The Relationship of Health Aid to Population Health Improvements

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**IMPORTANCE**  International aid to the health sector is an important component of all health spending in many developing countries. The relationship between health aid and changes in population health among aid recipients remains unknown.

**OBJECTIVE**  To quantify the relationship between health aid and changes in life expectancy and mortality in children younger than 5 years (under-5 mortality) among aid recipient nations.

**DESIGN**  Cross-country panel data analysis of the relationship between measures of health aid, life expectancy, and under-5 mortality. Using difference models for longitudinal data with fixed effects for countries and years, we estimated the unique relationship between health aid and changes in life expectancy and under-5 mortality, controlling for gross domestic product per capita, urbanization, and total fertility rate.

**SETTING AND PARTICIPANTS**  A total of 140 aid-recipient countries between 1974 and 2010.

**EXPOSURE**  Annual amount of development assistance directed to the health sector in constant 2010 US dollars.

**MAIN OUTCOMES AND MEASURES**  Improvements in under-5 mortality and life expectancy in the period following aid receipt.

**RESULTS**  Between 1974 and 2010, each 1% increase in health aid was associated with 0.24 months greater increase in life expectancy (95% CI, 0.02-0.46) (P = .03) and a 0.14 per 1000 live births faster decline in the probability of under-5 deaths per 1000 live births (95% CI, 0.02-0.26) (P = .02). The association between health aid and health improvements has strengthened over time, with the closest association occurring between 2000 and 2010. Health improvements associated with health aid are measurable for 3 to 5 years after aid disbursement. These findings imply that an increase of $1 billion in health aid could be associated with 364 800 fewer under-5 deaths (95% CI, 98 400-630 000).

**CONCLUSIONS AND RELEVANCE**  International aid to the health sector is related to increasing life expectancy and declining under-5 mortality. The benefits from aid appear to last for several years and have been greatest between 2000 and 2010, possibly because of improving health technologies or effective targeting of aid.
Whether international aid promotes development in recipient countries is a topic of substantial debate.\textsuperscript{1,2} Proponents of development aid argue that the world’s poorest nations are trapped in a cycle of poverty and ill health, and that aid can propel those nations into a cycle of development.\textsuperscript{3} On the other hand, opponents of international aid claim that aid has been associated with delayed development, that it fails to reach its intended recipients, and that it interferes with the incentives for recipients to solve development challenges.\textsuperscript{4}

Multiple studies have explored the relationship of international aid and economic growth, but there is little empirical evidence about the relationship between aid to the health sector and health outcomes.\textsuperscript{5–7} The relative recency of aid to the health sector may explain the paucity of empirical studies: nearly 80% of all health aid documented between 1990 and 2010 was disbursed since 2000, and one analysis of health aid and child mortality examined trends only through 2004.\textsuperscript{7,8} A positive relationship between health aid and health may be expected for recent years, when the majority of aid was earmarked for financing relatively new and highly efficacious technologies such as antiretroviral therapy, insecticidal-treated bed nets, and new vaccines.\textsuperscript{9–12} On the other hand, misuse and displacement of aid from the health sector may undermine the ability to use these resources for health improvements.\textsuperscript{13} For some diseases like smallpox and polio, the close links between health aid and disease eradication efforts are obvious.\textsuperscript{14} We have previously explored the relationship between health aid for human immunodeficiency virus (HIV) and changes in adult and child mortality in Africa.\textsuperscript{15,16} However, the overall relationship between health aid and health outcomes remains uncharacterized.

International aid investments from all sources for health improvements in developing countries have grown substantially since 2000. The Institute for Health Metrics and Evaluation’s Development Assistance for Health data set indicates that health aid increased from $5.7 billion to $9.9 billion per year between 1990 and 1999, and from $10.7 billion to $28.2 billion between 2000 and 2010, an annual growth of approximately 10.2%.\textsuperscript{6,17} Between 2007 and 2010 alone, during the global financial crisis, annual health aid increased by nearly $7 billion. In relative terms, health aid increased from approximately 6.8% of all nonmilitary aid in 2000 to 12.9% in 2010.\textsuperscript{18} Between 2010 and 2012, however, health aid has plateaued, and future commitments are declining: in the United States, the largest health aid donor, federal discretionary spending cuts mean that overall commitments to international aid are decreasing.\textsuperscript{19}

Understanding this relationship is important at a time when decisions about international aid allocation are facing tightening budget constraints and public discussions about investment priorities increasingly turn on questions of value and impact.\textsuperscript{20} Herein, we approach the issue of health aid effectiveness using broad definitions of health improvements. Our interest is to provide the first-order landscape on the relationship between money and health. While the ultimate causes of health improvements are many and complex, we provide several lines of evidence consistent with a role for health aid in population health improvements.

**Methods**

We report findings from a series of empirical probes into health aid and population health outcomes. Each analysis builds on limitations and new questions raised by the previous findings. The eAppendix in the Supplement contains additional descriptions of data sources, variable definitions, model specifications, and sensitivity analyses.

**Data Sources**

The principal data source for health aid is the Creditor Reporting System (CRS) of the Organisation for Economic Co-operation and Development.\textsuperscript{21–23} Member nations of the Development Assistance Committee, the forum of developed donor nations, report all development assistance grants to the CRS.\textsuperscript{21–23} With information on over 2 million grants and loans between 1973 and 2011, the CRS is the most extensive source of primary information on development assistance. We identified health aid disbursements (actual outlays) deflated to 2010 US dollars by restricting the CRS to those grants with the following keywords in the “purpose name” variable: basic drinking water supply and basic sanitation, basic health care, basic health infrastructure, basic nutrition, basic sanitation, health education, health personnel development, health policy & administration, infectious disease control, malaria control, medical education/training, medical research, medical services, population policy and admin, mgmt, reproductive health care, social mitigation of hiv/aids, std control including hiv/aids, tuberculosis control, and family planning.

The CRS is most complete after 2001. An alternative health aid data set is available from the Institute for Health Metrics and Evaluation. This Development Assistance for Health (DAH) data set complements CRS data with information from United Nations agencies, foundations, and nongovernmental organizations starting in 1990.\textsuperscript{17} The DAH also uses data harmonization and imputation techniques to complete missing data.

We use the CRS in the main analyses because of its methodologic transparency and longer coverage period. We address concerns over data completeness with 2 supplementary analyses: we repeat the analyses using the DAH, and we modify the CRS using information from the DAH and from separate analyses on the pattern of missing data in the CRS (eAppendix SA4.5 and 4.6 in the Supplement).\textsuperscript{7}

We analyze 2 primary health measures: mortality of children younger than 5 years (under-5 mortality) and total life expectancy. Under-5 mortality data, represented as 590 (the probability of death before age 5 per 1000 live births) comes from the United Nations Interagency Group for Child Mortality Estimation (IGME).\textsuperscript{24} and total life expectancy numbers come from the United Nations’ World Population Prospects.\textsuperscript{25} We focus on these measures because of their broad reflection of population health, the extensive efforts to improve their measurement, and their relevance to policy makers.\textsuperscript{25–27} Estimates of both health measures involve demographic transformations of imperfect data, especially for data-poor countries, and we test our findings using alternative data sources (eAppendix SA4.7 in the Supplement).\textsuperscript{28,29}
Probe 1: Association of Health Aid and Health Improvements Between 2000 and 2010

We first conducted a straightforward exploration of the associations between health aid and health improvements during the era of rapid growth in health aid, between 2000 and 2010. Our sample included all countries that received any health aid between 1974 and 2010 and for which estimates of under-5 mortality and life expectancy were complete in our data sources, a total of 140 countries observed over a median of 18 years. We used quartiles of total health aid received between 2000 and 2010 by country to examine the association. (We also examined the association with health aid per capita; see eAppendix SA4.1 in the Supplement.)

Probe 2: Ruling Out Health Aid Targeting

One potential explanation for an association between aid and health improvements is that aid may be directed to countries with poor health and a trajectory of improvement. In this situation, any observed relationship may be unrelated to aid. To explore this possibility, we examined whether health improvement trajectories preceded aid receipt by examining whether the receipt of health aid in the decade from 2000 to 2010 was related to health improvements in the preceding 2 decades.

Probe 3: The Evolving Relationship Between Health Aid and Health Improvements

The previous analyses only study the association of health improvements by aid amounts over time. Other factors such as economic development may enable adoption of more effective health-improving interventions and greater investments in health, either privately or through public-sector investments. Moreover, convergence theory suggests that poorer countries develop faster than (converge towards) wealthier countries, and thus targeting aid to the poorest countries could appear to be associated with differential trends in life expectancy and under-5 mortality.30 In addition, decadal associations may fail to detect underlying trends and nonlinear temporal associations.

To study these issues, we fit the following first-difference model to a country-year panel data set with information on life expectancy, under-5 mortality, and health aid to each country $i$ in year $t$:

$$H_{it} - H_{it-1} = \beta_0 + \beta_1 \text{Aid}_{it} + \beta_2 \text{GDPpc}_{it} + \beta_3 \text{Urban}_{it} + \beta_4 \text{TFR}_{it} + \eta_i + \delta_t + \epsilon_{it}$$

In this model, $H_{it}$ represents our 2 measures of health—life expectancy or under-5 mortality (fit separately); $H_{it-1}$ is a 1-year lag of the health measure; and their difference represents the change in the specified health measure; we included 1 lag after examination of autocorrelation plots suggested the data were stationary with 1 autoregressive component.31 Aid$_{it}$ is the log of the total health aid; GDPpc$_{it}$ is the log of gross domestic product (GDP) of the country per capita; Urban$_{it}$ is the percentage of the population living in urban environments; TFR$_{it}$ is the total fertility rate; $\eta_i$ and $\delta_t$ are country and year fixed effects; and $\epsilon_{it}$ is the error term. The main parameter of interest is the coefficient on the Aid$_{it}$ term. Because Aid$_{it}$ is logged, the coefficient can be interpreted as the change in the health outcome with each 1% increase in health aid. Data for health aid and health outcomes from 1974 to 2011 were used in this analysis.

This modeling approach estimated the relationship between the total amount of aid and changes in health outcomes. The 3 principal covariates represent time-varying measures with direct relevance to human and economic development that were available for the entire study period. Relevant indicators of health system performance such as antenatal care attendance or government health expenditures were available for fewer than half the observations and were not used. Female educational attainment was available through 2009 and used in a sensitivity analysis (eAppendix SA4.8 in the Supplement). We weighted the models by population size and calculated robust standard errors throughout.

Probe 4: The Lasting Effects of Health Aid

The benefits of effective health aid may last for several years. Aid grants are often spent gradually, and additional delayed effects may be due to lags in the provision of health services and the realization of health benefits over time. We examined this phenomenon by running the primary regression model with health aid lags of varying lengths. The model with each lag was fit separately.

Results

Probe 1: Association of Health Aid and Health Improvements Between 2000 and 2010

Over the decade between 2000 and 2010, we observed a consistent pattern of greater improvements in life expectancy and under-5 mortality associated with greater amounts of total or per-capita health aid (Figure 1 and eAppendix SA4.1 in the Supplement). In 2000, mean (SD) life expectancy was 69.8 (4.7) years in the lowest aid quartile countries, and 57.5 (9.5) years in the highest aid quartile countries; over the next decade, life expectancy increased by 2.7 years in the lowest aid quartile group and 4.8 years in the highest aid quartile group. Mean (SD) under-5...
mortality was 31.6 (25.7) per 1000 in the lowest aid quartile countries and 109.2 (53.6) per 1000 in the highest aid quartile countries in 2000; over the next decade, under-5 mortality decreased by 8.4 per 1000 in the lowest aid quartile and 36.8 per 1000 in the highest aid quartile (Table 1). These findings were also apparent when health aid was used as a continuous instead of a categorical variable (eAppendix SA4.2 in the Supplement).

Probe 2: Ruling Out Health Aid Targeting
In Figure 2, we show the health improvement trajectories during the 2 decades preceding the study decade (1980-1990 and 1990-2000) by quartile of aid receipt after 2000. Figure 2 suggests that the positive association between health aid quartile and life expectancy is most apparent for the 2000-2010 period and not apparent in the previous decades. This is supported statistically: nonparametric tests for trend of life expectancy changes across the health aid quartiles based on the Wilcoxon rank-sum test between the 1980-1990, 1990-2000, and 2000-2010 periods (separate model for each decade) favors a trend during the 2000-2010 decade ($P < .001$) and fails to support a trend during the previous periods ($P = .63$ for 1980-1990, and $P = .90$ for 1990-2000).

The findings for under-5 mortality show that receipt of aid between 2000 and 2010 was associated with declines between 2000 and 2010 ($P < .001$). The trends between 1990 and 2000 were not statistically significant ($P = .8$) and displayed only a weak association with health aid quartile (Figure 2B); trends between 1980 and 1990 showed no association at all ($P = .51$).

Probe 3: The Evolving Relationship Between Health Aid and Health Improvements
Our estimates suggest that, over the period from 1974 to 2011, each 1% increase in health aid was associated with 0.24 months greater increase in life expectancy ($P = .03$) and 0.14 faster decline in the probability of under-5 deaths per 1000 live births ($P = .02$). Neither urbanization, total fertility rate, nor GDP per capita were significantly associated with improvements in life expectancy or under-5 mortality. It is important to note that the relationship of health improvements with within-country changes in these covariates is not well characterized and differs conceptually from the large cross-sectional differences in health by GDP per capita or fertility rates. For example, some evidence suggests that within-country health improvements may occur more rapidly during times of poor economic growth.32

The rise of health aid has been most dramatic since 2000. We examined the extent to which health aid during the decade between 2000 and 2010 was associated with unique improvements in life expectancy and under-5 mortality by fitting models similar to the model specified herein in which the main coefficients of interest were on interaction terms between decade dummies and the log health aid variable. We noted an increasingly strong association over the 4 decades such that each 1% increase in health aid was associated with 0.76 (95% CI, 0.21-1.31) fewer under-5 deaths per 1000 live births between 2000 and 2010 ($P = .01$) but only 0.27 (95% CI, −0.17 to 0.70) fewer deaths between 1980 and 1989 ($P = .22$) (Table 2).

### Table 1. Summary Statistics by International Health Aid Quartile and Yeara

<table>
<thead>
<tr>
<th>Measure</th>
<th>1990</th>
<th>2000</th>
<th>2010</th>
<th>Total</th>
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<tbody>
<tr>
<td>Life expectancy, y</td>
<td>1 67.5 (5.4)</td>
<td>69.8 (4.7)</td>
<td>72.5 (4.5)</td>
<td>69.9 (5.3)</td>
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<tr>
<td></td>
<td>2 63.1 (8.0)</td>
<td>65.0 (9.0)</td>
<td>67.8 (8.8)</td>
<td>65.3 (8.8)</td>
</tr>
<tr>
<td></td>
<td>3 59 (10.0)</td>
<td>60.9 (10.1)</td>
<td>63.9 (9.6)</td>
<td>61.3 (10.0)</td>
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<tr>
<td></td>
<td>4 55.7 (8.8)</td>
<td>57.5 (9.5)</td>
<td>62.3 (8.0)</td>
<td>58.5 (9.1)</td>
</tr>
<tr>
<td>Under-5 mortality, deaths per 1000</td>
<td>1 43.6 (33.4)</td>
<td>31.6 (25.7)</td>
<td>23.2 (19.7)</td>
<td>32.8 (27.9)</td>
</tr>
<tr>
<td></td>
<td>2 75.4 (54.4)</td>
<td>60.4 (48.4)</td>
<td>43.9 (39.1)</td>
<td>59.9 (49.0)</td>
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<tr>
<td></td>
<td>3 115.1 (78.1)</td>
<td>92.2 (65.3)</td>
<td>64.3 (51.0)</td>
<td>90.5 (68.4)</td>
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<tr>
<td></td>
<td>4 132.5 (59.7)</td>
<td>109.2 (53.6)</td>
<td>72.4 (40.3)</td>
<td>104.7 (57.0)</td>
</tr>
<tr>
<td>GDP per capita, 2010 US dollars</td>
<td>1 4806 (3712)</td>
<td>5831 (4301)</td>
<td>6925 (5014)</td>
<td>5875 (4427)</td>
</tr>
<tr>
<td></td>
<td>2 1947 (1324)</td>
<td>2098 (1717)</td>
<td>3113 (2919)</td>
<td>2380 (2134)</td>
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<td></td>
<td>3 1494 (1393)</td>
<td>1566 (1653)</td>
<td>2055 (1963)</td>
<td>1707 (1690)</td>
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<tr>
<td></td>
<td>4 689 (876)</td>
<td>808 (862)</td>
<td>1020 (1126)</td>
<td>845 (966)</td>
</tr>
<tr>
<td>Total fertility rate, births per woman</td>
<td>1 4.0 (1.5)</td>
<td>3.0 (1.1)</td>
<td>2.6 (0.9)</td>
<td>3.2 (1.3)</td>
</tr>
<tr>
<td></td>
<td>2 4.1 (1.6)</td>
<td>3.4 (1.6)</td>
<td>3.1 (1.4)</td>
<td>3.5 (1.6)</td>
</tr>
<tr>
<td></td>
<td>3 5.1 (1.8)</td>
<td>4.3 (1.9)</td>
<td>3.7 (1.7)</td>
<td>4.4 (1.9)</td>
</tr>
<tr>
<td></td>
<td>4 5.6 (1.3)</td>
<td>4.8 (1.6)</td>
<td>4.1 (1.5)</td>
<td>4.9 (1.6)</td>
</tr>
<tr>
<td>Urban, %</td>
<td>1 48.4 (21.0)</td>
<td>52.1 (21.8)</td>
<td>55 (22.8)</td>
<td>51.8 (21.9)</td>
</tr>
<tr>
<td></td>
<td>2 48.4 (18.7)</td>
<td>50.8 (19.1)</td>
<td>53.9 (19.3)</td>
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<tr>
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<td>42.1 (19.2)</td>
<td>46.1 (19.6)</td>
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<td></td>
<td>4 30 (17.1)</td>
<td>33.6 (16.7)</td>
<td>37.7 (17.1)</td>
<td>33.8 (17.1)</td>
</tr>
</tbody>
</table>

Abbreviations: GDP, gross domestic product; under-5 mortality, mortality rate of children younger than 5 years.

aData are reported as mean (SD) values.

All measures are ranked by international health aid quartiles, ranked from 1 (lowest aid quartile) to 4 (highest aid quartile).
This information can be used to estimate the number of under-5 deaths that could be averted in association with an additional $1 billion in health aid, approximately a 4% increase over current levels. About 120 million births took place in the study countries in 2011. A 4% increase in health aid, then, would be associated with a decline of $0.76 \times 4 = 3.04$ deaths per 1000 live births (95% CI, 0.82-5.25), or 364,800 fewer under-5 deaths (95% CI, 98,400-630,000).

Finally, to examine the temporality of the association, we performed a Granger causality test. This test helps determine the time directionality of an association between 2 variables. The results of this test suggest that the temporal pattern we found favors a path from health aid to health improvements rather than vice versa (eAppendix SA4.3 in the Supplement).

**Probe 4: The Lasting Effects of Health Aid**

Figure 3 shows the lasting association between health aid and health improvements. The association of health aid with both life expectancy and under-5 mortality fades gradually. Figure 3 suggests that in our data, health aid remains significantly associated with under-5 mortality reductions for up to 3 years and with overall life expectancy increases for up to 5 years.

**Discussion**

This exploration of the relationship between health aid and health improvements provides consistent evidence supporting the position that health aid has played a role in the extension of life expectancy and the reduction of under-5 mortality, especially since 2000. For practitioners of global health programs supported by health aid, this outcome may confirm the links between the observed health improvements and the large expansion of activities over the past decade. For development and policy analysts, these findings could provide evidence supporting aid effectiveness in the health sector.

While this analysis only provides suggestive associations, the potential drivers of this relationship are worth noting. Health aid directed for HIV increased by over $6 billion dollars between 2000 and 2010, more than twice the increase to any other health sector. The population-level mortality decline associated with health aid for HIV and the provision of antiretroviral therapy have been previously demonstrated. In comparison, aid targeted for malaria and maternal, newborn, and child health had started increasing prior to 2000, potentially explaining the observed association between aid and under-5 mortality in the 1990s as well as after 2000.

We also observe that the link between health aid and health improvements was strongest between 2000 and 2010. Increasing returns to aid would be expected if each dollar spent were associated with greater health benefits. Two dynamics may help explain increasing returns to health aid: improved targeting and improved health technologies. Targeting could have been improved through better geographical allocation enabled by more accurate data about the distribution of disease. It could also have been achieved through improved disease targeting. While many studies have highlighted the mismatches between disease-specific aid and overall disease burden, our findings suggest that aid was spent more efficiently between 2000 and 2010 than in the 1990s. In that sense, the disease-specific funding structures that dominated the 2000s may have been more efficient at reducing mortality than previous approaches to health aid allocation.

In addition, improved health interventions enabled each dollar invested to translate into greater health improvements. Antiretroviral therapy, insecticide-treated bed nets, and the expansion of directly observed treatment short course for tuberculosis have been mainstays of aid-financed interventions over the past 20 years. Health aid for malaria, for example, has been shown to be associated with expanded use of insecticide-treated bed nets and credited with reductions in under-5 mortality. In this sense, aid has been an important driver of health improvements, the data and methodological limitations of this analysis deserve additional consideration. The life expectancy and under-5 mortality estimates come from trusted sources, but the underlying data quality used for generating these estimates is limited in comparison with mortality data available in more developed countries. Most low- and middle-income countries lack vital and health registration systems, and

[Diagram: Figure 2. Association Between Quartile of Total Health Aid and Changes in Life Expectancy and Mortality Rate for Children Younger Than 5 Years (Under-5 Mortality) by Decade Between 1980 and 2010]

The quartiles are calculated from the total health aid between 2000 and 2010 (1 is the lowest health aid quartile; 4 is the highest). A, Life expectancy. B, Under-5 mortality. A positive association with improving life expectancy and declining under-5 mortality is most apparent between 2000 and 2010, suggesting that preexisting trends in the association between health aid and health improvements do not explain the association in the 2000s.
An important issue is the possibility that health aid and health in the recipient countries have changed contemporaneously but not causally. That is, other causal factors could explain the observed health improvements. We attempted to address this possibility by controlling for common time trends and for time-varying covariates that capture broad concurrent trends such as economic development and declining fertility, and none of these meaningfully modified the independent effect of health aid. Alternatively, a bidirectional relationship where health aid is allocated at least partly in response to health needs may bias the main estimator. The direction of the bias is unclear, but if donors prioritize countries with poor health, this analysis may underestimate the true effect size. Finally, the choice of first-difference models and Granger directionality tests aim to relax this concern.

The evidence we present is correlational but consistent: health aid is closely linked to improvements in life expectancy and under-5 mortality; the relationship has strengthened since 2000; and health aid investments are associated with health improvements that are measurable for 3 to 5 years. These findings have implications for the overall allocation of international aid as well as for health aid prioritization. To the extent that health improvements have implications for economic development, investing in health could have important returns for donors as well.40

Each point graph point represents the coefficient (error bars, 95% confidence intervals) of aid on from a regression of the change in life expectancy or mortality rate for children younger than 5 years (under-5 mortality) on lagged health aid. The x-axis indicates the lag. The graph shows a gradual decline in the relationship of aid with both outcomes, suggesting a lasting relationship between health aid and health improvements.

This study’s outcomes often rely on household surveys and sophisticated demographic approaches. To the extent that alternative demographic approaches account for different shortcomings of the underlying data, this study’s findings are stable to alternative sources of health outcome estimates.

Table 2. Relationship of Health Aid on Life Expectancy and Mortality Rate for Children Younger Than 5 Years (Under-5 Mortality)*

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Change in Life Expectancy, mo</th>
<th>Change in Under-5 Mortality, 5q0</th>
<th>Decade Interactions*</th>
</tr>
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<tr>
<td>Health aid (log $US)</td>
<td>0.24 (.03)</td>
<td>-0.14 (.02)</td>
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</tr>
<tr>
<td>Period effect 1980-1989</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td>Period effect 1990-2000</td>
<td>NA</td>
<td>-0.14 (.03)</td>
<td>1.57 (.11)</td>
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<td>Period effect 2000-2010</td>
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<td>NA</td>
<td>1.75 (.14)</td>
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<td>Health aid prior to 1980</td>
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<td>NA</td>
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<td>0.34 (.11)</td>
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<td>Health aid 1990-1999</td>
<td>NA</td>
<td>0.52 (.17)</td>
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<td>1.12 (0)</td>
<td>-0.63 (.02)</td>
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<td>GDP per capita (log $US)</td>
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<td>0.16 (.77)</td>
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<td>Urban, %</td>
<td>-0.09 (.18)</td>
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<td>Total fertility rate, births per woman</td>
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<td>Year fixed effects</td>
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<td>Yes</td>
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</table>

Abbreviations: NA, not applicable; 5q0, probability of death before age 5 years per 1000 live births.

* Unless otherwise indicated, data are reported as coefficient from regression analysis (P value around the coefficient).

** The analysis with decade interactions tests the extent to which the association between health aid and health outcomes changed over the decades from the 1970s to the 2000s. The regression used to estimate this relationship can be represented as follows: HEit = β0 + β1Decadeit + β2Organizationit + β3Healthaidit + β4Totalaidit + β5Periodeffectit + β6Endingperiodit + εit. The abbreviations used in the equation are explained in the Methods section. In this specification, each decade is coded as a binary dummy variable. The main effects on the Decade dummies represent the changes in the outcome in the decade relative to the base period in the 1970s in the absence of any health aid. Thus, life expectancy increased more in the 1980s than in the 1970s but less in the 1990s and 2000s than in the 1970s. Similarly, under-5 mortality declined less in each subsequent decade than in the 1970s. The coefficients on the decade-aid interactions indicate the health improvements associated with a 1% increase in health aid during the decade. The main effect on the “Aid” variable (β3) represents the effect of aid prior to 1980. This analysis suggests that health aid was associated with life expectancy losses during the 1970s but has been associated with life expectancy gains and under-5 mortality improvements in the 1990s and 2000s. These improvements have been greatest in the 2000s such that each 1% increase in health aid has been associated with greater life expectancy gains and under-5 mortality declines in the 2000s than in prior decades.
Accepted for Publication: December 28, 2013.

Author Contributions: Dr Bendavid had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: Bendavid, Bhattacharya.

Analysis and interpretation of data: Bendavid, Bhattacharya.

Drafting of the manuscript: Bendavid.

Critical revision of the manuscript for important intellectual content: Bendavid, Bhattacharya.

Statistical analysis: Bendavid, Bhattacharya.

Conflict of Interest Disclosures: None reported.

Funding/Support: This research was supported by the George Rosenkranz Fellowship for Health Policy Research in Developing Countries and by National Institutes of Health grant K01AI084582.

Role of the Sponsors: The funding organizations had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; and preparation, review, or approval of the manuscript; or the decision to submit the manuscript for publication.

Additional Information: The analytic code for all the investigations reported in this article is available from the authors on request.

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