Child Health on a Dollar a Day: Some Tentative Cross-Country Comparisons

by

Adam Wagstaff

Development Research Group and Human Development Network, The World Bank, Washington DC, USA
and
School of Social Sciences, The University of Sussex, Brighton, UK

Second Draft: 5 November 2001
Please don't quote. Comments most welcome

Summary

Children living on a dollar a day—the international extreme poverty line—appear to have radically different chances of dying in childhood and being malnourished, depending on the country in which they live. In Kazakhstan, a child living on a dollar a day, has only a 10% risk of being underweight, while the risk facing a child living on a dollar a day in India is nearly 60%. The Kazakh child has a risk of less than 40 per 1000 of dying before his first birthday, while a child living on a dollar a day in Niger faces a risk of nearly 160 per 1000. Countries where mortality and malnutrition risks at a dollar a day are high are not typically those where there are large gaps in child survival and in malnutrition between the poor and better off. The two concepts of inequality and health risks at the poverty line are not only conceptually distinct—they are empirically distinct too. The large differences between countries in the risks of mortality and malnutrition in childhood beg the obvious question—what accounts for these differences? Some regression results presented in the paper suggest that these differences may be due to differences across countries in levels of per capita expenditure on the health sector. Regressions find that higher levels of per capita public spending on the health sector are associated with significantly lower levels of mortality and malnutrition amongst children living on a dollar a day.

Author's contact details: The World Bank, 1818 H Street NW, Washington, D.C. 20433, USA. Tel. (202) 473-0566. Fax (202)-522 1153. Email: awagstaff@worldbank.org.

Keywords: Child health; poverty; inequality.

Acknowledgements: My thanks to Davidson Gwatkin for comments on an earlier version of this paper. The findings, interpretations and conclusions expressed in this paper are entirely those of the author, and do not necessarily represent the views of the World Bank, its Executive Directors, or the countries they represent.

I. INTRODUCTION

This paper presents some tentative estimates of the health of children living at the international dollar-a-day extreme poverty line. Such numbers are of interest for two reasons. First, whilst much of the debate over the health of poor people has been directed at inequalities in health between the poor and better-off [1, 2], there is another equally respectable school of thought that focuses on health as a dimension of poverty [3]. Health and income are highly correlated, but not perfectly so, and focusing on income as a measure of poverty may fail to capture the other dimensions of poverty properly. Some people living on a dollar a day may have access to good quality and heavily subsidized health services and other social services, and this may help to dampen the effects of their low income on their health. For others the picture may be far bleaker—the adverse effects on health of low income may be reinforced by poor quality, expensive and inaccessible health services. Thus in addition to knowing how many people fall below the dollar-a-day poverty line, and how far they fall below it, one might also want to know how badly off the "income poor" are in other dimensions, such as health status. This paper contributes to this knowledge by attempting to measure child health—mortality and malnutrition—amongst children living on the dollar-a-day poverty line.

There is a second reason why such numbers might be of interest. Suppose one's concern is not with poverty per se but rather with inequalities in health between people on different incomes—irrespective of how many of them fall below the international poverty line. The question arises as to what drives these inequalities and what different ministries can do to reduce them. It can be shown that health inequalities—measured by the concentration index [4, 5]—depend on three key factors: (i) the degree of income inequality, (ii) the mean level of income, and (iii) the impact of income on health [6, 7]. One country might have larger health inequalities simply because it has higher income inequalities, or because it has a different average income.[1] At least in the short-term, a ministry of health has much more influence over (iii) (by pursuing policies that mitigate against the effects of low income on health) than over (i) and (ii), which are more likely to influenced in the short-term by macroeconomic and trade policies, employment policies, agriculture policies, and so on. For some purposes, therefore, when assessing health inequalities one might want to abstract from the influences of income inequality and average income, and focus instead on the health-income relationship, since this is more likely to be capable of being influenced by policies in the health ministry. The estimates presented in the paper fall far short of tracing out the full health-income relationship in each country studied, but they do provide an estimate of health levels at one point on this relationship—namely at one dollar a day.

[1] It cannot be said a priori whether countries with higher per capita incomes will, ceteris paribus, have higher or lower levels of health inequality. Equiproportionate income growth will raise health inequality if the elasticity of health with respect to income rises as income rises. If the elasticity stays the same, health inequality will remain unchanged, while if it falls with income, health inequality will fall following equiproportionate income growth.

II. **DATA AND METHODS**

One approach to estimating child health at a dollar a day would be to run regressions on child-level data of one's health status measure on household income, and then use the estimated relationship to predict health status at a dollar a day. This approach—used for twelve countries by the author elsewhere [8]—is time-consuming and data-intensive. For example, for child mortality one needs a dataset containing a fertility history and a good measure of household income or better still consumption. With a complete fertility history, one can then estimate a duration model, such as a Weibull model [9], linking the child's mortality hazard to its household consumption. With an incomplete fertility history, one an use regression methods to link the proportion of children surviving to income or consumption, and then superimpose the estimates on model life tables to get mortality rates [10]. Comparatively few household datasets exist, however, that have a fertility history *and* an income or consumption module. And the exercise is very time-consuming.

This paper employs a simpler and less direct route to estimating the health of children living on a dollar a day, that can be used for countries without a household survey containing both a fertility history and a consumption module. The starting point of the exercise is a recently assembled dataset [11] which contains estimates for 42 countries of child mortality and child malnutrition in five 'wealth' quintiles. The data are derived from Demographic and Health Survey (DHS) data. The typical DHS does not contain information on income or consumption, and the measure of 'wealth' is a synthetic one constructed through the use of Principal Components Analysis (PCA) on a battery of indicators of dwelling characteristics and ownership of consumer durables [12]. The dwelling characteristics included variables such as: flooring material, roof material, number of rooms in relation to household size, type of drinking water source and toilet type. The consumer durable questions included the household's ownership of a fan, a radio, a television, a bicycle, a car, a refrigerator, and so on. A PCA was undertaken on the full sample for each country separately, and the first principal component was retained and used to rank households and thereby children. In each case, the factor loading matrix was renormalized if necessary to ensure that the principal component was increasing in wealth. Separate means for the child health outcome variables were computed in the study for each of five wealth quintiles. These were obtained by ranking households into five groups equal in size in terms of the number of *people*. Though these are quintiles in terms of people, they are not quintiles in terms of children *at risk*, and this needs to be taken into account in what follows.

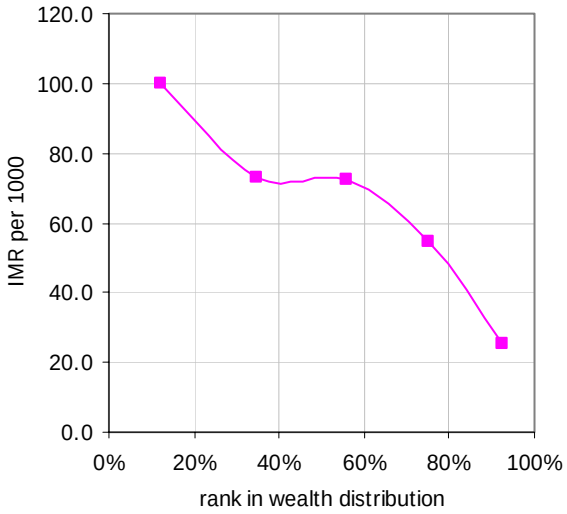
From the data, one can graph the relationship between, say, the infant mortality rate (IMR) and the child's rank in the wealth distribution *of those children at risk*. The child's rank is equal to

$$(1) \qquad R_i = \frac{1}{2} f_i + \sum_{\gamma=1}^{i-1} f_\gamma ,$$

where f_i is the fraction of the sample at risk in 'quintile' i. Thus if for the IMR the bottom 'quintile' contains 25% of children at risk, R_1=0.125. The markers in Figure 1 show the five observations from the Turkey quintiles dataset between IMR and a child's rank in the wealth distribution. By fitting a statistical relationship through the five observations, one can predict the IMR for a child at any rank. Evidently, a linear relationship would not in the case of Turkey fit the data very well. The same is true of many other countries, where non-linearities are observed, and where, as in the case of Turkey, the IMR does not decline monotonically with wealth rank.

The estimates below are therefore based on a cubic regression, where the health indicator is regressed on R_i, its square and its cube. This allows not only for non-linearity but also non-monotonicity in the relationship between health and wealth rank. The method of weighted-least squares (WLS) is used, where the weights reflect the proportions of children at risk in each 'quintile' for the indicator in question. In the case of the IMR and under-five mortality rate (U5MR), the latter is equal to the number of children born in the 10 years prior to the survey. In the case of malnutrition, it is equal to the number of children under the age of five (or, in some cases, four or three).

Figure 1: Infant mortality and wealth ranking, Turkey
Source: [11]



Using the regression results, one can predict the value of the health status indicator for a child at a particular rank in the wealth distribution. Next, we make two further assumptions—that a child's rank in the wealth distribution is close to his or her rank in the income or consumption distribution; and that the proportion of *people* who are living at or below the dollar-a-day poverty line is similar to the proportion of *children at risk* who are living at or below the international poverty line.

Evidence suggests that the former is not an unreasonable assumption. On data from India [13], the wealth index has been found to be robust and to produce a close correspondence with State Domestic Product and poverty rate data. On data from Indonesia, Pakistan and Nepal [13], where data are available on both consumption and asset ownership, the index has been found to have reasonable coherence with current consumption and to work as well or better than traditional expenditure-based measures in predicting enrollment status in school.

The second assumption—that similar numbers of people and children at risk are poor in each country—is necessary because the data available on poverty rates are for individuals not children. This assumption is more problematic, and it is here where analysis based on household-level datasets containing both child health and consumption data are likely to have their major payoffs. In the absence of data on children in poverty, the analysis below uses data

from the nearest available year on the proportion of people living on a dollar a day or less [14]. These data are derived from household surveys from different years, but in each case the consumption or income data are expressed in 1985 prices in US dollars converted using purchasing power parities (PPPs). PPP exchange rates are used because they take into account the local prices of goods and services not traded internationally. However, because PPP rates were designed for comparing aggregates from national accounts rather than for making international poverty comparisons, there is no guarantee that an international dollar-a-day poverty line measures the same degree of need or deprivation across countries. The data are, however, the best available.

The health status of children living at the rank in the wealth distribution corresponding to the proportion of the population living at or below the dollar-a-day poverty line is then predicted using the cubic WLS regression equation linking health status to wealth rank. So, for example, the poverty rate is 2.4% in Turkey, and the IMR reported below for Turkey is the IMR evaluated at wealth rank 0.024. This is the estimate of the risk of dying in the first year of life at a dollar a day in Turkey, based on the experience of cohort born in the ten years prior to Turkey's DHS.

III. **RESULTS**

Table 1 shows, for each country, the percentage of the population living on or below a dollar a day, and the year to which the poverty and the health (DHS) data refer. In 13 of the 32 countries for which there are quintile DHS data and income poverty data available, the year to which the poverty data refer is three or more years before or after the year in which the DHS data were collected. In 10 of these cases, the poverty data predate the collection of the DHS data, which might, in fact, be considered desirable, given that the mortality rates were computed over the ten years preceding the DHS. For the data on malnutrition, this seems less compelling and the discrepancy between the dates ought to be kept in mind, given the tendency for income poverty to change over time.

Table 1: Income poverty, and years for poverty and health data
Source: [11, 14]

Country	% of population living on or below dollar-a-day poverty line	Year to which poverty data refer	Year when DHS conducted
Bangladesh	29.07%	1996	1996/7
Bolivia	11.00%	1990	1998
Brazil	5.10%	1997	1996
Burkina Faso	61.18%	1994	1992/3
C.A.R.	66.58%	1993	1994/5
Colombia	10.99%	1996	1995
Côte d'Ivoire	12.29%	1995	1994
Dominican Republic	3.19%	1996	1996
Egypt	3.08%	1995	1995/6
Ghana	78.36%	1997	1993
Guatemala	39.81%	1989	1995
India	44.20%	1997	1992/3
Indonesia	26.33%	1998	1997
Kazakhstan	1.49%	1996	1995
Kenya	26.54%	1994	1998
Madagascar	60.17%	1993	1997
Mali	72.79%	1994	1995/6
Morocco	0.14%	1990/1	1993
Mozambique	37.85%	1996	1997
Namibia	34.93%	1993	1992
Nepal	37.68%	1995	1996
Nicaragua	2.95%	1993	1997/8
Niger	61.42%	1995	1998
Pakistan	30.96%	1996	1990/1
Peru	15.49%	1996	1996
Philippines	0.02%	1997	1998
Senegal	26.26%	1995	1997
Tanzania	19.89%	1993	1996
Turkey	2.35%	1994	1993
Uganda	36.70%	1992	1995
Uzbekistan	3.29%	1993	1996
Zimbabwe	35.95%	1990/1	1994

Table 2 shows the estimated rates of mortality and malnutrition at a dollar a day, along with the concentration indices of the indicators. Negative numbers in the concentration index (CI) indicate that poorer quintiles tend to have higher values of the indicator in question—the more negative the value, the more concentrated the indicator is amongst the worse off. As is clear from Table 2, there is no association whatever between inequality between the poor and better off and the estimated rate at a dollar a day. In the case of under-five mortality, for example, the correlation between the CI and the predicted rate at a dollar a day is only 0.14. Brazil, for example, has the most unequal distribution of under-five mortality between the poor

and better off, but the estimated risk of a child on the international extreme poverty line dying before his fifth birthday is only 100 per 1000. Niger, by contrast, has a very equal distribution of under-five mortality risk across the wealth distribution, but the chance of a child on a dollar a day in Niger dying before his fifth birthday is almost 300 per 1000. The other striking thing about Table 2 is the very large variation across countries in the risk of a child on a dollar a day dying before his first or fifth birthday and being malnourished. In Kazakhstan, a child living on a dollar a day, has only a 10% risk of being underweight, while the risk facing a child living on a dollar a day in India is nearly 60%. The Kazakh child has a risk of less than 40 per 1000 of dying before his first birthday, while a child living on a dollar a day in Niger faces a risk of nearly 160 per 1000.

Table 2: Inequality and estimated rates at a dollar a day: infant and under-five mortality, underweight, and stunting
Source: [11] and author's computations

	IMR		U5MR		Underweight		Stunting	
Country	CI	Rate at $1 a day	CI	Rate at $1 a day	CI	Rate at $1 a day	CI	Rate at $1 a day
Bangladesh	-0.067	96.9	-0.084	144.1	-0.121	54.3	-0.129	50.8
Bolivia	-0.211	107.4	-0.222	147.7	-0.312	17.6	-0.267	39.8
Brazil	-0.252	100.1	-0.260	116.9	-0.340	14.6	-0.411	32.5
Burkina Faso	-0.057	114.8	-0.040	221.0	-0.061	35.9	-0.079	35.3
C.A.R.	-0.137	98.4	-0.110	152.0	-0.109	25.8	-0.088	32.8
Colombia	-0.121	43.0	-0.130	54.7	-0.292	15.1	-0.237	24.3
Cote d'Ivoire	-0.108	115.9	-0.115	188.3	-0.141	30.5	-0.168	33.4
Dominican Republic	-0.169	71.5	-0.208	93.9	-0.418	16.5	-0.338	30.0
Egypt	-0.216	118.2	-0.231	156.1	-0.145	19.1	-0.121	40.6
Ghana	-0.093	59.0	-0.135	93.3	-0.139	21.4	-0.151	20.7
Guatemala	-0.082	76.6	-0.119	101.0	-0.190	33.4	-0.181	61.5
India	-0.149	99.8	-0.170	139.9	-0.092	57.5	-0.097	51.5
Indonesia	-0.196	63.4	-0.210	86.1				
Kazakhstan	0.009	37.9	0.002	49.0	-0.197	10.0	-0.259	48.7
Kenya	-0.153	85.6	-0.148	133.7	-0.189	28.1	-0.147	38.1
Madagascar	-0.122	99.1	-0.110	165.0	-0.052	39.9	-0.009	51.3
Mali	-0.075	127.2	-0.090	233.4	-0.088	36.4	-0.075	29.1
Morocco	-0.117	98.7	-0.154	128.7	-0.331	19.4	-0.253	46.2
Mozambique	-0.115	140.7	-0.118	221.6	-0.176	29.8	-0.131	37.2
Namibia	-0.003	56.4	-0.053	86.1	-0.163	30.4	-0.128	31.2
Nepal	-0.060	107.9	-0.096	165.3	-0.087	51.9	-0.099	51.3
Nicaragua	-0.094	47.7	-0.125	69.9	-0.233	20.0	-0.238	41.3
Niger	-0.050	156.4	-0.054	349.1	-0.047	53.3	-0.032	44.4
Pakistan	-0.051	108.4	-0.084	144.6	-0.131	45.7	-0.108	55.9
Peru	-0.223	76.7	-0.246	107.9	-0.403	15.7	-0.317	44.3
Philippines	-0.156	53.8	-0.191	88.6				
Senegal	-0.112	82.8	-0.164	184.5				
Tanzania	-0.040	99.7	-0.051	156.3	-0.128	36.6	-0.086	48.5
Turkey	-0.189	123.9	-0.211	159.9	-0.350	29.2	-0.310	40.0
Uganda	-0.081	81.7	-0.079	152.9	-0.116	29.0	-0.082	43.5
Uzbekistan	-0.039	46.1	-0.047	80.9	-0.142	25.7	-0.077	45.6
Zimbabwe	-0.007	45.5	-0.054	74.5	-0.121	18.3	-0.093	24.9

IV. **WHAT ACCOUNTS FOR THE RESULTS?**

Children living on a dollar a day—the international extreme poverty line—appear to have radically different chances of dying in childhood and being malnourished, depending on the country in which they live. This begs the obvious question—why? One possibility was already suggested in the Introduction, namely that subsidized health services may help to dampen the effects of low income on health. Thus whilst the effect on average health outcomes of public spending on health services may be somewhat small [15], the effect on the poor may be

appreciable if the poor (unlike the better-off) are unable (or less able) to protect themselves from low levels of public spending by relying on private care [16]. Evidence in support of the hypothesis that higher levels of per capita public spending on health care leads to better health outcomes *amongst the poor* is provided by Bidani and Ravallion [16]. However, their evidence is indirect—they do not observe health outcomes amongst the poor. Instead, they derive their results by assuming a linear relationship between health and its determinants (including public spending), allowing this to vary between the poor and the nonpoor, and exploiting the fact that the health of the population must be a weighted average of the health of the poor and nonpoor, with the proportions of the population in poverty and out of poverty serving as weights.

We can test the hypothesis that public spending on health improves the health of poor children, by linking our estimates of child health at a dollar a day to per capita public spending on health care. The latter is obtained by taking the share of national income absorbed by public spending on health care (averaged over the period 1997-99) and multiplying this by GNP per capita in 1999 converted at PPPs [17]. In addition to per capita public spending on health care, GNP per capita itself is also included. In the initial regressions, public spending per capita on education was also included. However, although this entered the regressions with a negative coefficient, the *t*-value on the coefficient was always very small (the largest being 0.6 in absolute size) and it was dropped from the final regressions. To account for the non-linearity between our measures of child health, on the one hand, and income and spending, on the other, the natural logarithm of the estimate of health status at a dollar a day was regressed on the natural logarithm of per capita public health spending and per capita GNP.

Table 3 shows the results of these regressions. The coefficients on per capita income vary in sign depending on the indicator, and in none of the regressions is the coefficient on per capita income significant. Thus, holding constant public spending on health care, it does not appear to be the case that per capita income in the country influences child health outcomes *at a dollar a day*. By contrast, the coefficients on per capita public health spending are all negative and are all statistically significant—at least at the 10% level, and in two cases at much lower significance levels. The regression results thus suggest that increases in per capita public expenditure on health services are associated with significant reductions in rates of mortality and malnutrition amongst children living on a dollar a day. These results lend support to the hypothesis that public spending on health improves the health of the poor, and are consistent with the aforementioned indirect evidence of Bidani and Ravallion [16]. The functional form used here allows the coefficients to be interpreted as elasticities—a 10% increase in per capita public spending on health is estimated to reduce infant mortality at a dollar a day by 2.4%.

Table 3: Determinants of child health at a dollar a day
Source: author's computations

Dependent variable		Intercept	Per capita GNP	Per capita public spending on health	Adjusted R^2	*N*
IMR	coefficient	4.861	0.060	-0.243	0.300	31
	t-statistic	5.423	0.374	-2.200		
U5MR	coefficient	6.701	-0.149	-0.194	0.463	31
	t-statistic	7.385	-0.912	-1.740		
Underweight	coefficient	3.880	0.095	-0.353	0.489	28
	t-statistic	3.824	0.514	-2.789		
Stunting	coefficient	3.000	0.173	-0.175	0.062	28
	t-statistic	3.719	1.174	-1.741		

V. **CONCLUSIONS**

The results in the paper can be quickly summarized. Children living on a dollar a day—the international extreme poverty line—appear to have radically different chances of dying in childhood and being malnourished, depending on the country in which they live. Countries where there are large gaps in child survival prospects and in malnutrition between the poor and better off are typically not the same countries where mortality and malnutrition risks at a dollar a day are high. The two concepts of inequality and health risks at the poverty line are not only conceptually distinct—they are empirically distinct too. The large differences between countries in the risks of mortality and malnutrition in childhood beg the obvious question—what accounts for these differences? Some regression results presented in the paper suggest that these differences may be due to differences across countries in levels of per capita expenditure on the health sector. Regressions find that higher levels of per capita public spending on the health sector are associated with significantly lower levels of mortality and malnutrition amongst children living on a dollar a day.

The results presented in the paper suggest, therefore, two important conclusions. First, it would indeed seem useful to adopt a multidimensional view of poverty and to think of poverty as more than simply living on or below a dollar a day. The survival prospects of a child living on a dollar a day, and its likelihood of being malnourished, is not a constant—it is several times higher in some countries than in others. Second, public expenditure on the health sector may indeed have a differential impact on the health of the poor and the nonpoor. The evidence presented here suggests that such spending significantly reduces the risks of mortality and malnutrition of children living on a dollar a day.

References

1. Gwatkin, D., Health inequalities and the health of the poor: What do we know? What can we do? *Bulletin of the World Health Organization*, 2000. **78**(1): p. 3-17.

2. Wagstaff, A., *Poverty and health*. 2001, Boston, MA: WHO Commission on Macroeconomics and Health, Working Group #1 Working Paper #5.

3. World Bank, *World Development Report 2000/2001: Attacking Poverty*. 2000, Oxford, New York: Oxford University Press.

4. Kakwani, N., A. Wagstaff, and E. Van Doorlsaer, Socioeconomic inequalities in health: Measurement, computation and statistical inference. *Journal of Econometrics*, 1997. **77**(1): p. 87-104.

5. Wagstaff, A., P. Paci, and E. van Doorslaer, On the measurement of inequalities in health. *Social Science and Medicine*, 1991. **33**: p. 545-557.

6. Contoyannis, P. and P. Forster, The distribution of health: a theoretical framework. *Journal of Health Economics*, 1999. **18**: p. 605-622.

7. Contoyannis, P. and M. Forster, Our healthier nation? *Health Economics*, 1999. **8**: p. 289-296.

8. Alderman, H. and A. Wagstaff, *Life and death on a dollar a day: Does it matter where you live?* 2001, Washington DC: World Bank, Mimeo.

9. Lavy, V., J. Strauss, D. Thomas, and P. de Vreyer, Quality of care, survival and health outcomes in Ghana. *Journal of Health Economics*, 1996. **15**(333-357).

10. Trussell, J. and S. Preston, Estimating covariates of childhood mortality from retrospective reports of mothers. *Health policy and Education*, 1982. **3**: p. 1-36.

11. Gwatkin, D., S. Rutstein, K. Johnson, R. Pande, and A. Wagstaff, *Socioeconomic Differences in Health, Nutrition and Population*. 2000, Washington DC: The World Bank, Health, Nutrition & Population Discussion Paper.

12. Filmer, D. and L. Pritchett, The effect of household wealth on educational attainment: evidence from 35 countries. *Population and Development Review*, 1999. **25**(1): p. 85-120.

13. Filmer, D. and L. Pritchett, *Estimating Wealth Effects without Expenditure Data -- or Tears: An Application to Educational Enrollments in States of India*. 1998, Washington DC: World Bank, Policy Research Working Paper #1994.

14. World_Bank, *Global Poverty Monitoring Project*. 2001: World Bank. http://www.worldbank.org/research/povmonitor/. World Wide Web. 1 November 2001.

15. Filmer, D. and L. Pritchett, The impact of public spending on health: does money matter? *Social Science and Medicine*, 1999. **49**: p. 1309-1323.

16. Bidani, B. and M. Ravallion, Decomposing social indicators using distributional data. *Journal of Econometrics*, 1997. **77**: p. 125-139.

17. World Bank, *World Development Indicators 2001*. 2001, Washington DC: The World Bank.