



JOURNAL OF CRITICAL THOUGHT AND PRAXIS

IOWA STATE UNIVERSITY DIGITAL PRESS & SCHOOL OF EDUCATION

Volume 7

Issue 2 *Engaging in the Struggle: Health Justice*

Article 2

Accessibility and Health: An International Analysis of Government Expenditure, Socioeconomic Development and Infant Mortality

Isaac Zvi Christiansen & Robert Mazur

Follow this and additional works at: <http://lib.dr.iastate.edu/jctp/vol7/iss2/>



This article is distributed under a Creative Commons Attribution-NonCommercial 4.0 International License (CC-BY-NC). Users may reproduce, disseminate, display, or adapt this article for non-commercial purposes, provided the author is properly cited. See <https://creativecommons.org/licenses/by-nc/4.0/>.

The Journal of Critical Thought and Praxis is published by the Iowa State University School of Education and Iowa State University Digital Press. View the journal at <http://lib.dr.iastate.edu/jctp/>.

Accessibility and Health: An International Analysis of Government Expenditure, Socioeconomic Development and Infant Mortality

Isaac Zvi Christiansen*
Robert Mazur
Midwestern State University

This research examines the relationship between government's share of health expenditures and infant mortality (IMR). Public healthcare funding is a critical component of ensuring access to care for the poor. Financial barriers may lead to postponement of care, thereby exacerbating health outcomes. We find a moderate association between the government's share of health expenditures and IMR and strong support for a multifaceted approach to accessibility that includes doctor density, vaccination coverage, improved water and sanitation, and female literacy in reducing IMR. Findings suggest that the effect of government's share of health spending on IMR is stronger in poorer nations.

Keywords: Public Health Spending | Infant Mortality | Healthcare Access | Accessibility

This research examines the relationship between the government's share of health expenditure and infant mortality rates that lies at the heart of the debate over healthcare financing. The significance of this relationship is often overlooked by studies that have examined the relationship between aggregate public healthcare spending and health outcomes (Filmer and Pritchett, 1999; Houweling et al., 2005; McGuire, 2010; Schell et al., 2007). This debate centers on whether or not healthcare financing should be the responsibility of individuals to purchase health insurance coverage from profit-driven firms and treated as a commodity or whether it should be the responsibility of the state and treated as a right. While government expenditure on health as a percentage of total expenditure on health (GEHPTEH) may not capture all elements of a rights-based approach to healthcare financing, it is a pragmatic quantitative measure available to use in a cross-national analysis.

We also examine other central aspects of accessibility including the population's access to improved water and sanitation, vaccination coverage, and the number of physicians per 1000 people. Like McGuire (2010), our research contrasts with a narrow 'wealthier is healthier' hypothesis. We suggest a multidimensional approach to accessibility as a strategy to reduce infant mortality and promote population wellbeing.

Despite significant progress globally, high infant mortality rate (IMR) and child mortality rates (CMR) remain significant problems in many developing nations. Disparity

*Correspondence can be directed to Isaac Christiansen at
isaac.christiansen@msutexas.edu

in life chances is observed when comparing infant and child mortality in the Americas (13 and 16 per 1000 live births) in 2011 Africa (63 and 97), and the Eastern Mediterranean (45 and 59).¹

Researchers have documented relationships between various socio-economic and public health variables and the IMR, including education (e.g., Rajan, Kennedy, & King, 2013; Song & Burgard, 2011), poverty (e.g., Houweling, Kunst, Looman, & Mackenbach, 2013; Rajan et al., 2013), social class (Antonovsky & Bernstein, 1977), neoliberal policies and population health (Coburn, 2009; Laurell 2015; Palma-Solís et al., 2009), vaccination rates (Breiman et al., 2004; Sadoh & Oladokun, 2012), and aspects of clean water and sanitation (McGuire, 2010). Since many of these variables vary among countries depending on income and resources, the relationship between income and IMR has a prominent place in the literature. In this regard, there is ample empirical support for the hypothesis that per capita income is inversely causally related to infant mortality (Arik & Arik, 2009; Filmer & Pritchett, 1999; Pritchett & Summers, 1996; Schell et al., 2007; Wilkinson, 1992). The importance of income has led to research examining the impact of inequality in general on IMR (e.g., Avendano, 2012; Hosseinpoor et al., 2005; Kim & Saada, 2013; Wilkinson & Pickett, 2006).

Relationships among income, within-country inequality, and IMR highlight the need for research on policies likely to reduce IMR among poorer populations. Focusing on inequality and measures that may protect impoverished populations, Avendano (2012) reasoned that,

strong social protection policies such as universal access to care and favorable maternity leave benefits may reduce infant mortality directly and may at the same time cluster in countries with strong redistribution policies, without necessarily having an impact through reducing income inequality. (p.759)

Thus, social spending that increases access to care may serve as a countervailing force protecting poorer populations by buffering the impact of inequality on the IMR.

Still other studies have examined the relationship between neoliberal policies and population health (Laurell, 2015; Palma-Solís et al., 2009). For example, while Wilkinson and Pickett (1992, 2006) argue that higher income inequality leads to worse population healthcare outcomes through reducing social cohesion, Coburn (2009) argues that both increased inequality and the decline in social cohesion are caused by neoliberal policies. Shandra et al. (2004) analyzed the impact of commodity concentration, multinational penetration, and International Monetary Fund conditionality on the IMR and found more harmful impacts on IMR at lower levels of political democracy.

Insufficient human resources for health and prohibitive costs of healthcare services may constitute barriers to poor populations that ultimately affect the IMR. Governments may potentially mitigate the effect by increasing public health expenditure and by encouraging health professionals to practice in underserved areas. While some research has focused on or included human resources for health (Anand & Bärnighausen, 2004; Arik & Arik, 2009) and aspects of health financing (Filmer & Pritchett, 1999; Houweling et al., 2013; Mays and Smith 2011) into their models, few (e.g., Çevik & Taşar, 2013; Kuhn,

¹These 2011 regional estimates of infant and child mortality are from the WHO Global Health Observatory Data Repository accessed on 10/31/2014. The national figures are from the WHO data gathered on 11/2013.

2010) have accounted for the relationship between the public/private split in healthcare spending and IMR. Our research seeks to fill these gaps by examining the relationship of physician density and the government's share of total health expenditure to IMR across countries.

Regarding the relationship between public health spending and the IMR, the results have varied. Mays and Smith (2011) found a robust inverse relationship in a time series multivariate analysis of U.S. city and county data. Conversely, Schell et al. (2007) observed that public spending on health was ultimately insignificant when examining IMR as a function of inequality, GNP per capita, public health expenditure, and female literacy. Like Filmer and Pritchett (1999), these researchers found that once gross domestic product (GDP) per capita and female illiteracy rate were included public spending on health was not significant. McGuire (2010) also did not find a significant association between government health spending as a percentage of GDP and the IMR while controlling for an array of other variables.

Schell and colleagues (2007) concluded that increased public health spending alone is not sufficient and needs to be coupled with effective strategies to better use healthcare dollars and to address other factors such as female illiteracy, income levels, and inequality. Farag (2010) used fixed-effect regression models and found that both total spending on health as a share of GDP and government health spending as a percentage of GDP (in separate models) had statistically significant impacts towards reducing IMR on data from 131 and 133 countries. In another key study, Houweling et al. (2005) showed that although the level of public spending on health was an insignificant predictor of IMR across income levels when controlling for income, literacy and region; they did find that public spending on health reduced infant mortality more dramatically among poorer population quintiles than among wealthy ones.

Of all the research reviewed, only Çevik and Taşar (2013) examined the relationship between GEHPTEH and IMR. Their multivariate regression of 131 countries controlled for a 'law and order' ordinal variable, GDP per capita, total health expenditure as a percentage of GDP, percentage of population under age 14, and a dummy variable for region. They found a robust inverse relationship between GEHPTEH and both IMR and CMR.

Nevertheless, right wing think tanks such as the Heritage Foundation and the Galen Institute argue that publicly provided and financed care is ultimately harmful to patients. Focusing on healthcare within the U.S., Book (2009), argues that public financing limits access to care by providing less pay for physicians, creating a disincentive to pursue a career in medicine. Similarly, Das et al. (2015) found that unqualified private care providers provided greater effort and misdiagnosed at a lower level than public service providers. They found that per patient cost was higher in the public sector, implying that public health spending is an inefficient use of resources. In this context, our research examining the impact of government's share of healthcare spending on IMR is especially pertinent.

Underlying Theory and Research Design

The aforementioned studies examined the contribution of the level of government spending on health to IMR variation. However, with the exception of Çevik and Taşar (2013), all

utilized measures of public spending on health *irrespective of its proportion to the society's total spending on health* and did not capture the impact of the degree of socialization of health financing on infant mortality. This overlooks a central function of public healthcare spending, since a greater portion of the total health care bill covered by the government lowers the portion of total costs incurred by individuals and families as private insurance or out-of-pocket expenditure.

Hence, while their indicator of public spending may measure government commitment to healthcare and money poured into the health sector, it does not reflect the degree to which government spending reduces financial barriers to healthcare, given that private expenditure represents these barriers. If costs of accessing care are prohibitive, financial barriers could lead to adverse health effects, particularly among the most vulnerable. Furthermore, countries that have universalized care, such as Cuba, Denmark and Norway, all have very high GEHPTEH.

The government's share of total health spending, GEHPTEH, provides a measure of how 'socialized' a country's total healthcare financing is. It also reflects how much governments reduce financial barriers to care. This is evidenced by GEHPTEH's strong inverse correlation (-0.87) to out-of-pocket health expenditure. GEHPTEH's numerator measures the total amount of government expenditure on health of pooled government funds and includes those budgeted for health services, "expenditure on health by parastatals, extra-budgetary entities and notably compulsory health insurance payments" (WHO, 2011). The denominator is the total of government and private health expenditures. Thus, GEHPTEH provides us with a quantitative approximation of the degree to which healthcare is treated as a right in a particular country.

Our model for examining the impact of public health spending on IMR is distinct from the aforementioned studies. This research focuses on multiple aspects of accessibility: GEHPTEH, physician density, access to improved water and sanitation and implementation of preventative care reflected by polio vaccination coverage. If medical personnel are too few in a country relative to the population, or are concentrated solely in wealthy, urban areas within the private sector, that may create barriers to needed care particularly for poorer and remote populations. The overarching hypothesis that accessibility of health services and public health infrastructure is inversely related to infant mortality is consistent with McGuire's 2010 finding that greater utilization of social services (including access to improved water supplies, percentage of births attended by trained personnel, and immunizations) is inversely associated with IMR. Following McGuire (2010), we contrast these models, the 'wealthier is healthier' model that includes income inequality in addition to GNI per capita.

In contrast to Çevik and Taşar (2013), we control for physician density, vaccination rates and access to potable water, and introduce an interactive model. We expect that financial barriers emanating from low GEHPTEH (and thus higher insurance or out-of-pocket costs) would lead people to postpone or abandon care, leading to worse healthcare outcomes reflected in higher IMR. Our first hypothesis (H_1) is that GEHPTEH is inversely associated with IMR. Reflecting the importance of human resources for health (WHO 2006), we expect that physician density will be significantly and robustly inversely associated with IMR, since the presence of physicians is a key aspect of making healthcare available to the population (H_2 .) We also expect that the impact of GEHPTEH will be more pronounced in poorer nations, since with greater poverty fewer people will be able to

afford insurance or out-of-pocket costs, and thus interacts with GNI per capita (H₃). We hope that this research will provide a scientific contribution to understanding the importance of the government's role in the reduction of financial and human resource barriers to healthcare.

Methods

We used additive and interactive multivariate linear regression models to measure the impact of the explanatory variables on IMR, as in similar studies (Rajan et al., 2013; Schell et al., 2007; Filmer & Pritchett, 1999). Multivariate regression provides a way of examining the direct effect of a predictor variable while controlling for other predictors (Cohen et al., 2003).

Data Sources

All data for 185 countries are from the World Health Organization Global Health Observatory Data Repository except gross national income (GNI) per capita, GINI coefficients, and female literacy rate² that came primarily from the World Bank. GNI (with few exceptions) and GEHPTEH are from 2011. Since countries do not report GINI and physician density every year, the years for which GINIs and physician density are available vary, thus these data are for the most recent year available for each country at the time data was gathered.

GINI values not available from the World Bank were gathered from the Global Peace Index, CIA, United Nations Development Program, and the Organization for Economic Cooperation and Development. Most of the GINI data are from between 2008 and 2013. While six values (Algeria, Bahamas, Guyana, Papua New Guinea, Suriname and Trinidad and Tobago) are before 2000, these were preferred to imputing the data. Eight missing GINI values were imputed using expected maximization in SPSS. This process of imputing missing GINI values was used in McGuire (2010) where a higher ratio (25 out of 105) of cases were imputed. Furthermore, as McGuire (2010) notes in his discussion of the implications of his models, GINI data fluctuates very little from year to year. Data for IMR, access to improved water sources and percent of children under age one who received the polio vaccine are from 2012.

Female literacy data are largely from the World Bank. Values for countries not reported by the World Bank were gathered from the CIA (reported in Index Mundi), with Algeria's value coming from UNICEF. Data are for the most recent year available (at the time of the research) with the vast majority of values from 2010, 2011 and 2012. Most of the older values are for OECD countries, which have achieved 99% or 100% female literacy rates. The only other values prior to 2005 are Belize (2000), Micronesia (1980), Fiji (2003), Djibouti, (2003), and Dominica (2003). Seven missing values were imputed using expected maximization on SPSS.

² We accessed female literacy data largely from the World Bank, however it ultimately comes from UNESCO. Data on the GINI coefficient came from the World Bank's World Income Inequality Database. For additional information on the studies data please contact the author.

Table 1
Descriptive Statistics

Variable	Min.	Max.	Mean	Standard Deviation
GEHPTEH	15.90	99.90	59.27	19.53
DocDen	0.01	6.72	1.56	1.44
GNIpc (in 1000s)	0.58	122.30	16.24	18.38
GINI	24.40	66.00	39.98	9.56
PolioVac	30.00	99.00	89.70	11.35
TEHPGDP	1.65	19.48	6.99	3.11
ImprWat	40.00	100.00	88.16	14.96
FemLit	8.90	100.00	80.96	22.85
ImprSan	9.00	100.00	72.51	29.50
IMR	1.70	117.40	26.12	24.39

Note. N=185. GEHPTEH = Governmental expenditure as a percentage of total expenditure on health; DocDen = doctor density per 1000 of population; GNIpc = Gross National Income per capita; GINI = GINI coefficient; PolioVac = percentage of children under one year that received the polio vaccine; TEHPGDP = Total Expenditure on Health as a Percentage of Gross Domestic Product; ImprWat = percentage of population with access to improved water sources; FemLit = Female literacy Rate; ImprSan = percentage of population with access to improved sanitation; IMR = Infant Mortality Rate.

Physician Density data (gathered from the World Health Organization) is also for the most recent year available. The vast majority of cases (74%) are between 2008 and 2012. There is one case from 1998 (Haiti), three from 2000, five from 2001, two from 2002 and two from 2003. Data for four missing countries (Bosnia and Herzegovina, Iraq, Serbia and Macedonia) for doctor density came from the World Bank. The few countries (Greece and Slovakia) for which no information on doctor density could be gathered were excluded from the sample.

Variables

Table 1 provides descriptive statistics for the 185 countries included in this study. The dependent variable, IMR, is the number of infants born that die before reaching one year of age per 1000 live births. The high standard deviation indicates that the chances of a child surviving to his/her first birthday fluctuate considerably based upon where he or she is born. Infant mortality ranges from 1.7 in Luxembourg to 117.4 in Sierra Leone.

GEHPTEH, as previously mentioned, reflects the government's share of total health expenditures. Total expenditure on health as a percentage of GDP (TEHPGDP) is the WHO estimate of the sum of all public and private expenditures as a percentage of purchasing power parity GDP (WHO 2011a). This provides a measure of how much society as a whole spends on healthcare.

Physician density is the number of physicians per 1000 people. This provides a simple, albeit imperfect, measure of human resources for health, an important dimension of healthcare accessibility. We included the percentage of adult women age 15 and older who are literate (FemLit). The United Nations Educational Scientific and Cultural Organization (UNESCO) define literacy as the ability to read and write a short statement regarding one's life.

The inverse relationship between access to safe drinking water and IMR is well documented (McGuire, 2010). The WHO (2011b) classifies “piped water into dwelling, plot or yard, public tap/stand pipe, tube well/borehole, protected dug well, protected spring and rainwater collection” as improved water sources. Countries ranged from 40% of the population with access to improved drinking water sources (ImprWat) in Papua New Guinea to 100% in much of Europe, Japan, the US, and the UAE. The percentage of the population using improved sanitation (ImprSan) facilities (pit latrines with slabs, composting toilets and flushed or pour flush toilets that connect to a sewer system) was included due to its recognized relationship to infant mortality and role in the great mortality decline (McGuire, 2012; Leys, 2009).

GNI per capita (PPP) provides a standardized measure of purchasing power between countries (World Bank, 2015). It ranged from \$600 in Central African Republic to \$122,030 in Qatar. In spite of GNI's kurtosis and skewness (6.86 and 2.23 in the global sample, respectively), we decided to not log the variable because logging implies unrealistic jumps in GNI. Country GINI coefficients were also included as a summary measure of income inequality (0 represents absolute equality and 100 represents absolute inequality).

The percentage of children under age one vaccinated for polio provides a good measure of overall vaccination coverage. It correlates in our sample with the percentage of children under one year of age who receive the diphtheria, pertussis and tetanus 3-dose (DTP3) vaccine at 0.97. Polio vaccine coverage was chosen over DTP3 largely because it exhibited less kurtosis (5.30) and skewness (-2.04) than DTP3 (9.18 and -2.63, respectively). The percentage of polio vaccination coverage ran from 30% in Equatorial Guinea to 99% in 30 countries.

Analysis and Procedures

SPSS was used for all statistical analysis. First, we examined simple regressions between each independent variable and IMR. Next, we conducted a bivariate analysis to examine relations among predictors. No variable was included in any model where there was a 0.7 correlation or higher with another predictor. We present ordinary least squares (OLS) regression models for 185 countries (including OECD and wealthy countries) and for 145 countries (without most OECD and wealthy countries). The results of 12 models are shown in Table 2.

To prepare the interaction model, centered GNI per capita and GEHPTEH were multiplied to create the centered cross product. $\hat{IMR} = \beta_0 + \beta_1 GEHPTEH + \beta_2 LogGNIpcap + \beta_3 XPGNIGE H$ was the interactive model used to test H₃. Table 3 provides the relevant results; we interpret the coefficients at low, middle and high levels of GNI.

Results

Using multivariate regression, we examined the specific contribution of each public health and socioeconomic variable on variation in IMR. Similar results were obtained (not shown) using the under-five mortality rate in all tests. In this section we provide the correlation coefficients of each explanatory variable regressed on IMR for global and lower-income country regressions, bivariate correlations among predictors, additive regression models, test for interaction between GEHPTEH and GNI per capita, and provide regression coefficients for countries with GNI per capita below \$40,000.

Examining the correlations with IMR, the largest effect is access to improved sanitation (-0.82), followed closely by adult female literacy (-0.80), access to improved water sources (-0.78), physician density (-0.67), polio vaccination (-0.58), GNI per capita (-.55), GEHPTEH (-0.45), GINI (0.39), and TEHPGDP (-0.13). Similar results are observed when wealthy countries are dropped. Since TEHPGDP was not significantly correlated with IMR in either data set, it was dropped. The strong inverse correlations that GNI, improved sanitation, access to improved water, and female literacy all have with IMR reflect well-documented relationships (Arik & Arik, 2009; Filmer & Pritchett, 1999; McGuire, 2010; Schell et al., 2007).

A simple regression model using GEHPTEH to predict IMR suggests a 5.7 reduction for every 10-unit increase in GEHPTEH above its mean. However, this model explains a small portion ($R^2 = 0.21$) of IMR. A one-unit increase in physician density, by comparison, suggests an 11.3 reduction in IMR with an R^2 of 0.44 in a simple regression. The relatively low R^2 for GEHPTEH is unsurprising given that IMR is a function of multiple proximate and distal factors.

Relations Among Predictors

We observed strong correlations between GNI and physician density ($r = 0.55$), GINI and physician density ($r = -0.52$), female literacy and physician density ($r = 0.65$), and GNI and improved sanitation ($r = 0.58$) in the 185-country sample. It is likely that the large correlation between female literacy and physician density reflect greater societal investment in education that in turn would affect both variables. Correlations among predictors are similar among the low-mid income countries; notable differences include larger correlations between GNI per capita and improved sanitation ($r = 0.66$). Countries with improved sanitation tend to have higher physician density ($r = 0.70$) as well as a greater share of the population with access to improved water sources ($r = 0.76$). Countries with widespread access to improved sanitation or access to improved water sources have higher female literacy rates ($r = 0.83$ and $r = 0.71$, respectively). Here what is likely reflected is that countries that tend to invest in training physicians also realize the importance of providing water and sanitation infrastructure, given sufficient resources to make such improvements feasible, reflecting the correlations with GNI per capita. These strong interrelations indicate that many variables are likely important determinants of each other, influencing infant mortality both directly and indirectly.

Table 2a
Global Centered Predictor Additive Regression Models with IMR as Dependent Variable

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	26.12 (1.16)**	26.12 (0.95)**	26.12 (1.40)**	26.05 (0.93)**	26.12 (0.92)**	26.12 (0.95)**
GEHPTEH	-0.16 (0.05)** [-0.13]	-0.11 (0.06)^ [-0.09]	-0.33 (0.08)** [-0.27]	-0.13 (0.05)* [-0.11]	-0.07 (0.05) [-0.05]	-0.13 (0.06)* [-0.11]
Doc. Density	-4.61 (0.84)** [-0.27]	-3.60 (0.88)** [-0.21]			-1.68 (1.01)^ [-0.10]	-3.81 (0.96)** [-0.23]
GNIPC			-0.50 (0.09)** [-0.38]	-0.10 (0.07) [0.07]	-0.19 (0.06)** [-0.14]	-0.16 (0.07)* [-0.12]
GINI			0.49 (0.16)** [0.19]	0.11 (0.11) [0.04]	0.23 (0.12)^ [0.09]	0.18 (0.12) [-0.07]
Fem Lit		-0.56 (0.06)** [-0.53]			-0.58 (0.06)** (-0.54)	
Polio vac.	-0.35 (0.10)** [0.17]	-0.45 (0.10)** [-0.21]		-0.44 (0.10)** [0.20]	-0.40 (0.10)** [0.18]	-0.35 (0.10)** [-0.17]
ImprWat	-0.80 (.09)** [-0.49]					-0.76 (0.09)** [-0.47]
ImprSan				-0.52 (0.04)** [-0.63]		
R ²	0.718	0.725	0.404	0.740	0.745	0.727
DF	4	4	3	5	6	6

Note. N = 185. Unstandardized coefficients with standard error in parenthesis. Standardized coefficients reported in brackets.
^P < .10 *P < .05 ** P < .01

Table 2b
Low-Mid Income Country Centered Predictor Additive Regression Models with IMR as Dependent Variable

	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Intercept	32.10 (1.21)**	32.10 (1.09)**	32.10 (1.15)**	32.10 (1.16)**	32.10 (1.15)**	32.10 (1.17)**
GEHPTEH	-0.17 (0.07)* [-0.13]	-0.08 (0.07) [-0.07]	-0.30 (0.08)** [-0.24]	-0.14 (0.06)* [-0.11]	-0.08 (0.06) [-0.06]	-0.15 (0.06)* [-0.12]
Doc. Density	-4.89 (1.09)** [-0.26]	-3.20 (1.15)** [-0.17]			-1.25 (1.27) [-0.07]	-3.19 (1.21)** [-0.17]
GNIPC			-1.62 (0.21)** [-0.51]	-0.41 (0.20)* [-0.13]	-0.58 (0.19)** [-0.18]	-0.67 (0.19)** [-0.21]
GINI			0.46 (0.17)** [0.17]	0.11 (0.13) [0.04]	0.26 (0.14)^ [0.10]	0.08 (0.14) [0.03]
Fem Lit		-0.56 (0.07)** [-0.55]			-0.53 (0.07)** (-0.52)	
Polio vac.	-0.34 (0.12)** [0.17]	-0.43 (0.11)* [-0.22]		-0.45 (0.11)** [-0.22]	-0.39 (0.11)** [-0.20]	-0.34 (0.11)** [-0.17]
Impr. Wat.	-0.76 (.09)** [-0.49]					-0.67 (0.10)** [-0.43]
Impr. San.				-0.46 (0.06)** [-0.56]		
R ²	0.650	0.665	0.421	0.680	0.692	0.679
DF	4	4	3	5	6	6

Note. N = 145. Unstandardized coefficients with standard error in parenthesis. Standardized coefficients reported in brackets.
^P < .10 *P < .05 ** P < .0

Global OLS Regression Models

Models 1, 3, 4 and 6 provide support for H1 with model 2 providing only modest support. Models 1, 2, and 6 provide support for H2 with model 5 providing only modest support. While all variables maintained significance in these models, it is noteworthy that GEHPTEH lost most of its significance when female literacy was substituted for improved water, and its effect appears to be entirely indirect in model 5³. The correlation between the two variables is 0.44 and is the highest correlation that GEHPTEH has with any other independent variable in this study.

Models 1 and 2 use a multifaceted concept of accessibility to explain IMR. The variables that most contributed were access to improved water source and physician density. Model 1 predicts that increasing physician density by one doctor for every 1000 people from its mean of 1.56 would lead to a 4.6 drop in infant mortality from 26.1, and a 10-point increase in access to improved water source would lower IMR by 8. Model 2 predicts that a 10 percent increase in adult female literacy would reduce IMR by 5.6.

Model 3 provides a largely economic explanation for infant mortality. This model is consistent with McGuire's (2010) 'wealthier is healthier' hypothesis. Here, while GNI per capita has the largest coefficient, income inequality accounts for 23 percent of IMR's variation ($pr2 = .23$) while GEHPTEH accounts for 30% ($pr2 = .30$). Here, a 10-point reduction in income inequality from a GINI of 40 predicts a decline in IMR from 26.1 to 21.2.

Model 4 evaluates the impact of improved sanitation, which, due to high collinearity with several other predictors, could not be run in the other models. This model obtains the second highest R². Holding all other values in the model at their mean, an increase in access to improved water sources from 72% to 82% would reduce IMR by 5.2. Similarly, a 10% increase in vaccination coverage would have only a slightly smaller impact. Models 5 and 6 combine the broad 'wealthier is healthier' model with the social development models.

Low-Income Country OLS Regression Models

Models 7-12 parallel models 1-6. Here the same phenomena are observed as above. GEHPTEH is strongest in model 9, and in models where female literacy is included it ceases to explain infant mortality. Finally, while GEHPTEH is not the strongest predictor, it contributed significantly to explaining IMR in most models in the expected direction. In both the global and low-mid income country regressions, all broad accessibility models explained more variation in infant mortality than 'wealthier is healthier' models. These models suggest that countries which have policies to promote gender equality, reduce financial barriers to care, focus on preventative care, invest more heavily in public sanitation and water will reduce infant mortality significantly.

³In models where both independent and dependent variables were logged GEHPTEH did not lose any significance when combined in models with the female literacy rate. Often, logging the variable is done to correct the violation of the assumption of normality- notable primarily in the 185-country sample. We chose to present non-logged results here to facilitate centering and interpretation. Log-log models are available from the author.

An Interactive Model

Next, we check for interaction between GEHPTEH and GNI per capita to test whether GEHPTEH has a greater effect on reducing the IMR in poorer nations than in wealthier ones. Table 3 provides evidence of an interaction effect, indicating that

Table 3
Centered interactive model with IMR as dependent variable⁴

Model	Unstandardized Coefficients		Standardized Coefficients		Collinearity
	B	Std.Error	Beta	Sig.	VIF
(Constant)	23.46	1.49		.000	
GEHPTEH	-.24	0.08	-.19	.003	1.31
GNIpc	-.83	0.10	-.63	.000	1.73
XPGNIGE	.02	0.00	.30	.000	1.48

Note. N=185 R² = 0.432

GEHPTEH matters more in reducing infant mortality in poorer nations than in wealthier ones. To illustrate, we ran a few cases through the interaction model.

Papa New Guinea’s 2011 GNI per capita was \$2,240. At this level of GNI per capita with a GEHPTEH of 89.4 or 30 points above the mean, the predicted IMR is 19.5, or a 15.6 reduction in the IMR as compared to a case where the country’s GEHPTEH is at the mean (predicted IMR of 35.1). Likewise, if one reduces GEHPTEH when GNI is low, to 29.4 or 30 percentage points below the mean, this model predicts an increase in the IMR by 19.5 to 54.6. Given an average GNI (\$16,236) and high GEHPTEH, the predicted IMR would be 16.26, or 7.2 fewer deaths per 1000 live births as compared to the mean GEHPTEH. In the case of high GNI (\$35,760) the impact of a high GEHPTEH versus the mean reduces IMR by 5.4 to 0.64. Certainly prior to this point the effect would taper off much further than suggested by the model as the IMR approaches 0.

A Look at the Extremes

Since IMR is a function of multiple social and economic forces, it is not surprising that of 15 countries with a GEHPTEH over 82% and with an IMR over 25, six (Bhutan, Micronesia, Nauru, Solomon Islands and Marshall Islands) have less the one physician for every 1,333 people. In the Solomon Islands, 19% lacked access to improved drinking water sources, 14% of children under age one had not received their polio vaccine and 71% lacked access to improved sanitation.

Some interesting cases with low GNI and high GEHPTEH (Cuba, Cook Islands, Vanuatu, and Samoa) suggest that high GEHPTEH may have helped some countries overcome low GNI when accompanied by high access to clean water, sanitation coverage, physician density, and/or vaccination coverage. This suggests that although improving

⁴ Equations for this model are available in the online statistical appendix

access to clean water and sanitation are highly correlated with GNI, their improvement may be more feasible paths for poorer countries to reduce IMR.

Nevertheless, increasing GEHPTEH and access to clean water is not enough. Based on model 7, the Solomon Islands' *predicted* IMR would be 33.5 (7.6 infant deaths more than the actual figure), and while their GEHPTEH of 96.7 reduced the predicted IMR by 7 infant deaths, increasing physician density to the mean value of 1.49 from 0.22 would decrease the predicted value by 4.7 deaths. If the Solomon Islands increased access to clean water sources to the mean of 88.1, their predicted IMR would drop by 3.1. Model 10 predicts a much higher IMR (47.4) for the Solomon Islands, driven by its low sanitation coverage and GNI. Thus, while model 7 suggests that the most important step to improve health outcomes in the Solomon Islands is to train and retain more physicians, model 10 (which excluded physician density to avoid multicollinearity) strongly suggests that the country's primary focus should be expanding improved sanitation infrastructure.

Examining the 15 countries with GEHPTEH lower than 30, Georgia stands out as a country with a highly privatized healthcare system, medium income and moderately low IMR. Nevertheless, Georgia has high physician density, reports 100% female literacy, everyone has access to clean water, and most people have access to improved sanitation. The cases of Sierra Leone, Chad, Guinea Bissau, Côte d'Ivoire and Afghanistan are troubling. These countries suffer from low physician density, high poverty, low female literacy, and poor access to clean water and sanitation. Further, when residents do have access to a physician, the cost is the individual's responsibility. The IMR for these countries suggests that this combination is devastating.

For example, Guinea Bissau's predicted IMR using model 12 is 55.2 (25.6 fewer than the reported figure), if it increased its GEHPTEH from 26.8 to the mean of 55.5, the predicted IMR would drop to 50.9 while increasing physician density to the mean of 1.49 would reduce the county's IMR by 3.5. In this model, Guinea Bissau's population without access to potable water adds 7.4 infant deaths, the low GNI adds 5, and low vaccination coverage contributes 3.4 deaths to the predicted IMR of 32.1 compared to a situation where these predictors were at their mean. Model 11 predicts an IMR of 62.9, with Guinea Bissau's extremely low level of literacy among women contributing 17.3 deaths. Finally, Model 10 predicts an IMR of 63.9 with the low level of sanitation contributing 20.9 infant deaths. Thus, with limited resources in Guinea Bissau, it appears urgent to prioritize investments in gender equality and public health infrastructure.

Discussion

In this study, we found that a broad approach to accessibility contributed more to the explanation of IMR than a relatively narrow 'wealthier is healthier' model. While both explanations provide important insights, and while wealthier societies unquestionably have more money to develop infrastructure, we found that improving populations' access to improved water, sanitation, and attracting physicians while reducing financial barriers to care was paramount. Below, we provide a discussion of how these results compare with earlier research organized by explanatory variable. We conclude by providing suggestions for future research and by positioning the results within the context of austerity measures that cut public healthcare spending.

Implications of Results

One should keep in mind that while according to this study's models moving up one physician per 1000 population is associated with a large drop in infant mortality, many physicians need to be trained and retained to achieve a one-unit increase in physician density. Furthermore, other models (not shown) accounted for the curvilinear relationship between physician density and IMR, indicating that as physician density increases to greater than one per 1000 the impact on IMR decreases. Similarly, the vast gulf between rich and poor nations reflects that it is difficult to increase GNI per capita sufficiently to achieve a rapid decline in IMR. Finally, increasing GEHPTEH, while important in its own right to reduce financial barriers to care, helps reduce IMR but it is not sufficient and should be accompanied by significant investment in increasing access to improved water and sanitation and in strategies that promote gender equality in education. Results of the interactive model indicate that GEHPTEH plays a larger role in reducing IMR among poorer nations than among wealthy ones.

Nevertheless, while a holistic approach would be ideal with abundant resources, many countries must be selective in designing strategies to reduce IMR. These models and bivariate correlations suggest that many variables are interrelated. More human resources for health and increased GEHPTEH may help increase vaccine coverage, while higher GNI attracts more physicians and enables governments to invest in public health infrastructure that helps provide water and sanitation to vulnerable populations. Ultimately, each country has to decide how to allocate its resources to maximize the short and long term health impacts of those allocations.

Accessibility Measures: GEHPTEH

Our research supports Çevik and Taşar's (2013) results, which found an inverse relationship between GEHPTEH and IMR and CMR. Our inclusion of different controls and additional cases provide further evidence in support of this relationship. Since few other studies have used this as a predictor of IMR, we compare our findings with research on the impact of public health expenditure in general. An increase in GEHPTEH is not identical to an increase in government spending *per se*, but is an increase in the government's share of spending *relative to* the share of private insurance and out-of-pocket expenditure. Despite this distinction, one may expect that the relationship between each of these variables and the IMR to be similar. In this regard, our findings are consistent with May and Smith (2011) who found a robust inverse relationship between public healthcare spending and IMR using U.S. county and city data, and somewhat inconsistent with McGuire's (2010), Filmer and Pritchett's (1999) and Schell et al. (2007) results. It is noteworthy that total expenditure on health as a percentage of GDP was not significantly correlated with IMR in our study.

The results of the interaction model support Houweling et al.'s (2005) study, which found that public health spending had a stronger impact in reducing the IMR in poorer countries than in wealthier ones. Our interactive model suggests that a 10-percentage point increase in GEHPTEH could result in 5.2 fewer deaths per 1000 live births for poorer countries. Thus, although there are high-income countries (Monaco, Norway, Denmark) that have both high GEHPTEH and very low IMR, this model indicates that the more

significant partial effect of GEHPTEH originates from poorer countries whose scores on IMR are lower than GNI alone would predict.

These results provide empirical support for the inverse relationship between GEHPTEH and IMR. We suggest that this is likely for two reasons. First, GEHPTEH is strongly inversely correlated with out-of-pocket health expenditure as a percentage of total health expenditure (-0.858), indicating that GEHPTEH reduces financial barriers to care. Secondly, poorer populations are very limited sources of effective demand despite having an abundance of health care needs, and thus would likely not attract the necessary health services when most financing for these services is relegated to the private sector.

Underlying this research is a philosophy in favor of a rights-based approach to healthcare provision. Although GEHPTEH may not capture all dimensions of rights-driven healthcare financing, it does provide a quantitative proxy measure. A rights-based approach implies that the state has primary responsibility to provide healthcare services regardless of ability to pay (Farmer, 2005; UN, 1948). This is at odds with the trend towards privatization of health services. When healthcare is commodified, the gap between absolute need and demand backed by ability to pay leads to distortions in which services are provided and where. For example, Rodelis Therapeutics, a private pharmaceutical company, recently increased 21-fold the price of Cycloserine that treats multiple drug resistant tuberculosis, and Turning Pharmaceuticals increased the price of Daraprim (pyrimethamine), a drug that is used to treat parasitical infections such as malaria, from \$14 to \$850 a tablet (Pollack, 2015). These price increases reduce affordability of medications for vulnerable populations. In short, commodification of healthcare promotes inequality in healthcare access, utilization, and outcomes.

Other Accessibility Measures

A salient result emanating from this study is that a broad approach to improving accessibility is needed to reduce IMR. High among these measures are access to improved water and sanitation, gender equitable education that increases women's literacy, the presence of sufficient and equitably distributed medical personnel in the country, and vaccination coverage. This perspective is consistent with the bulk of the literature reviewed. Like Rajan et al. (2013), McGuire (2010) and Schell et al. (2004), our research supports the consensus that increasing female literacy is a strong pathway for infant mortality decline. Likewise, our results reflect the critical role of public health infrastructure and vaccination in the efforts to reduce IMR that is reflected in previous studies (McGuire, 2010; Breiman et al., 2004).

Similar to Anand and Bärninghusen's (2004) study, we show that physician density contributes to the explanation of IMR (and CMR). These findings differ from Arik and Arik's (2005) results that did not find physician density to be a significant predictor of IMR in provincial level analysis of IMR in Turkey.

GNI Per Capita and Income Inequality

Our results show that the GNI has a large effect on reducing the IMR in our multivariate models. This is generally consistent with previous research (McGuire, 2010; Arik & Arik, 2009; Schell et al., 2007; Filmer & Pritchett, 1999; Pritchett & Summers,

1996). Regarding inequality, our results were mixed. In the models where only GEHPTEH and GNI per capita were controlled, we found a strong inverse relationship between GINI and IMR. However, when access to improved sanitation or water was controlled, the effect was much more indirect. Thus, our research extends Avendano's (2012) suggestion that progressive social spending buffers the impact of inequality and poverty to developing nations, particularly if that spending increases vaccination coverage, access to sanitation, female literacy and medical personnel retention. One final point is that both reducing inequality and increasing GNI, significantly impacting infant mortality, may be less feasible than increasing access to sanitation, public health and improving gender equality in education (McGuire 2010: 60-63).

Study Limitations

Ideally, this research would demonstrate connections between the government's share of health spending and IMR more as mediated by country estimates of forgone care rates. Unfortunately, such data are unavailable at the international level. An additional limitation is the unavailability of each indicator at identical points in time, particularly concerning GINI, female literacy, and physician density. This complicates gathering panel data for a wide range of countries, blocking our ability to pursue a longitudinal panel regression, and limiting our ability to make causal inference. Finally, the data cannot account for how public health spending is actually used; therefore, the research could not identify which allocation strategies are most effective towards reducing IMR.

Research and Policy Implications

Further research could examine the relationship between the inequality in within-country human resource for health density and health outcomes. Another avenue for future research would be to analyze the impact of GEHPTEH on IMR over time both among and within countries. Finally, future research could examine the connection between GEHPTEH and forgone care rates, given reliable estimates of the latter.

These findings reinforce a rights-based approach to healthcare financing and are pertinent to efforts to reduce infant and child mortality. One central argument of proponents of neo-liberal policies is that governments are inherently inefficient and, in terms of healthcare, private sector control, provision and financing should lead to better population health. If this were true, one would expect a positive (rather than an inverse) association between GEHPTEH and IMR. Our argument is further strengthened when one considers that water and sanitation systems are largely the result of public endeavors. The results of this research are thus inconsistent with the neoliberal paradigm.

This research is pertinent as many countries are pressured to pursue austerity policies in the wake of ongoing economic difficulties with many measures aimed at decreasing the role of government in healthcare provision and finance (Kentikelenis et al., 2014). Furthermore, our anti-neoliberal conclusions are supported elsewhere. Neo-liberal policies have been found to have a detrimental impact on health outcomes by increasing inequality and creating more barriers to healthcare services (Coburn et al., 2015; Palma-Solis et al., 2009).

Author Notes

Isaac Christiansen is an Assistant Professor in Sociology at Midwestern State University in Wichita Falls, Texas. His primary interests are Marxist theory, social, economic and health inequalities, social change and development, and the dynamics of economic crises. He has recently been published in *World Review of Political Economy* and has taught various classes in sociology including: Sociological Theory, Introduction to Sociology, Global Social Problems, Race and Ethnic Relations, and Sociology of Work.

References

- Anand, S., & Båringhausen, T. (2004). Human Resources and Health Outcomes: Cross-country Econometric Study. *The Lancet*, 364 (9445), 1603-1609.
- Antonovsky, A., & Bernstein, J. (1977). Social Class and Infant Mortality. *Social Science and Medicine*, 11, 453-470.
- Arik, H., & Arik, M. (2009). Is it economic growth or socioeconomic development? A cross sectional analysis of the determinants of infant mortality. *Journal of Developing Areas*, 42(2), 31-55.
- Avendano, M. (2012). Correlation or Causation? Income Inequality and Infant Mortality in Fixed Effect Models in the Period 1960-2008 in 34 OECD Countries. *Social Science and Medicine*, 75 (4), 754-760.
- Book, R. A. (2009). *Single Payer: Why Government Run Health Care Will Harm Both Patients and Doctors*. Retrieved 11 22, 2017, from The Heritage Foundation: <http://www.heritage.org/health-care-reform/report/single-payer-why-government-run-health-care-will-harm-both-patients-and>
- Breiman, R. F., Streatfield, P. K., Phenlan, M., Shifa, N., Rashid, M., & Yunus, M. (2004). Effect of Infant Immunization on Childhood Mortality in Rural Bangladesh: Analysis of Health and Demographic Surveillance Data. *The Lancet*, 364, 2204-2211.
- Çevik, S., & Okan, T. M. (2013). Public Spending on Health Care and Health Outcomes: Cross-Country Comparison. *Journal of Business, Economics and Finance*, 2(4), 82-100.
- Coburn, C., Restitivo, M., & Shandra, J. M. (2015). The World bank and Child Mortality in Sub-Saharan Africa: A Cross-National Analysis of Structural Adjustment and Health Lending. *Sociology of Development*, 1 (3), 348-373.
- Coburn, D. (2009). Inequality and Health. In L. P. Leys (Ed.), *The Socialist Register: Health Under Capitalism* (pp. 39-58). New York: Monthly Review Press.
- Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2003). *Applied Multiple Regression/ Correlation Analysis for the Behavioral Sciences* (Third Edition ed.). Mahwah, New Jersey: Lawrence Erlbaum Associates.
- Das, J., Holla, A., Mohpal, A., & Muralidhadran, K. (2015). *Quality and Accountability in Health Care Delivery: Audit Evidence from Primary Care Providers in India*. Policy Research Working Paper 7334, World Bank Group.
- Declaration of Alma Ata. (1978, September 6-12). Declaration of Alma Ata. Alma Ata, USSR: International Conference on Primary Health Care.
- Farag, M. (2010). *Spending on Health Care: What Drives it and Does it Matter?: Three Essays on Wealth, Health Spending, and Health of Nations*. Ann Arbor, MI: Brandeis University, ProQuest Publishing.
- Farmer, P. (2005). *Pathologies of Power: Health, Human Rights and the New War on the Poor*. Berkeley, CA: University of California Press.
- Filmer, D., & Pritchett, L. (1999). The Impact of Public Spending on Health: Does Money Matter? *Social Science and Medicine*, 49, 1309-1323.
- Himmelstein, D. U., & Wollhandler, S. (2016). The Current and Projected Taxpayer Shares of US Health Costs. *American Journal of Public Health*, 106 (3), 449-452.
- Hosseinpoor, A. R., Mohammad, K., Majdzadeh, R., Naghavi, M., Abolhassani, F., Sousa, A., et al. (2005). Socioeconomic inequality in infant mortality in Iran and across its provinces. *Bulletin of the World Health Organization*, 83, 837-844.
- Houweling, T. A., Kunst, A. E., Looman, C. W., & Mackenbach, J. P. (2005). Determinants of Under-5 Mortality Among the Poor and the Rich: A Cross-national Analysis of 43 Developing Countries. *International Journal of Epidemiology*, 34, 1257-1265.
- Kentikelenis, A., Karanikolos, M., Reeves, A., McKee, M., & Stuckler, D. (2014). Greece's Health Crisis: From Austerity to Denialism. *The Lancet*, 383, 748-753.

- Kim, D., & Saada, A. (2013). The Social Determinants of Infant Mortality and Birth Outcomes in Western Developed Nations: A Cross-Country Systematic Review. *International Journal of Environmental Research*, 10, 2296-2335.
- Kuhn, R. (2010). Routes to Mortality Revisited. *Population and Development Review*, 36, 655-692.
- Laurell, A. C. (2015). Three Decades of Neoliberalism in Mexico: The Destruction of Society. *International Journal of Health Services*, 45 (2), 246-264.
- Mays, G. P., & Smith, S. A. (2011). Evidence Links Increases in Public Health Spending to Declines in Preventable Deaths. *Health Affairs*, 30 (8), 1585-1593.
- McGuire, J. W. 2010. *Wealth, Health, and Democracy in East Asia and Latin America*. New York, NY: Cambridge University Press.
- Palma-Solis, M. A., Álvarez-Dardet Díaz, C., Franco-Girardo, Á., Hernandez-Aguado, I., & Pérez Hoyos, S. (2009). State Downsizing as a Determinant of Infant Mortality and Achievement of Millennium Development Goal 4. *International Journal of Health Services*, 39 (2), 389-403.
- Pollack, A. (2015, 9 20). Drug Goes From \$13.50 a Tablet to \$750 a Tablet Overnight. *The New York Times*.
- Pritchett, L., & Summers, L. H. (1996). Wealthier is Healthier. *The Journal of Human Resources*, 31 (4), 841-868.
- Rajan, K., Kennedy, J., & King, L. (2013). Is Wealthier Always Healthier in Poor Countries: The Health Implications of Income, Inequality, Poverty and Literacy in India. *Social Science and Medicine*, 88, 98-107.
- Sadoh, A. E., & Oladokun, R. E. (2012). Re-emergence of Diphtheria and Pertussis: Implications for Nigeria. *Vaccine*, 30, 7221-7228.
- Schell, C. O., Reilly, M., Rosling, H., Peterson, S., & Ekström, A. M. (2007). Socioeconomic Determinants of Infant Mortality. *Scandinavian Journal of Public Health*, 35, 288-297.
- Song, S., & Burgard, S. A. (2011). Dynamics of Inequality: Mother's Education and Infant Mortality in China, 1970-2001". *Journal of Health and Social Behavior*, 52 (3), 349-364.
- United Nations. (1948). *Universal Declaration of Human Rights*.
- Wilkinson, R. G. (1992). Income Distribution and Life Expectancy. *British Medical Journal*, 304, 165-168.
- Wilkinson, R. G., & Pickett, K. (2006). Income Inequality and Population Health: A Review and Explanation of the Evidence. *Social Science and Medicine*, 62, 1768-1784.
- World Bank. (2015). *GNI Per Capita, PPP (current international \$)*. Retrieved 6 22, 2015, from <http://data.worldbank.org/indicator/NY.GNP.PCAP.PP.CD>
- World Health Organization. (2011). *General Government Expenditure on Health as a Percentage of Total Expenditure on Health*. Retrieved 07 28, 2015, from Indicator and Measurement Registry Version 1.7.0.: http://apps.who.int/gho/indicatorregistry/App_Main/view_indicator.aspx?iid=93
- World Health Organization. (2011). *Population Using Improved Drinking Water Sources*. Retrieved 7 30, 2015, from Indicator and Measurement Registry Version 1.7.0.: http://apps.who.int/gho/indicatorregistry/App_Main/view_indicator.aspx?iid=8
- World Health Organization. (2010). *The World Health Report: Health Systems Financing: The Path to Universal Coverage*. The World Health Organization, Geneva.
- World Health Organization. (2011). *Total Expenditure on Health as a Percentage of GDP*. Retrieved 7 23, 2015, from Indicator and Measurement Registry Version 1.7.0.: http://apps.who.int/gho/indicatorregistry/App_Main/view_indicator.aspx?iid=122
- World Health Organization. (2006). *Working Together for Health: The World Health Report 2006*. Annual, The World Health Organization, Geneva.