SOCIOECONOMIC INEQUALITY IN MALNUTRITION IN DEVELOPING COUNTRIES

ABSTRACT

Objective The objectives of this study are to report socioeconomic inequalities in childhood malnutrition in the developing world, to provide evidence on the association between socioeconomic inequality and average malnutrition, and to draw attention to the different patterns of socioeconomic inequality in malnutrition.

Methods Both stunting and wasting were measured using the new WHO child growth standards. Socioeconomic status was estimated through principal component analysis using a set of household assets and living conditions. Socioeconomic inequality was measured in terms of an alternative concentration index that avoids problems with mean dependence.

Findings Within almost all countries in this study, stunting and wasting disproportionably affected the poor, although socioeconomic inequalities in wasting were much smaller and insignificant in about one third of the countries. When correcting for mean dependence of the concentration index, there appeared no clear association between average stunting and socioeconomic inequality. The latter showed different patterns that were labelled as mass deprivation, queuing and exclusion. Although average levels of malnutrition were higher when using the new WHO reference standards, estimates of socioeconomic inequality were fairly robust to this change in growth standards.

Conclusion

Socioeconomic inequalities in childhood malnutrition were present in the entire developing world, and were not evidently related to average rates of malnutrition. Failure to tackle these inequalities is a cause of social injustice and a reduction of these inequalities does not seem to arrive as a windfall profit from reducing the overall rate of malnutrition. Therefore policies should take into account the entire distribution of childhood malnutrition across socioeconomic groups.

INTRODUCTION

Epidemiological evidence points to a small set of primary causes of child mortality – pneumonia, diarrhea, low birth weight, asphyxia and, in some parts of the world, HIV and malaria – as the main killers of children under five years. Malnutrition is the underlying cause of every one out of two such deaths.[1,2] The evidence also shows that child deaths and malnutrition are not equally distributed throughout the world. They cluster in Sub-Saharan Africa and South Asia, and in poor communities within these regions.[3,4] Poor-rich disparities in health outcomes are increasingly drawing the attention of researchers and policy makers, hereby fostering a substantial growth in the health-equity related literature.[5,6,7,8] S*ocioeconomic inequality* in malnutrition refers to the degree to which childhood malnutrition rates differ between more and less socially and economically advantaged groups. This is different from *pure inequalities* which take into account all variation in childhood malnutrition. The available literature that documents socioeconomic inequality in malnutrition is mainly focused on one specific country or region.[9,10,11,12,13,14] On a more global level, Wagstaff and Watanabe[15] provided evidence on the socioeconomic inequalities in malnutrition across 20 developing countries. Other relevant cross-country studies include those of Pradhan *et al*[16] and Smith *et al*[17], respectively describing total inequalities and inequalities between urban and rural populations. The latter two studies however provide no evidence on socioeconomic inequalities within developing countries.

This paper contributes to the literature in several ways. First, it updates and enlarges the evidence base on average malnutrition and socioeconomic inequalities in malnutrition,

using the most recent Demographic Health Survey data from 47 developing countries. The use of such a large number of countries allows getting insight into the regional clustering of poor-rich malnutrition disparities in the developing world and into the association between average levels of malnutrition and socioeconomic inequality. Given the focus in international development targets on average rates of malnutrition, it is of interest to establish how countries compare on average rates of malnutrition and inequalities in malnutrition. In addition to quantifying the degree of socioeconomic inequality by a single index, the different patterns of the distribution of malnutrition across socioeconomic groups are also illustrated.

Second, this paper measures childhood malnutrition using the new growth standards that have been recently released by the World Health Organization.[18] The new standards are based on children from Brazil, Ghana, India, Norway, Oman and the US and adopt a fundamentally prescriptive approach designed to describe how all children should grow rather than merely describing how children grew in a single reference population at a specified time.[19] For example, the new reference population only includes children from study sites where at least 20% of women are willing to follow breastfeeding recommendations. To our knowledge this is the first study presenting estimates of malnutrition in a large set of countries based upon these new standards. To check sensitivity of the results to this change in reference group, the analysis is also done using the older US National Center for Health Statistics (NCHS) reference population.[20]

Finally, this paper measures socioeconomic inequality in malnutrition by means of the concentration index, which takes into account inequality across the entire socioeconomic distribution. Applied to binary indicators, such as mortality and stunting, the

concentration index depends upon the mean of the indicator. This would impede cross country comparisons due to substantial differences in means across locations. To avoid this problem, we use an alternative but related index recently introduced by Erreygers[21].

METHODS

Data

Data was used from all 47 Demographic Health Surveys (DHS) that contain information on the nutritional status of children aged up to five years. The data represents countries from four regions: 26 countries in sub-Saharan Africa, 7 in the Near East, 5 in South-South East Asia and 9 in Latin America and the Caribbean region. Table 1 shows the countries and datasets used.

Analysis

Anthropometric data on the height-for-age and the weight-for-height of children were used to measure chronic and acute malnutrition respectively. Low height-for-age reflects slowing in skeletal growth, and is considered to be a reliable indicator of long-standing malnutrition in childhood. Low weight-for-height on the other hand indicates a deficit in tissue and fat mass and is more sensitive to temporary food shortages and episodes of illness. Low weight-for-age is also used in the literature, but not used here as it does not discriminate well between temporary and more permanent malnutrition.[9,20,22]

A child was considered stunted/wasted if its height-for-age/weight-for-height was below minus two standard deviations from the median of the reference population.[9,16] We used these crude binary indicators of stunting/wasting as their averages are much easier to intuitively interpret – compared to the continuous height-for-age/weight-for-age z-scores

– and therefore facilitate the comparison of stunting/wasting rates across socioeconomic groups and across countries.

This paper used the new WHO child growth standards that were released by the World Health Organization in April 2006.[18] Robustness of the results against this change from the NCHS growth standards[20] was also checked.

An indicator of socioeconomic status was developed using principal component analysis.[23] The indicator combined information on a set of household assets and living conditions: the ownership of a car, phone, TV, radio, fridge, bike and motorcycle; the availability of electricity, clean water and a toilet; and the material used to construct the wall, roof and floor of the household dwelling.

Socioeconomic inequality in stunting and wasting was calculated by means of a recently proposed generalisation – introduced by Erreygers[21] (see also Van de Poel *et al*[24] for an application) – of the traditional concentration index (C) which was proposed by Wagstaff *et al*[25]. The generalisation preserves the main characteristics of the traditional concentration index – (i) negative values imply that malnutrition is more concentrated among poorer children and vice versa, (ii) if all children, irrespective of their socioeconomic status, would equally suffer from malnutrition, the C would equal zero, and (iii) transferring malnutrition from a richer to a poorer individual reduces socioeconomic inequality – but overcomes several of its methodological shortcomings. In particular for this paper, it is worth mentioning that the generalisation avoids dependence upon the mean of the binary indicator (Wagstaff[26] discussed a related issue for the bounds of the concentration index). Not correcting for mean dependence would impede cross

country comparisons due to substantial differences in means across locations. In addition it would predetermine the association between average levels of malnutrition and socioeconomic inequality.

Since DHS rely on multi-stage sampling procedures, all estimates take account of sampling weights and statistical inference is adjusted for clustering on the level of the primary sampling unit. The statistical inference for the index recently proposed by Erreygers was based on an adapted version of the convenient regression approach.[27,28]

RESULTS

Table 2 shows the socioeconomic inequalities in stunting. In almost all countries, stunting was disproportionably affecting the poor. Concentration indices (based upon the WHO child growth standards and calculated as suggested by Erreygers[21]) were significant in all countries, except in Madagascar, and ranged from -0.0005 in Madagascar to -0.42 in Guatemala. Socioeconomic inequality in stunting appeared largest in the Latin American and Caribbean (LAC) region, where the median C equaled -0.22.

The results with respect to wasting are presented in Table 3. Wasting was generally more concentrated among the poor, but the socioeconomic inequality was much smaller as compared to stunting. For about one third of the countries socioeconomic inequalities were insignificant. The median concentration index (calculated as suggested by Erreygers[21]) was largest in South Southeast Asia (SSEA) (-0.05 based upon WHO child growth standards).

Table 2 and Table 3 also show average stunting and wasting rates based upon the new WHO child growth standards and the NCHS growth standards. For both malnutrition indicators, average rates were higher using the new WHO reference standards. However, socioeconomic inequalities were fairly similar across the different growth standards; therefore the following discussion is mainly based upon the WHO child growth standards.

Figure 1 plots the average level of stunting against socioeconomic inequality in stunting. For illustrative purposes, the negative of the concentration index (calculated as suggested by Erreygers[21]) is shown in these figures such that higher values on the y-axes indicate higher socioeconomic inequality in favour of the rich. There was no clear association between average stunting and socioeconomic inequality in stunting (Spearman coefficient=0.20, p-value=0.17). If attention was restricted to socioeconomic inequalities in the LAC region, higher average stunting levels were associated with higher socioeconomic inequalities in stunting. Figure 2 shows the same association for wasting and clearly illustrates the much smaller socioeconomic inequalities in wasting as compared to stunting. There appeared a negative association between average wasting and the concentration index of wasting (Spearman coefficient=-0.60, p-value<0.001), meaning that countries with higher average wasting tended to have higher socioeconomic inequalities. However, Figure 2 shows that the magnitude of the association was low at best. The low values of the socioeconomic inequalities, combined with the finding that the relative variability in average wasting levels across countries (coefficient of variation=0.68) was higher than that in average stunting levels (coefficient of

variation=0.35), suggest that one should not focus too much on the significance of the association between average wasting and socioeconomic inequality in wasting.

When using the traditional concentration index (or the one suggested by Wagstaff[26]), different results for the association were found, i.e. there appeared a strong positive association between average stunting and socioeconomic inequality in stunting (Spearman coefficient=0.78, p-value<0.001), whereas the association between average wasting and socioeconomic inequality in wasting was insignificant (Spearman coefficient=0.14, p-value=0.35). This confirms the importance of correction for mean dependence.

Table 2 and Table 3 also show the distribution of stunting and wasting across quintiles of socioeconomic status. These distributions can take different patterns, which are illustrated for three selected countries in Figure 3.[29] In Rwanda, socioeconomic inequality in stunting could be characterized as *mass deprivation* – stunting is highly prevalent within the majority of the population while a small privileged class is much better off. A second pattern, as was seen in Ghana, could be described as *queuing* – average stunting is lower than in the previous pattern, but richer population groups are better off while the poor had to wait for a "trickle-down" effect. Third, socioeconomic inequality in stunting in Brazil was in the form of *exclusion* whereby stunting prevalence is relatively low within the majority of the population, but where a poor minority of the population was deprived.

DISCUSSION

This study illustrates the existence of socioeconomic inequality in malnutrition across the developing world. The results show that malnutrition favours the better-off and that this inequality is much more pronounced for stunting than for wasting. This could be expected as previous evidence has suggested that socioeconomic status has a smaller effect on the stochastic conditions that precipitate wasting (e.g. unforeseen environmental factors and diseases) than it has on long-term malnourishment.[9,15] Socioeconomic inequalities in stunting were largest in the Latin American and Caribbean region, with Guatemala being an outlier, which is also in line with previous findings.[11,15,30]

Average wasting and stunting rates based upon the WHO child growth standards were larger than those based upon the NCHS reference population. This has also been found by de Onis *et al*[31] for Bangladesh, Dominican Republic and a pooled sample of North American and European children. However, estimates of socioeconomic inequalities in both stunting and wasting were similar across the different growth standards, as were the associations between socioeconomic inequalities and averages.

When studying the association between average malnutrition and socioeconomic inequality in malnutrition, the choice of the inequality index does matter. Using Erreygers' index[21], there appeared no clear association between average stunting and socioeconomic inequality in stunting (and some evidence of a limited association for wasting was presented), while the traditional concentration index (or the one suggested by Wagstaff[26]) gave rather opposite findings. It is worth noting that Wagstaff and

Watanabe[15] found evidence of an inverse relationship between underweight and socioeconomic inequality using the traditional concentration index. Applying Erreygers' index to the data in their paper reversed this finding, which illustrates Erreygers' point about the need to be careful when comparing concentration indices across countries with highly differing stunting levels.

Socioeconomic inequality was found in different patterns that varied between mass deprivation, queuing and exclusion. The manner in which systems based on primary health care develop will vary across these differing contexts. In the case of exclusion, programs targeted at specific population groups, i.e. the poorest, are urgently needed to achieve pro-equity outcomes while in other instances, such as mass deprivation, broad strengthening of the whole system or a combination of the two approaches is required.[29] In this respect, the distribution of malnutrition across socioeconomic groups, as shown in Table 2 and Table 3, can provide a useful tool for health policy makers as it can easily be used to classify countries according to the above mentioned patterns.

There are some limitations to this study. First, it has to be noted that for 6 out of the 47 countries (Central African Republic, Comoros, Niger, Togo, Kyrgyzstan Republic and India) data was only available for children aged 0-3 years instead of 0-5. Since anthropometric deficits accumulate over time, the average malnutrition rates for these countries are underestimated as compared to the other countries. However, as already discussed by Wagstaff and Watanabe[15], changes in the age limit do not systematically

produce an upward or downward bias in socioeconomic inequality. Furthermore, the results were found to be robust to the exclusion of these countries.

Second, the use of an asset index to capture socioeconomic status has its shortcomings. Houweling *et al*[32] have shown that the choice of the assets can influence the observed magnitude of health inequalities, but also conclude that in the absence of reliable information on income or expenditure, the use of such an asset index is generally a good alternative to distinguish socioeconomic layers within a population (see also Wagstaff and Watanabe[33]). With respect to this study, it is important to note that a separate asset index is constructed for each country. Therefore it is allowed that the correlation between assets and socioeconomic status varies across countries.

Third, this study only investigates socioeconomic inequalities in childhood malnutrition across the developing world and the extent to which these relate to average malnutrition rates. Clearly, this is only a first step in a broader research agenda that analyzes the determinants of socioeconomic inequalities in childhood malnutrition within and across developing countries. The next step should consist of combining the literature on both *socioeconomic* and *proximate* determinants of malnutrition, such as feeding practices, health care seeking behavior and mother's nutritional status (see e.g. Smith *et al*[17]; Mosley and Chen[34]; Ruel *et al*[35]) with decomposition approaches such as the one proposed by Wagstaff *et al*[10].

CONCLUSION

The findings of this study are relevant from both a methodological and policy point of view. Regarding the methodological contribution, this paper is the first to study

socioeconomic inequalities in childhood malnutrition in the developing world using the recently introduced WHO child growth standards. It is found that although average malnutrition is higher when using this reference population, estimates of socioeconomic inequality are fairly similar compared to the ones based upon the NCHS reference population. Second, the analysis demonstrates that when studying the association between average malnutrition and the concentration index, it is important to account for mean dependence of the latter index. When doing so, no clear relationship was found between average malnutrition and socioeconomic inequality.

The lack of any relationship between average malnutrition and socioeconomic inequality is also important from a health policy perspective. It suggests that countries with lower average malnutrition levels did not perform fundamentally different in terms of socioeconomic inequalities compared to countries with much higher average malnutrition levels. While it is not clear from this study whether this is due to a deliberate policy focus on average malnutrition levels, it shows policy makers should realize that there do not seem to be obvious windfall profits resulting from focussing on a reduction of average malnutrition levels. Nevertheless, the main goals and targets of large scale development programs such as the Millennium Development Goals continue to be couched in terms of improving population averages.[36]

The results of this study also indicate that not only the degree, but also the pattern of socioeconomic inequalities in malnutrition should be a concern in setting health policies. To reduce malnutrition in e.g. many Latin American countries, policies should be targeted to the poor. In contrast, in a lot of Sub-Saharan African countries, next to

targeting the poor, there also is a great scope for progress by simply focussing on the general population.

country	country code	year of survey	sample size	country	country code	year of survey	sample size
Sub-Saharan Africa (SSA)				**Near East (NE)**			
Benin	BJ	2001	3842	Armenia	AM	2000	1517
Burkina Faso	BF	2003	8142	Egypt	EG	2000	10296
Cameroon	CM	2004	3168	Morocco	MA	2003/04	5356
Central African Rep*	CF	1994/95	2297	Turkey	TR	1998	2782
Chad	TD	2004	4414	Kazakhstan	KZ	1999	566
Comoros*	KM	1996	921	Kyrgyzstan Rep*	KG	1997	971
Cote d'Ivoire	CI	1998/99	1477	Uzbekistan	UZ	1996	954
Ethiopia	ET	2000	2833	**South & Southeast Asia (SSEA)**			
Gabon	GA	2000	3482	Bangladesh	BD	2004	5911
Ghana	GH	2003	3094	Cambodia	KH	2000	3522
Guinea	GN	1999	2961	India*	IN	1998/99	24989
Kenya	KE	2003	4719	Nepal	NP	2001	6163
Madagascar	MG	2003/04	2908	Pakistan	PK	1990/91	4079
Malawi	MW	2000	9162	**Latin America & Caribbean (LAC)**			
Mali	ML	2001	9382	Bolivia	BO	2003	9134
Mauritania	MR	2000/01	3306	Brazil	BR	1996	4056
Mozambique	MZ	2003	3808	Colombia	CO	2005	12393
Namibia	NA	2000	2925	Dominican Rep	DO	2002	9288
Niger*	NE	1998	3914	Guatemala	GT	1998/99	3879
Nigeria	NG	2003	4293	Haiti	HT	2000	5510
Rwanda	RW	2000	6038	Nicaragua	NI	2001	5875
Tanzania	TZ	2004	7132	Paraguay	PY	1990	3614
Togo*	TG	1998	3443	Peru	PE	2000	11585
Uganda	UG	2000/01	5145				
Zambia	ZM	2001/02	1932				
Zimbabwe	ZW	1999	2632				

Table 1: Description of DHS datasets. Data marked with * corresponds to births in three years preceding survey instead of five.

	Country	Prevalence of stunting by quintiles of socioeconomic status (based upon MGRS)					Average stunting	Average stunting	C	C
		Q1	Q2	Q3	Q4	Q5	WHO	NCHS	WHO	NCHS
	Benin	43.78	45.38	39.98	34.96	27.35	38.61	30.37	-0.15	-0.13
	Burkina Faso	48.44	46.96	46.49	40.20	27.45	42.98	38.56	-0.15	-0.15
	Cameroon	44.19	43.42	38.85	31.25	19.20	36.49	31.68	-0.21	-0.21
	CAR	47.26	41.80	39.89	42.03	33.22	39.84	33.65	-0.11	-0.12
	Chad	48.62	44.84	46.07	39.43	33.92	44.16	40.95	-0.09	-0.09
	Comoros	46.11	47.08	41.45	37.97	26.47	40.53	33.77	-0.15	-0.19
	Cote d'Ivoire	38.66	29.41	31.07	26.10	19.28	31.26	25.17	-0.17	-0.17
	Ethiopia	60.94	55.04	58.23	54.07	42.27	56.91	51.22	-0.09	-0.10
	Gabon	43.46	35.53	26.44	18.17	18.17	26.03	20.65	-0.22	-0.20
	Ghana	45.11	38.27	40.42	30.42	20.01	35.62	29.43	-0.19	-0.19
	Guinea	39.08	38.87	35.50	32.42	24.95	34.44	26.07	-0.13	-0.11
	Kenya	43.18	39.34	35.48	27.98	22.87	35.90	30.56	-0.17	-0.16
S	Madagascar	53.90	54.72	59.96	58.15	50.51	56.06	48.34	-0.00	-0.01
S	Malawi	60.64	59.59	52.80	57.79	39.32	54.08	49.02	-0.14	-0.14
A	Mali	48.79	49.60	45.10	42.40	28.43	41.78	37.57	-0.17	-0.17
	Mauritania	45.05	41.47	40.69	32.80	31.65	39.25	34.50	-0.14	-0.16
	Mozambique	55.79	53.08	53.84	43.45	34.70	51.50	46.16	-0.11	-0.14
	Namibia	33.10	31.68	23.87	18.45	25.00	28.07	22.64	-0.13	-0.09
	Niger	50.81	49.09	46.26	49.30	36.53	47.05	41.08	-0.08	-0.09
	Nigeria	54.30	50.13	49.55	36.33	25.20	43.19	38.41	-0.25	-0.25
	Rwanda	52.34	51.60	51.52	47.00	31.88	47.21	42.37	-0.14	-0.15
	Tanzania	48.17	48.22	46.44	44.22	23.91	43.63	37.05	-0.15	-0.16
	Togo	37.45	34.25	30.05	25.88	19.03	30.37	21.72	-0.16	-0.14
	Uganda	45.84	46.75	49.46	42.79	29.00	44.50	38.61	-0.07	-0.08
	Zambia	59.53	58.41	58.33	49.88	40.59	53.21	46.15	-0.17	-0.18
	Zimbabwe	37.37	34.65	32.33	29.87	23.45	31.48	26.45	-0.11	-0.12
	median	46.69	46.06	43.28	38.70	27.40	41.15	35.77	-0.15	-0.15
	Bangladesh	58.19	55.89	53.32	43.03	30.26	49.85	43.02	-0.20	-0.20
	Cambodia	54.32	52.78	48.60	43.51	39.86	48.47	44.29	-0.15	-0.16
S	India	56.43	53.35	49.02	45.54	41.56	49.68	43.75	-0.13	-0.13
S	Nepal	63.76	63.40	58.92	47.08	42.01	56.46	50.51	-0.19	-0.18
E	Pakistan	61.91	62.94	53.58	49.13	35.98	54.12	49.59	-0.20	-0.24
A	median	58.19	55.89	53.32	45.54	39.86	49.85	44.29	-0.19	-0.16
	Armenia	25.08	26.01	14.88	14.01	12.45	18.36	13.00	-0.12	-0.09
	Egypt	31.80	26.41	22.69	19.23	15.18	24.00	18.66	-0.13	-0.12
	Kazakhstan	17.81	14.91	9.29	9.40	6.32	13.93	9.75	-0.10	-0.10
N	Kyrgyzstan	41.40	37.66	24.36	28.64	18.88	32.89	24.84	-0.18	-0.17
E	Morocco	34.87	26.06	20.07	16.68	16.02	23.28	18.18	-0.18	-0.17
	Turkey	34.25	23.52	17.48	9.50	5.01	19.04	16.01	-0.24	-0.22
	Uzbekistan	41.12	38.35	32.21	33.77	36.00	37.46	31.28	-0.07	-0.09
	median	34.25	26.06	20.07	16.68	15.18	23.28	18.18	-0.13	-0.13
	Bolivia	48.50	39.71	29.68	22.87	14.29	32.43	26.38	-0.31	-0.29
	Brazil	29.46	13.25	7.61	5.41	5.42	13.42	10.46	-0.22	-0.19
	Colombia	25.14	17.19	13.89	10.59	6.39	15.70	11.52	-0.15	-0.13
	Dominican	21.11	13.51	12.44	8.28	7.45	11.76	8.85	-0.12	-0.10
L	Guatemala	68.45	67.75	64.23	43.06	25.46	52.80	46.37	-0.42	-0.42
A	Haiti	38.01	33.83	29.97	21.65	11.74	27.10	21.93	-0.22	-0.19
C	Nicaragua	42.16	31.73	22.14	12.05	9.46	24.67	20.13	-0.30	-0.27
	Paraguay	28.52	24.60	20.84	11.00	7.17	18.20	13.92	-0.20	-0.18
	Peru	54.91	43.00	24.91	17.00	14.36	31.29	25.42	-0.41	-0.38
	median	38.01	31.73	22.14	12.05	9.46	24.67	20.13	-0.22	-0.23

Table 2: Estimated stunting rates in under-five children by quintiles of socioeconomic status, average stunting rates and concentration indices (C) based upon WHO and NCHS growth standards. Underscored averages and C indicate insignificance at the 10% level. Concentration indices are calculated as suggested by Erreygers[21].

	Country	Prevalence of wasting by quintiles of socioeconomic status (based upon MGRS)					Average wasting	Average wasting	C	C
		Q1	Q2	Q3	Q4	Q5	WHO	NCHS	WHO	NCHS
	Benin	12.09	12.06	8.42	7.94	5.76	9.33	7.55	-0.06	-0.04
	Burkina Faso	22.01	23.04	23.22	21.27	15.50	21.48	18.72	-0.04	-0.02
	Cameroon	8.24	8.46	5.86	4.00	2.93	6.23	5.28	-0.06	-0.05
	CAR	10.64	10.79	10.53	8.55	7.44	9.25	7.18	-0.03	-0.03
	Chad	17.69	14.89	15.90	16.77	15.88	16.09	13.53	0.00	0.00
	Comoros	15.52	13.78	10.36	5.91	8.43	11.00	8.40	-0.08	-0.06
	Cote d'Ivoire	7.80	8.25	5.66	5.06	4.25	6.85	7.80	-0.02	-0.04
	Ethiopia	13.11	13.51	13.52	12.19	7.10	12.70	10.71	-0.02	-0.04
	Gabon	4.35	3.02	5.33	5.17	3.27	4.26	2.83	0.00	-0.01
	Ghana	8.57	7.90	8.67	10.20	8.15	8.70	7.12	0.00	0.00
	Guinea	12.38	10.02	10.48	8.34	8.27	9.92	9.17	-0.04	-0.02
	Kenya	8.70	5.35	4.80	3.65	7.59	6.23	5.62	-0.05	-0.05
S	Madagascar	11.83	11.40	9.17	8.95	7.19	10.04	7.75	-0.04	-0.04
S	Malawi	8.71	7.32	6.92	6.62	5.76	7.02	5.52	-0.02	-0.02
A	Mali	12.68	15.49	14.24	13.26	9.49	12.91	10.65	-0.04	-0.04
	Mauritania	18.25	16.26	15.20	12.04	12.38	15.27	13.40	-0.06	-0.07
	Mozambique	8.44	5.88	5.99	5.39	4.70	6.55	4.60	-0.03	-0.02
	Namibia	13.76	8.61	7.71	6.53	9.14	9.85	8.91	-0.08	-0.04
	Niger	30.78	27.24	27.02	25.25	14.98	25.66	20.63	-0.08	-0.09
	Nigeria	12.41	13.76	9.98	10.98	9.11	11.34	9.48	-0.03	-0.03
	Rwanda	9.11	10.52	8.69	8.14	7.66	8.88	6.85	-0.02	-0.02
	Tanzania	4.62	4.00	3.50	2.93	3.09	3.68	3.12	-0.01	0.00
	Togo	13.86	19.59	13.48	12.17	8.57	13.98	12.42	-0.06	-0.04
	Uganda	5.37	5.15	5.99	4.60	3.50	5.11	4.04	-0.01	0.00
	Zambia	5.83	4.70	7.79	5.84	6.39	6.11	4.88	0.01	0.01
	Zimbabwe	9.87	12.26	9.72	6.38	4.99	8.64	6.44	-0.06	-0.04
	median	11.24	10.66	8.93	8.04	7.51	9.29	7.65	-0.04	-0.03
	Bangladesh	16.51	16.48	14.62	12.84	11.51	14.72	12.90	-0.05	-0.03
	Cambodia	17.33	17.49	13.68	17.93	18.37	16.89	15.01	0.01	-0.01
S	India	22.88	21.82	19.22	16.96	17.13	19.82	15.61	-0.05	-0.04
S	Nepal	12.26	14.51	11.91	9.36	7.53	11.46	9.69	-0.04	-0.03
E	Pakistan	18.97	12.47	9.16	12.03	7.88	12.56	9.21	-0.08	-0.05
A	median	17.33	16.48	13.68	12.84	11.51	14.72	12.90	-0.05	-0.04
	Armenia	2.19	2.76	2.32	3.27	2.03	2.53	1.97	0.00	0.01
	Egypt	3.33	3.41	3.20	2.89	2.82	3.17	2.52	-0.01	-0.01
	Kazakhstan	3.04	3.09	1.69	0.86	1.76	2.51	1.82	-0.01	0.00
N	Kyrgyzstan	3.21	3.43	4.11	3.16	1.06	3.28	3.44	-0.01	-0.01
E	Morocco	14.22	9.34	9.87	9.19	10.52	10.74	9.31	-0.04	-0.05
	Turkey	4.00	3.73	2.27	1.98	2.67	3.01	1.90	-0.01	0.00
	Uzbekistan	19.44	7.41	12.10	13.53	10.26	13.74	11.63	-0.08	-0.11
	median	3.33	3.43	3.20	3.16	2.67	3.17	2.52	-0.01	-0.01
	Bolivia	1.77	1.40	2.01	1.79	1.55	1.70	1.24	0.00	0.00
	Brazil	4.41	2.48	2.24	1.41	2.64	2.75	2.34	-0.02	-0.01
	Colombia	1.74	1.69	1.68	1.27	1.12	1.54	1.29	-0.01	-0.01
	Dominican	3.16	1.90	2.77	1.88	1.44	2.15	1.70	-0.01	-0.02
L	Guatemala	2.76	3.86	4.21	1.10	2.71	2.91	2.52	-0.01	-0.01
A	Haiti	8.09	5.40	5.91	4.05	5.52	5.81	4.61	-0.02	-0.01
C	Nicaragua	3.86	2.23	2.78	0.87	1.66	2.37	2.07	-0.02	-0.01
	Paraguay	0.73	0.56	0.47	0.67	0.39	0.56	0.33	0.00	0.00
	Peru	2.16	1.02	1.03	0.72	0.71	1.15	0.94	-0.01	-0.01
	median	2.96	2.07	2.51	1.34	1.61	2.26	1.88	-0.01	-0.01

Table 3: Estimated wasting rates in under-five children by quintiles of socioeconomic status, average wasting rates, and concentration indices (C) based upon WHO and NCHS growth standards. Underscored averages and C indicate insignificance at the 10% level. Concentration indices are calculated as suggested by Erreygers[21].

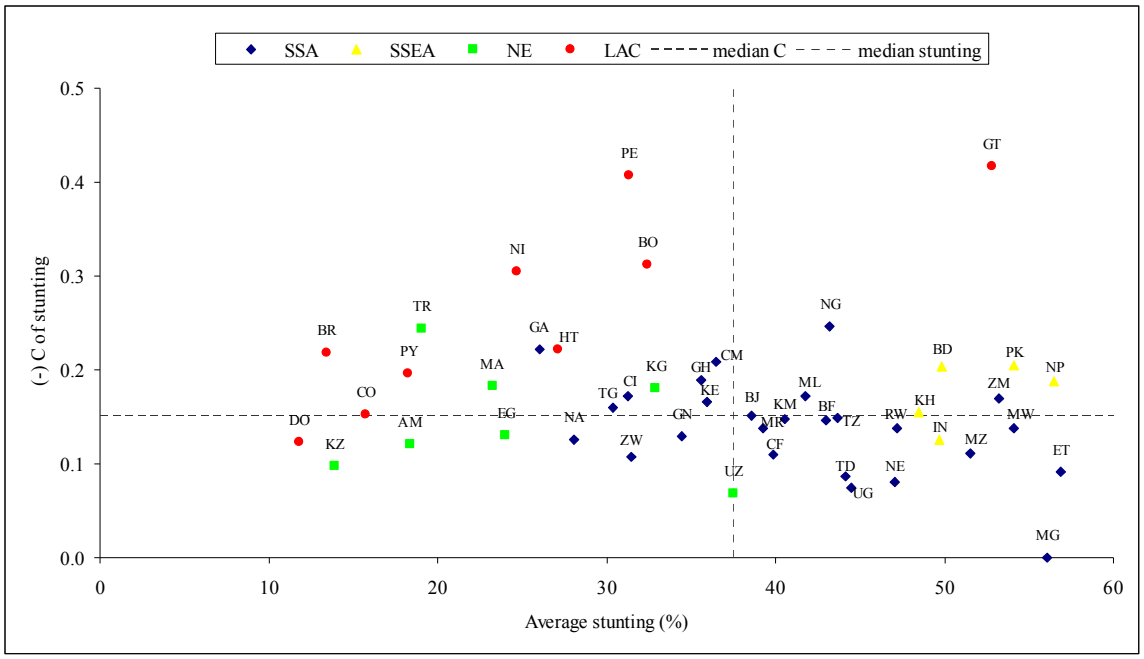

Figure 1: Average stunting versus (-) concentration index. Stunting rates based upon WHO growth standards. Concentration indices are calculated as suggested by Erreygers.[21]

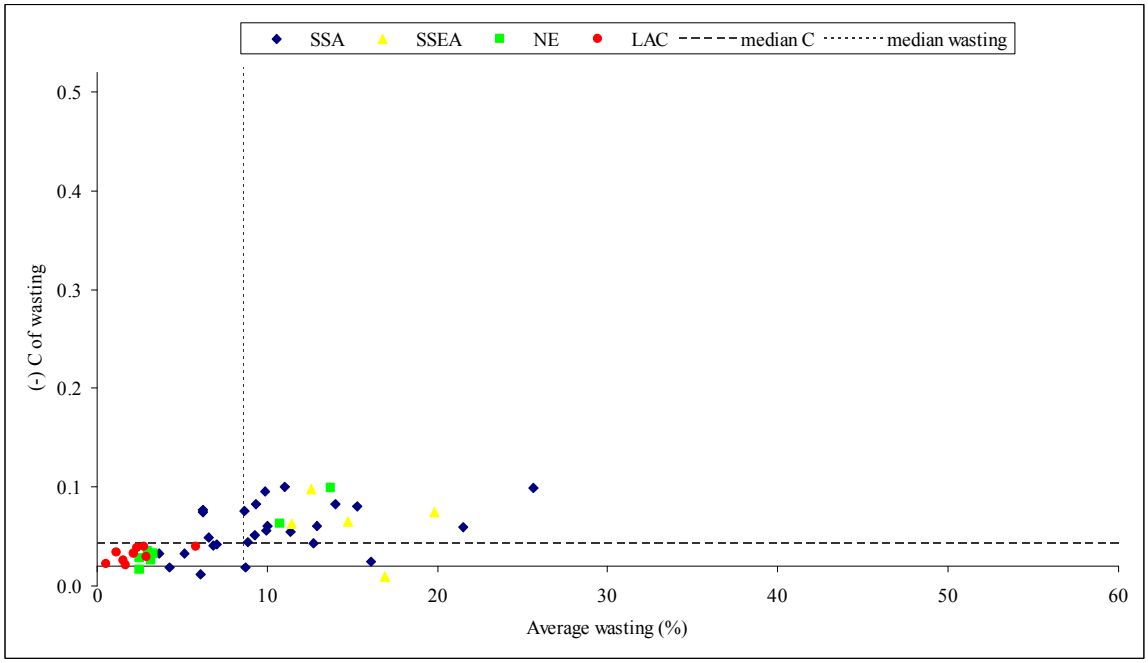

Figure 2: Average wasting versus (-) concentration index. Stunting rates based upon WHO growth standards. Concentration indices are calculated as suggested by Erreygers.[21]

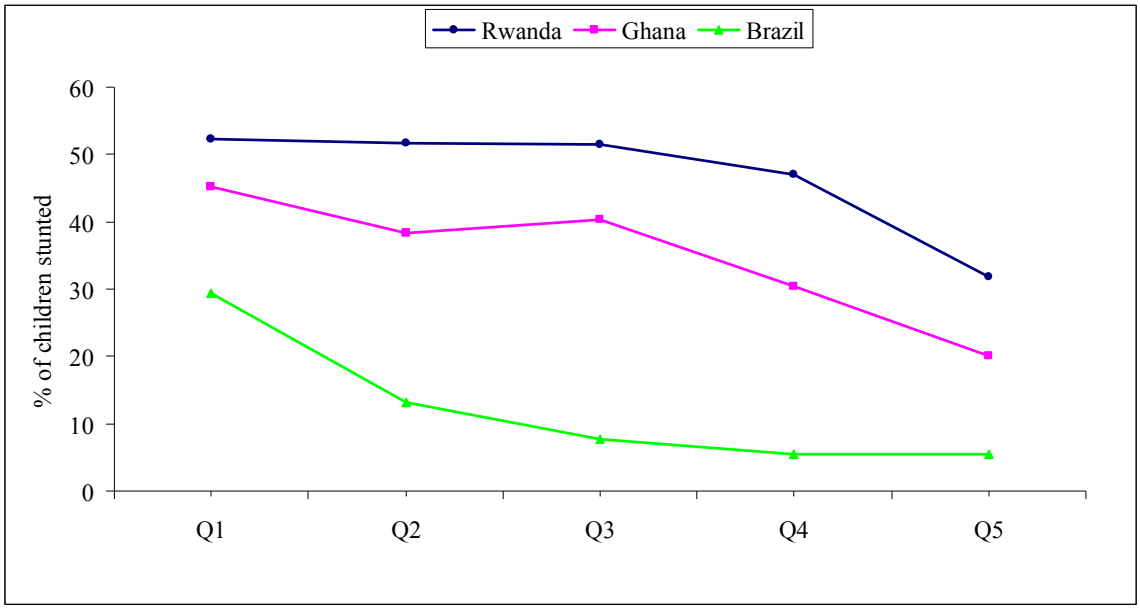

Figure 3: Distribution of stunting across quintiles of socioeconomic status for three selected countries. Stunting rates based upon WHO growth standards.

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