in the 1990s to 34% in the year 2015 [6]. The same applies for the under-five mortality rate. The sex-specific under-five mortality rate dropped from 171 to 54 per 1000 births for boys and from 159 to 47 per 1000 births for girls from 1990 to 2019 [8]. But despite improvements in recent year, stunting and child mortality in Tanzania are still an ongoing issue in the country.

#		2005	2010	2015
Stunting				
no	3775 (48.9%)	3772 (51.7%)	5736 (62.6%)	13283 (54
yes	2854 (36.9%)	2581 (35.3%)	2501 (27.3%)	7936 (32.8
missing	1098 (14.2%)	950 (13.0%)	931 (10.2%)	2979 (12.3
Under-five mortality				
no	7303 (94.5%)	7050 (96.5%)	8928 (97.4%)	23281 (96
yes	424 (5.5%)	253 (3.5%)	240 (2.6%)	917 (3.8%
Household income				
Mean (SD)	66.6 (56.5)	78.0 (60.1)	82.2 (68.1)	76.0 (62.5
Median [Min, Max]	48.2 [6.43, 485]	60.3 [13.2, 438]	62.7 [11.2, 426]	60.3 [6.43
Place of residence				
rural	6383 (82.6%)	5918 (81.0%)	7034 (76.7%)	19335 (79
urban	1344 (17.4%)	1385 (19.0%)	2134 (23.3%)	4863 (20.1
Mothers age (years)				
Mean (SD)	29.1 (6.80)	29.7 (6.98)	29.5 (7.13)	29.4 (6.99
Median [Min, Max]	28.0 [15.0, 49.0	] 29.0 [15.0, 49.0]	29.0 [15.0, 49.0]	29.0 [15.0
Mothers age (years) at first birth				
Mean (SD)	19.0 (3.10)	19.2 (3.12)	19.4 (3.34)	19.2 (3.20
Median [Min, Max]	19.0 [10.0, 35.0	] 19.0 [10.0, 41.0]	19.0 [10.0, 46.0]	19.0 [10.0
Mothers total children				
Mean (SD)	4.18 (2.55)	4.26 (2.52)	4.06 (2.57)	4.16 (2.55
Median [Min, Max]	4.00 [1.00, 14.0	] 4.00 [1.00, 15.0]	3.00 [1.00, 17.0]	4.00 [1.00
Mothers breastfeeding status				
no	3017 (39.0%)	2926 (40.1%)	3789 (41.3%)	9732 (40.2
yes	4710 (61.0%)	4377 (59.9%)	5379 (58.7%)	14466 (59
Mother received prenatal care				
no	4230 (54.7%)	3344 (45.8%)	8705 (94.9%)	16279 (67
yes	3497 (45.3%)	3959 (54.2%)	463 (5.1%)	7919 (32.7
Childs age (months)				
Mean (SD)	28.2 (17.6)	29.1 (17.6)	29.0 (17.5)	28.8 (17.6
Median [Min, Max]	27.0 [0, 60.0]	29.0 [0, 60.0]	28.0 [0, 60.0]	28.0 [0, 60
Childs sex				
male	3846 (49.8%)	3626 (49.7%)	4590 (50.1%)	12062 (49
female	3881 (50.2%)	3677 (50.3%)	4578 (49.9%)	12136 (50
Water: improved				
no	4048 (52.4%)	3822 (52.3%)	3999 (43.6%)	11869 (49
yes	3679 (47.6%)	3481 (47.7%)	5169 (56.4%)	12329 (51
Sanitation: improved				
no	7328 (94.8%)	5841 (80.0%)	3068 (33.5%)	16237 (67
yes	399 (5.2%)	1462 (20.0%)	6100 (66.5%)	7961 (32.9
Mother education				
noedu	3390 (43.9%)	2986 (40.9%)	3208 (35.0%)	9584 (39.6
primary	4235 (54.8%)	4225 (57.9%)	5052 (55.1%)	13512 (55
secondary	102 (1.3%)	92 (1.3%)	908 (9.9%)	1102 (4.6%
dead1				
no	1664 (21.5%)	1541 (21.1%)	1887 (20.6%)	5092 (21.0
yes	282 (3.6%)	167 (2.3%)	144 (1.6%)	593 (2.5%
missing 5781 (74.8%)	5595 (76.6%)	7137 (77.8%)	18513 (76.5%)	
dead0				

Other literature

Previous research have shown a number of different factors that have an influence on stunting and under-five mortality. Those include the age and sex of the child and various factors concerning the mothers health and education. But also socio-economic factors like the household wealth are mentioned. The factors mentioned in the literature differ for stunting and under-five mortality. Unfinished listings for both, stunting and under-five mortality, can be found in the according tables in Appendix A and Appendix B. The tables in the appendix also show how the factors are matched with the variables in our dataset.

2 Data and Methods

Sample

In order to analyse the relationship between income and under-5 mortality and stunting rate a dataset based on the Demographic and Health Surveys (DHS) [1] by ICF International is used. The dataset contains panel data of Tanzanian households for the years 2005, 2010 and 2015. The dataset consists of 24,198 observations for 15,273 households.

Research Strategy

The aim of this research is to provide a better understanding of the effectiveness of income on under-5-mortality and stunting. For this reason multiple regression models are built to estimate the influence of different independent variables on the two dependent variables (stunting and under-5-mortality). In a first step, only the influence of income on stunting and under-5-mortality IS examined. The formula for the traditional ordinary least squares model (1) is shown below:

$$Y_i = \beta_0 + \beta_1 X_i + u_i \tag{1}$$

Next, the models are adjusted for survey-year time-fixed effects (2) with the formula:

$$Y_{it} = \beta_0 + \beta_1 X_{it} + \delta_T BT_t + u_{it} \tag{2}$$

The models are then further improved by adding other potentially meaningful variables (3) to further reduce the error term. The formula for the multiple regression with regard to time-fixed effects is:

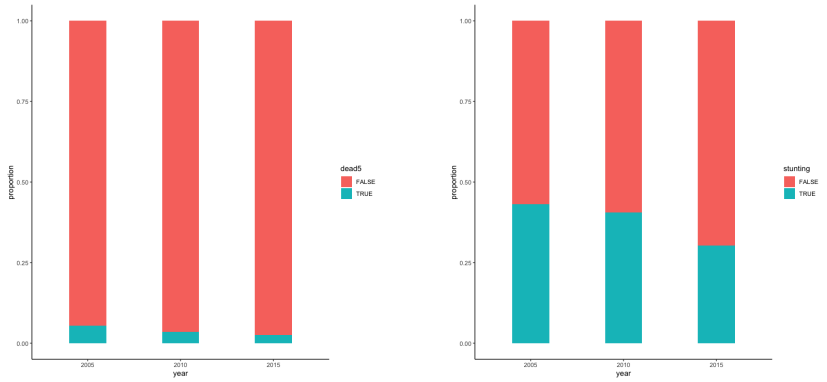
$$Y_{it} = \beta_0 + \beta_1 X_{it} + \delta_2 B2_t + \cdots + \delta_T BT_t + u_{it} \tag{3}$$

Starting from the simple OLS regression the model will be further enhanced by including additional variables and time fixed effects.

Variables

- Binary outcome variables (stunting & dead5)
- Main explanatory variable (log_y)

Dataset / Descriptive Statistics



(a) dead5 over time (b) stunting over time

Figure 1: Stunting and Under-5-Mortality over time

Another often quoted factor for the well-being of children is their mothers education. The dataset include information on three different variables for education. Namely primary, secondary and no education. The interpretation of the data is somewhat difficult. Some of the observations have specify that a mother has both primary and no education at the same time. When this data is interpreted as "the mother has started but not finished her primary education", the corresponding barplot is shown in figure (4)(a).

But when looking at other studies [3] on the distribution of primary, secondary on no-education in Tanzania, the share of uneducated women seems to be too high. If the ambiguous values are interpreted as "the education is not finished yet, but will be"[1], our data is more in line with other studies. The graphic representation of this can be found in figure (4)(b).

[1]When an observation has "mo_noedu == 1" and "mo_primary== 1" the variables are aggregated to to "education = primary".

Table 1: Regressions Using Demographic and Health Surveys

	Dependent variable:					
	stunting				dead5	
	(I)	(II)	(III)	(IV)	(V)	(VI)
		NA	NA	NA	NA	NA
log_y	−0.10287***	−0.09724***	−0.06086***	−0.00832***	−0.00632***	−0.00353
	(0.00431)	(0.00433)	(0.00578)	(0.00162)	(0.00161)	(0.00222)
as.factor(urban)urban			−0.04084***			0.00568*
			(0.00891)			(0.00341)
c_age			0.00287***			
			(0.00020)			
c_sex			−0.05035***			−0.00095
			(0.00645)			(0.00244)
c_first						0.02076***
						(0.00370)
mo_assistance						−0.00631**
						(0.00314)
mo_breastfeeedingyes						−0.02894***
						(0.00267)
mo_age_birth			−0.00142***			0.00180***
			(0.00048)			(0.00023)
as.factor(mo_breastfeeeding)yes			−0.04470***			
			(0.00756)			
mo_noedu			0.06406***			
			(0.01163)			
mo_primary			−0.02500***			−0.00395
			(0.00724)			(0.00272)
mo_secondary			−0.02048			−0.01305***
			(0.01592)			(0.00442)
water_improved_total			−0.02182***			−0.00982***
			(0.00710)			(0.00273)
sani_improved_total			−0.01866**			−0.00636**
			(0.00908)			(0.00317)
Constant	0.79150***	0.81154***	0.70546***	0.07170***	0.07966***	0.04437***
	(0.01817)	(0.01828)	(0.03274)	(0.00689)	(0.00710)	(0.01115)
Observations	21,219	21,219	21,219	24,198	24,198	24,198
R^2	0.02397	0.03486	0.05976	0.00102	0.00462	0.01457
Adjusted R^2	0.02392	0.03472	0.05919	0.00098	0.00449	0.01404

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

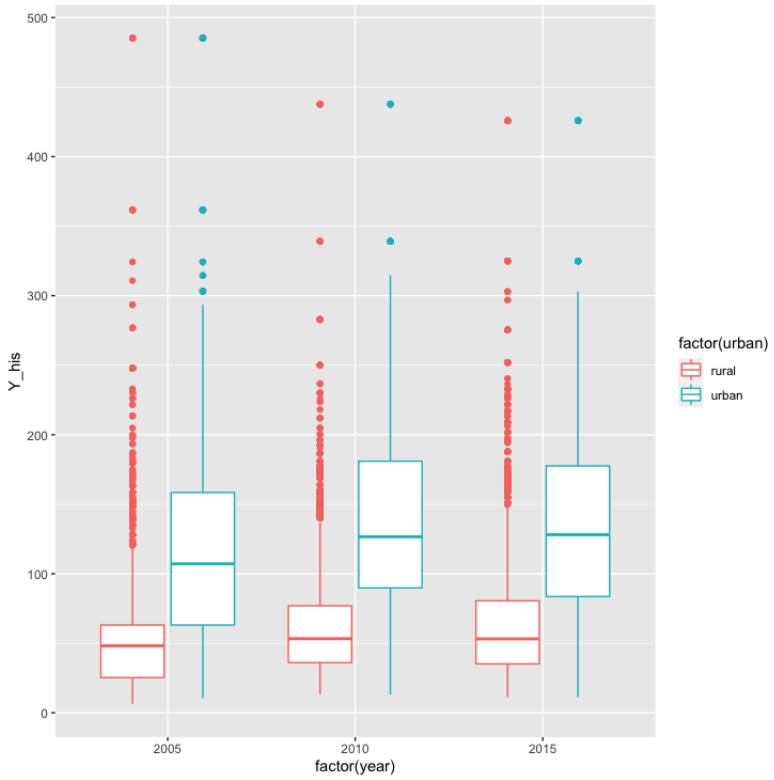
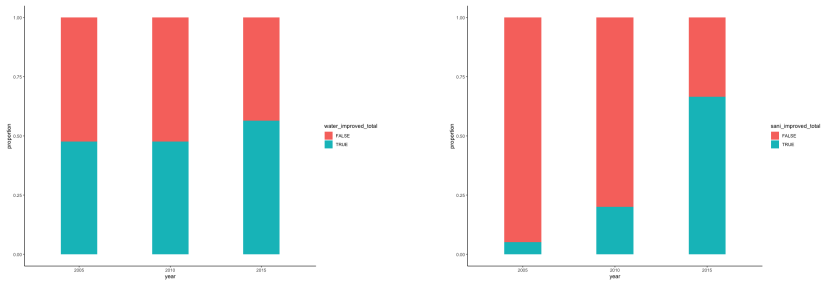


Figure 2: Y_his over time



(a) water situation over time (b) sanitation over time

Figure 3: Water and Sanitation over time

References

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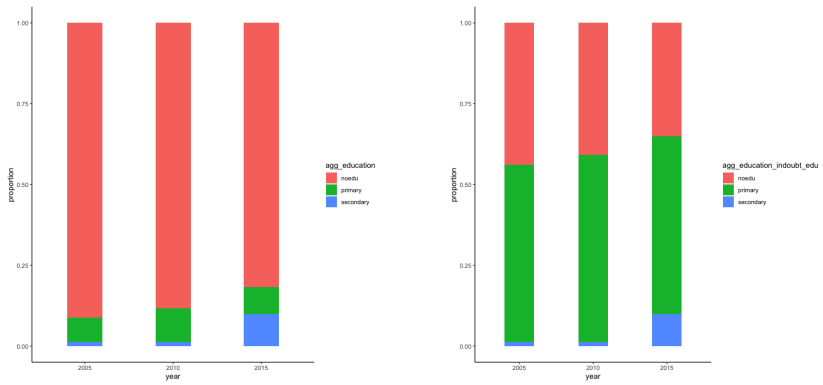
2. Blessing J. Akombi, Kingsley E. Agho, John J. Hall, Nidhi Wali, Andre M. N. Renzaho, and Dafna Merom. Stunting, Wasting and Underweight



(a) highest education over time (b) highest education over time

Figure 4: Highest education over time - aggregated

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Appendices

A Factors and variables for stunting

#	Factors	Corresponding variable
1	Childs age	c_age
2	Sex of child	c_sex
3	Birth weight	-
4	Birth size	-
5	Mothers health	-
6	Mothers education	mo_noedu, mo_primary, mo_secondary
7	Mothers age	mo_age_birth
8	Mothers BMI	-
9	Breastfeeding	mo_breastfeeding
10	Wealth of household	Y_his
11	Social inequality	income_quintile
12	Source of drinking water	water_improved_total
13	Sanitation	sani_improved_total
14	Place of residence	urban

Table 2: Factors associated with childhood stunting, wasting and underweight. Sources: [2] [6]

B Factors and variables for under-five mortality

#	**Factors**	**Corresponding variable**
1	Sex of child	c_sex
2	Birth order	c_first
3	Malnutrition	-
4	Vaccinations	-
5	Access to postnatal care	mo_assistance
6	Mothers age	mo_age_birth
7	Education	mo_noedu, mo_primary, mo_secondary
8	Breastfeeding	mo_breastfeeding
9	Place of delivery	-
10	Household wealth	Y_his
11	Place of residence	urban
12	Source of drinking water	water_improved_total
13	Sanitation	sani_improved_total

Table 3: Factors associated with under-five mortality. Sources: [4][9] [5]

C Correlation-matrix for stunting

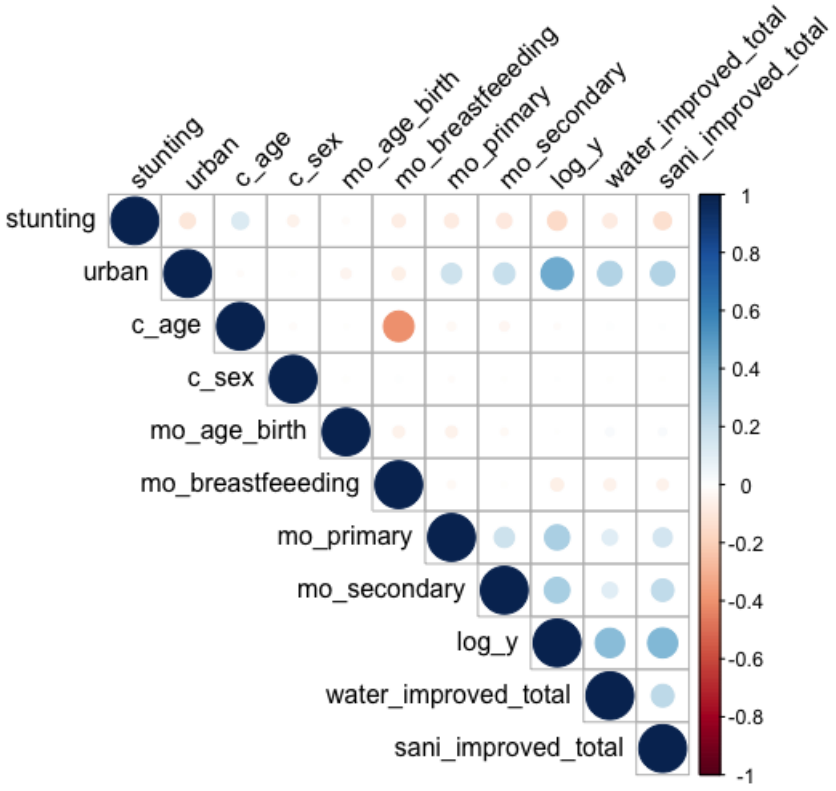

Figure 5: Correlation-matrix that should help to find variables that have a significant effect on stunting.

D Correlation-matrix for under-five mortality

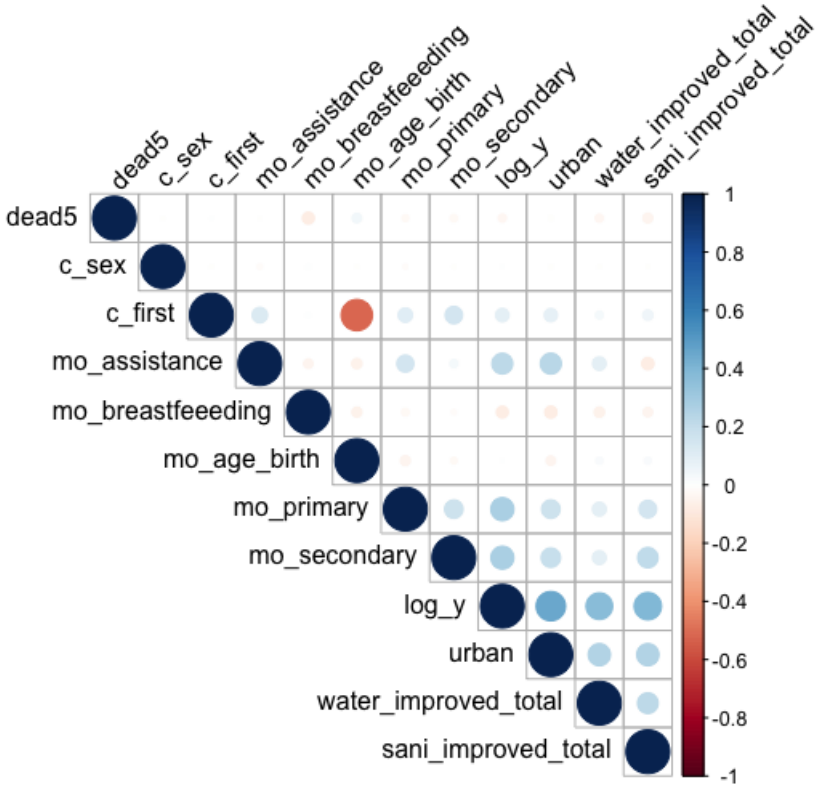

Figure 6: Correlation-matrix that should help to find variables that have a significant effect on under-five mortality.