Income and child mortality in developing countries: A systematic review and Meta-analysis

O'Hare BA, Makuta I, Chiwaula L, Bar-Zeev N

ABSTRACT

National Income is an important determinant of child survival. We aimed to quantify the relationship between national income and infant and under-five mortality in low-income countries through a systematic literature search and a Meta-analysis. The systematic literature search identified 24 studies, which produced 38 estimates that examined the impact of income on the mortality rates. Using Meta-analysis, we produced pooled estimates of the relationship between income and mortality. The pooled estimate of the relationship between income and infant mortality before adjusting for covariates is -0.95 (95% CI -1.34 to -0.57) and that for under-five mortality is -0.45 (95%CI -0.79 to -0.11). After adjusting for covariates, pooled estimate of the relationship between income and infant mortality is -0.33 (-0.39 to -0.26) while the estimate for under-five mortality is -0.28 (-0.37 to -0.19). In this case, if a country has an infant mortality of 50 per 1000 live births and the GDP per capita purchasing power parity increases by 10%, the infant mortality will decrease to 45 per 1000 live births. This work confirms the importance of income for child health and provides a pooled estimate for the relationship.

INTRODUCTION

Rationale

Child mortality is regarded as one of the best measures of the health status of a country (1). There have been gains over the last few years, in 2010, under-five mortality was estimated at 7.6 million, which was a decline from 9.6 million in 2000 (2). However, it has been noted that over the last 20 years the burden of these child deaths is increasingly being concentrated in the resource poor countries of sub-Saharan Africa (SSA) and South Asia (3). Since the seminal works of Preston in 1975 (4) and Pritchett and Summers in 1996 (5), it has become established that wealthier people are healthier people as indicated by life expectancy and child mortality within countries and that higher income at country level correlates closely with better health outcomes for that country's population (6). However, the degree of this impact in different regions and the degree of the influence of other socioeconomic factors, including the distribution of wealth has been the subject of an ongoing discourse in the literature. Many authors have studied the relationship between income and child mortality using econometric methods but thus far, the exact nature of the relationship is not settled.

Objectives

Our objective was to produce a pooled estimate for this relationship by systematically reviewing the literature and meta-analysing published estimates. The importance of having a single pooled estimate, produced after systematic review and meta-analysis, is that macroeconomic indicators can be related to the impact they have on child mortality and therefore on the health status of a country. A pooled estimate will be of use to policy makers who make decisions that will influence the economy of their countries and to those who advocate for fairer global economic governance.

METHODS

Search strategy and selection criteria

We conducted a structured query in Pubmed and Google Scholar for all available full-text English language studies that examined the relationship between income and infant or under-five mortality in developing countries. We included studies that examined the mortality among children aged less than one year and less than five years. The intervention was national level income and other social determinates of health. We included studies that compared the relationship between countries or regions. We used the search term ("infant mortality" OR "under-five mortality" OR “under-5 mortality”) AND (income OR “Gross National Income (GNI) per capita purchasing power parity (PPP)" OR "Gross Domestic Product (GDP) per capita purchasing power parity (PPP)" AND (“low income countries” OR “developing countries"). We searched the publications of the United Nations Conference on Trade and Development (UNCTAD), the World Bank and World Health Organization (WHO). We also searched articles referenced by the included studies. Search date was March 2012. Studies were included if they examined the impact of national income on the mortality rates of infants or children under the age of five years. In order to be eligible for inclusion, studies had to use an internationally comparable measure of income, such as GDP, or GNP per capita purchasing power parity and to report the relationship of income to either infant or under-five mortality (Definitions - box1). The principal summary measure was the elasticity. There was no limitation to the years covered.

The first two authors independently read all titles and available abstracts, and excluded studies unlikely to meet the selection criteria. Articles selected by either author were kept for full article review. Both authors read the full articles and excluded those not meeting selection criteria. For all included articles, the authors recorded the primary aim of the study, the income level of the countries included in the study, the region or regions included, the years covered and the measure or measures of mortality used. The covariates adjusted for, the elasticity (see box 1) and the measure of precision of this estimate was recorded. The method for controlling for reverse causation and the study design (cross sectional or longitudinal) was recorded.

Box 1: Definitions of measures of income

Gross Domestic Product (GDP) is the value of all final goods and services produced in a country in one year.

Gross National Product (GNP) is the value of all final goods and services produced in a country in one year (i.e. GDP) plus income that residents have received from abroad, minus income claimed by non-residents.

GDP or GNP per capita is the GDP or GNP divided by the midyear population and considered as a measure of the standard of living in a country or the level of economic development (12).

GDP or GNP per capita purchasing parity power (PPP) is the exchange rate of a currency relative to a standard, which is usually the United States Dollar and measured in international dollars. An international dollar has the same purchasing power as one US dollar would have if spent in the United States (34).

A lagged analysis is when the dependent variable (the mortality rates in this case) is regressed against socioeconomic variables from a number of years previously.

The GINI coefficient is a measure of income inequality on a scale of zero (perfect income equality) to 1 (perfect income inequality).

Elasticity reports the proportionate change in the dependent variable for a unit proportionate change in the independent variable. In this paper, the dependent variable is a measure of the mortality and the independent variable is either the GDP or GNP per capita PPP.

Meta-analysis

In order to obtain a weighted pooled estimate of the magnitude and direction of the relationship between income and under-five and infant mortality, that takes into account differences in study design, geographic setting and time periods, we conducted a random effects meta-analysis of published estimates. We separately analysed papers reporting under-5 mortality and infant mortality, and separately analysed adjusted and unadjusted estimates. We used log-transformed infant and child mortality rates and log-transformed income (in order to capture elasticity). We conducted the analysis using Comprehensive Meta-analysis Software ™ Bio stat (7). We conducted analysis for sources of heterogeneity and report the I^2 statistic. This statistic describes the percentage of variation across studies which is due to heterogeneity rather than chance and a value of zero indicates no observed heterogeneity (8). We restricted analysis by cadre of countries included (low, middle or high income), geographic region, decade in which data were collected, and by analytical method used (Table 1). We examined the subgroup analyses for reduction in I^2 compared with the unrestricted analysis. We also constructed funnel plots to examine for publication bias (results not shown).

RESULTS

Pubmed and Google Scholar yielded 1,014 and 17,900 citations respectively. On review of titles and abstracts, we selected 89 articles (46 Pub med, 43 Google Scholar) for full text review. Secondary search of these yielded a further 53 studies. After removal of duplicates, the total number of studies was 81. Of these, full-text access was freely available for 54 studies, of which 24 fulfilled the selection criteria. A summary of the results of studies and the estimates produced by each study is in Table 6. A summary of the covariates adjusted for is in Table 7.

The 24 eligible studies produced 38 estimates on the relationship between income and a measure of mortality (Table 6). Eleven estimates combine data from high, middle and low-income countries (HIC, MIC, and LIC), 20 estimates that combine data from MIC and LIC, 5 estimates that included LIC data only and one that uses only MIC data and one that uses HIC data only. There were 9 estimates of the relationship between unadjusted log transformed income and log of mortality and 23 estimates of the relationship between adjusted log transformed income and the log of mortality which could be meta-analysed. Some studies provided both adjusted and unadjusted estimates. Most studies used log-transformed scale for both income and mortality but there were seven log linear estimates. We did not Meta-analyse the log linear estimates. The income elasticity of infant and under–five mortality was negative in all studies (see Table 1 and Table 6). The pooled elasticity of the unadjusted and adjusted estimates for the two measures of mortality, infant mortality and under-five mortality is summarised in Table1.

Table 1: Summary of Meta-analysis on unadjusted and adjusted elasticity (For forest plots see Table 2-5)
IMR = infant mortality rate, U5M = under-5 mortality rate. LAC = Latin America and the Caribbean. (95% confidence intervals in paracentesis)

	Unadjusted log of income				**Adjusted log of income**			
	Log IMR	**I^2**	**Log U5M**	**I^2**	**Log IMR**	**I^2**	**Log U5M**	**I^2**
All estimates	-0.95 (-1.34 to -0.57)	93%	-0.45 (-0.79 to -0.11)	99%	-0.33 (-0.39 to -0.26)	68%	-0.28 (-0.37 to -0.19)	87%
Income groups								
Estimates which included HIC, MIC, LIC	-1.05 (-1.64 to -0.46)	99%	-0.76 (-0.79 to -0.73)		-0.39 (-0.42 to -0.36)	0	-0.39 (-0.57 to -0.21)	88%
Estimates which included MIC and LIC	-0.85 (-1.43 to -0.26)	94%	-0.30 (-0.46 to-0.14)	94%	-0.20 (-0.30 to -0.11)	29%	-0.22 (-0.29 to -0.15)	61%
Estimates which included LIC only	No estimates		-0.21(-0.28 to -0.15) 1 estimate		No estimates		-0.18 (-0.31 to -0.05)	79%
Regions								
All regions	-0.92 (-1.34 to -0.50)	99%	-0.21 (-0.28 to -0.15) 1 estimate		-0.36 (-0.42 to -0.30)	33%	-0.33 (-0.44 to -0.21)	79%
LAC	-1.17 (-1.68 to -0.66) 1 estimate		No estimates		No estimates		-0.37 (-0.48 to -0.26) 1 estimate	
SSA	No estimates		-0.38 (-0.43 to -0.33) 1 estimate		-0.24 (-0.51 to -0.03)	94%	-0.14 (-0.19 to -0.09)	0
Time period								
1950s	-1.18 (-1.67 to -0.69)	99%	No estimates		-0.36 (-0.45 to -0.28)	64%	-0.12(-0.18 to -0.06) 1 estimate	
1960s	-0.87 (-1.29 to -0.44)	66%	-0.45(-0.79 to -0.11)	99%	-0.38 (-0.42 to -0.33)	0	-0.32(-0.45 to -0.19)	90%
1970s	-0.31 (-0.56 to -0.06) 1 estimate		No estimates		-0.34 (-0.54 to -0.15)		No estimates	
1980s or 1990s	No estimates		No estimates		-0.16 (-0.27 to 0.05)	87%	-0.17 (-0.31 to -0.03)	0
Study design								
Cross sectional	No estimates		No estimates		-0.24 (-0.39 to -0.10)	0	No estimates	
Longitudinal, no lagging	-0.82 (-0.96 to -0.67)	79%	No estimates		-0.35 (-0.50 to -0.19)	77%	-0.20 (-0.52 to -0.13) 1 estimate	
Longitudinal, lagging	-1.01 (-1.49 to - 0.54)	99%	-0.45 (-0.79 to -0.11)	99%	-0.28 (-0.41 to -0.16)	87%	-0.16 (-0.32 to -0.00) 1 estimate	

Meta-analysis on *unadjusted* elasticity and *adjusted* elasticity

There were six estimates for unadjusted income elasticity of infant mortality and the pooled estimate is -0.95 (95%CI -1.34 to – 0.57) (Table 1 and Table 2). For the unadjusted income elasticity, there were five estimates for under-five mortality and the pooled estimate is -0.45 (95%CI -0.79 to -0.11) (Table 1 and Table 3). There were 11 estimates for the adjusted income elasticity of infant mortality and the pooled elasticities for adjusted infant mortality is -0.33 (95%CI -0.39 to -0.26) (Table 1 and Table 4). Twelve estimates of income elasticity for adjusted under five mortality were identified and the pooled estimate is -0.28 (95% CI -0.37 to -0.19) (Table 1 and Table 5). The findings show that the pooled income elasticity estimates that are not adjusted for covariates are higher than those adjusted for covariates.

Sub group analysis:

The income elasticity estimates were analysed by subgroups. The pooled unadjusted income elasticity estimates of infant mortality rate for HIC, MIC and LIC is -1.05 (-1.64 to -0.46), those which include MIC and LIC is -0.85 (-1.43 to -0.26). The less negative values when HIC are excluded are reflected in all pooled estimates, both unadjusted and adjusted. Unadjusted pooled income elasticity of U5M that included all regions is lower -0.21(-0.28 to -0.15) than those which just included estimates from SSA -0.38 (-0.43 to -0.33), but this trend is reversed in adjusted estimates. The pooled unadjusted income elasticity estimates from earlier decades is higher than later decades. Pooled estimates for adjusted elasticity remains constant in earlier decades but falls in later decades. The pooled elasticity from unadjusted estimates from studies, which used longitudinal and lagged unadjusted estimates were higher than the pooled elasticity from studies that did not use lagged data but the adjusted estimates remain fairly constant regardless of the study design. The I^2 statistic is generally high in all unadjusted estimates but zero in several of the adjusted estimates.

DISCUSSION

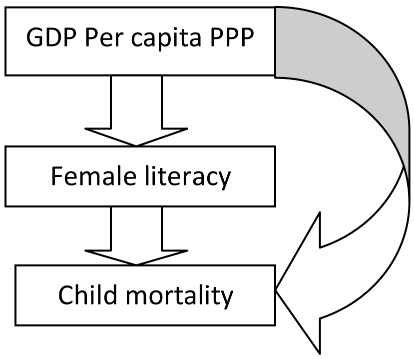
Statement of principal findings

All studies reported a negative relationship between income and mortality. The pooled income elasticity from unadjusted estimates are higher than the pooled elasticities from estimates that are adjusted for covariates. The pooled elasticities for unadjusted estimates of income on infant mortality is - 0.95 (95%CI -1.34 to – 0.57). Therefore, if the GDP per capita PPP increases by 10% in a country where the infant mortality is 50/1000 live births, the infant mortality would be expected to decrease by 10% to 45/1000 live births.

Adjusted elasticity may be appropriate if the covariates controlled for act as confounders. However, many covariates, along the social determinants of health pathway may actually mediate the effect of upstream variables. When covariates that contribute to the same pathway are entered into the same multivariate model, the influence of the upstream covariates will be reduced relative to the downstream covariates - a phenomenon known as "over-adjustment" (9). Biggs et al did not control for midstream determinants of health, arguing correctly in our opinion, that these are mediators of the effect of national income and the elasticity from this paper is therefore higher than the other papers (10). Bhalotra et al found that the unadjusted elasticity between income and child mortality in India was -0.7, but controlling for government health expenditure resulted in the elasticity falling to -0.5 (11).

For example, female literacy (midstream) is heavily influenced by income (upstream) and is also independently of income, associated with reduced child mortality, but female literacy also mediates the effect of income on child mortality (10), see figure 1. If both income and female literacy are included in the same multivariate model, the relative influence of income will be reduced and this is described as over adjustment. The influence may even be reversed, in which case it is called the Yule Simpson paradox.

Figure 1. Directed acyclic graph for income, female literacy and child mortality.



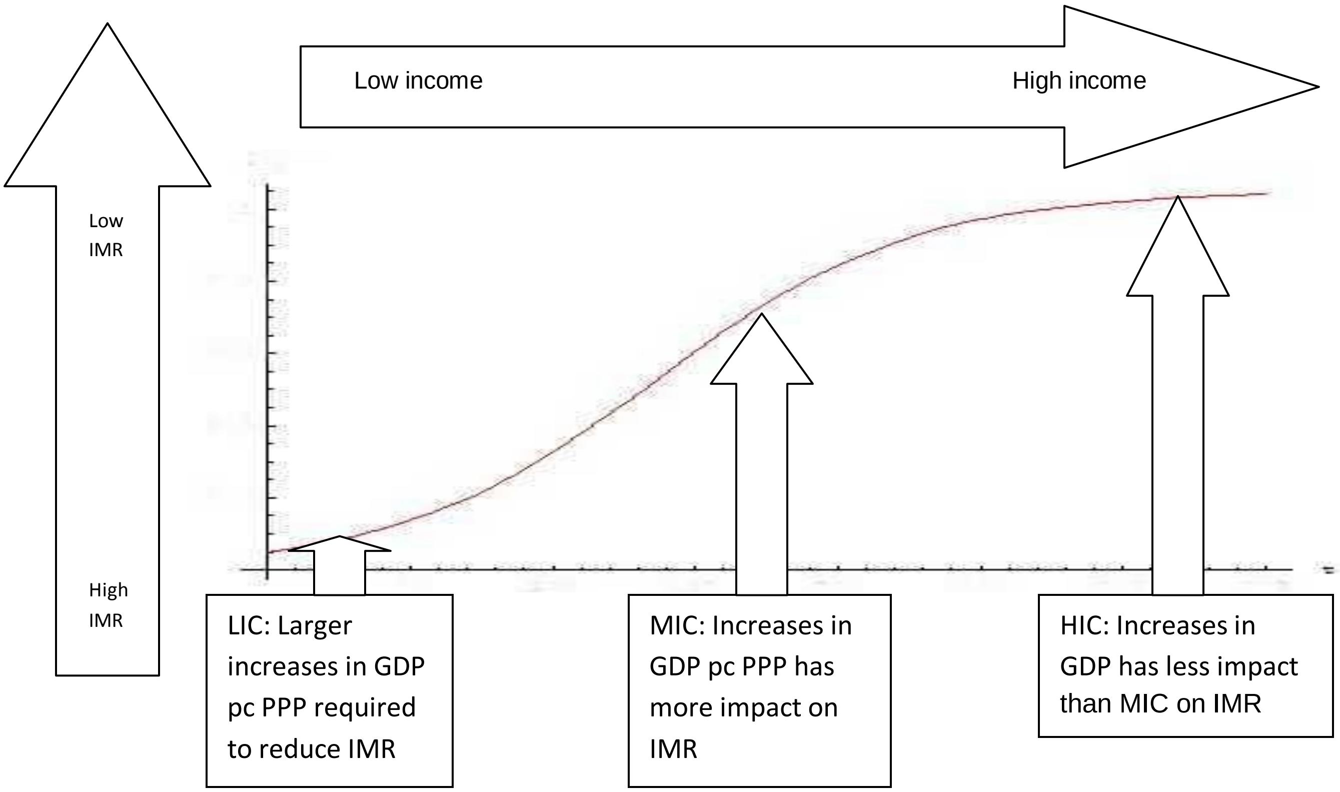
Given these considerations, we have concluded that the pooled elasticities from estimates that are unadjusted are the most accurate. The pooled elasticity of income on infant mortality is - 0.95 (95%CI - 1.34 to – 0.57).

Sub group analysis

The pooled adjusted and unadjusted elasticities are less negative when just MIC and LIC are included. However, the unadjusted pooled elasticities are generally more negative for poorer regions (LAC and SSA that include MIC and LIC) while the adjusted elasticities are less negative in these regions. As discussed, adjusting for covariates that contribute to the same pathway will dilute the effect of income and dampen the differences between the subgroups and in our opinion are less valid. The observation that pooled unadjusted elasticities are less negative for estimates which include just MIC and LIC but more negative for regions which include MIC and LIC, could suggest a hypothesis that the income mortality relationship is weaker at very low-income levels, stronger at middle income level and disassociates at high income level. The I^2 statistic is generally high in all unadjusted estimates which indicates that the variation across these estimates is due to heterogeneity. There is less heterogeneity among the adjusted estimates.

In 1975, Preston suggested that the relationship between income and life expectancy may be weaker at very low levels of income but had insufficient data points to confirm this, and his famous curve does not suggest such a relationship (12), there are now ample data on LIC. It is also known that when countries have reached a high level of development, further increases in terms of income has little impact on child mortality (9) or that mortality becomes increasingly disassociated from income per capita (12). Larger increases in income may be required to reduce child mortality in LIC. In preference to the Preston curve (4), we propose conceptualising the relationship between income and child mortality as a sigmoid curve with LIC on the flat part of the curve, MIC on the steep part and HIC on the plateau, see Figure 2. For low-income countries, the contribution of income to reduced infant mortality is because of low investments in supporting services (midstream variables). In order to appreciate this consider a country with very limited road infrastructure or low literacy levels, a larger increase in GDP per capita will be required to impact the child mortality than will be required in a country with some road infrastructure or some level of literacy.

Figure 2: A possible framework for the relationship between income and child mortality



Strengths and weakness of the study

Studies used different data sources, different measures of income and adjusted for disparate covariates or similar covariates but measured differently, see Table 7. The use of meta-analysis in the face of such marked heterogeneity is challenging, even when using a random effects model. However, for our main finding, we used unadjusted elasticities and the use of a wide variety of covariates will not influence this result.

The differences between the pooled estimates of unadjusted and adjusted estimates highlights the importance of carefully considering the causal pathways under investigation when studying the impact of income on child mortality. Our sub-group analysis raises questions about the sources of heterogeneity between regions and income groups and the influence of income at LIC, MIC and HIC level.
To the best of our knowledge this is the first time that the econometric literature on the relationship between income and child mortality has been systematically reviewed and Meta-analysed.

Implications for policymakers and future research

There is an inverse and significant relationship between income and child mortality. The pooled elasticity for those estimates, which are unadjusted for downstream covariates, or mediators, is -0.95 for infant mortality. If the IMR is 50/1000 and the GDP increases by 10%, we can expect the IMR to decrease to 45/1000.
Health policy makers often emphasize downstream interventions without considering the upstream determinants of health. We would appeal that socioeconomic determinants of health are considered alongside improving the coverage and availability of those downstream interventions, which have proven effectiveness. In order to reduce child mortality upstream as well as downstream interventions will be required.

This work confirms the importance of income for child health and provides a pooled estimate for the relationship. Further analyses at regional and country level, with adequate consideration of confounding factors, uniformity of methods, and thorough consideration of causality are important. It may be that there is differential impact of income on different causes of death, for example, diseases which are sensitive to nutrition may be more influenced by income (13). This review provides an estimate of the pooled elasticity of income for all-cause mortality only however, as cause of death data becomes more widely available, more detailed studies may become possible.

Competing interests: None

Authors' contribution:

Concept of the paper NBZ, LC and BOH

Protocol design LC, NBZ and BOH

Literature search and review IM and BOH

Data analysis NBZ and BOH

First draft of the manuscript BOH and IM

Final draft of the manuscript BOH, IM NBZ and LC

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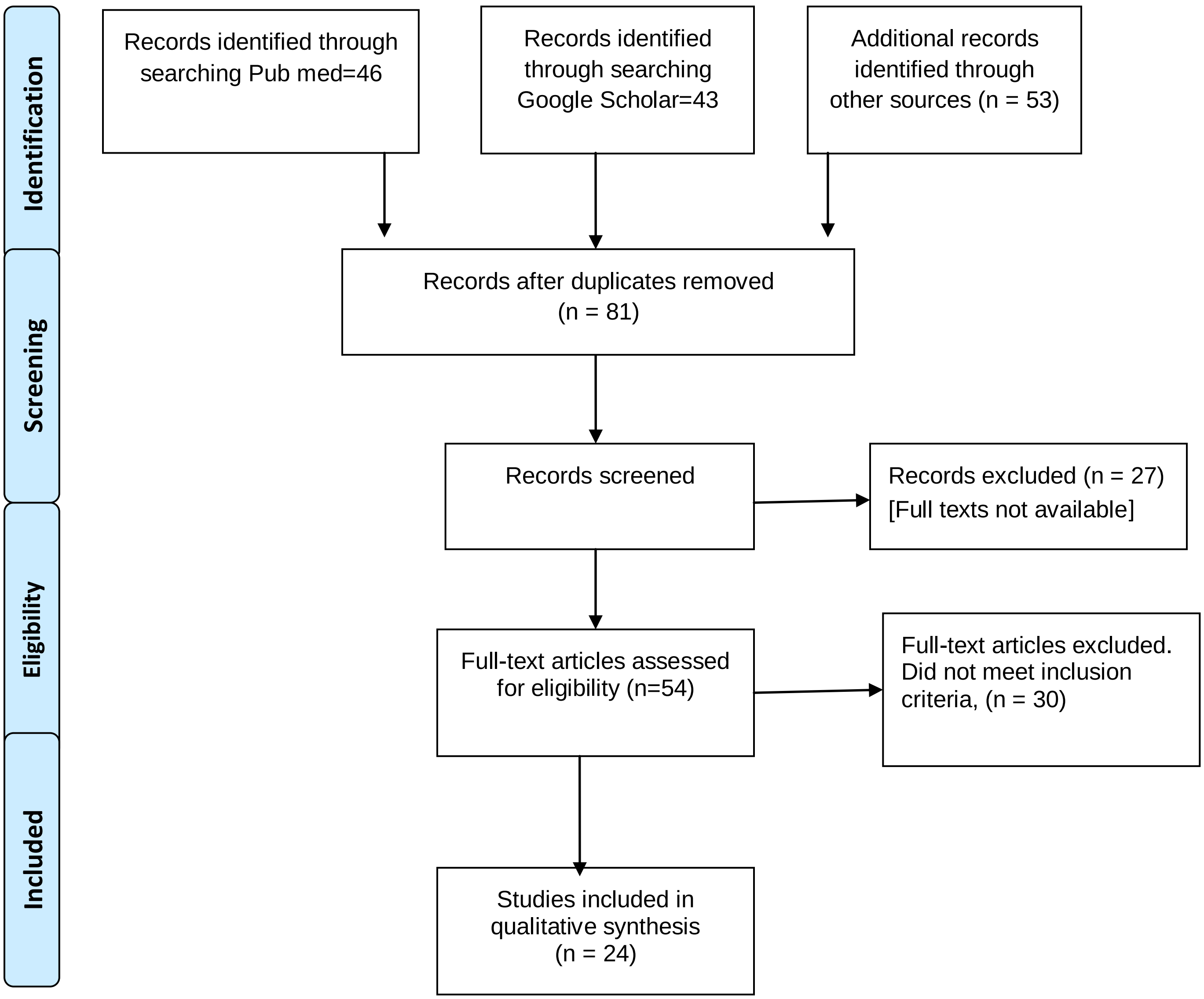
Figure 3: Flow Diagram summarizing the retrieval and selection process



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<tr><th>Table 2</th><th>IMR and Unadjusted Income</th></tr>
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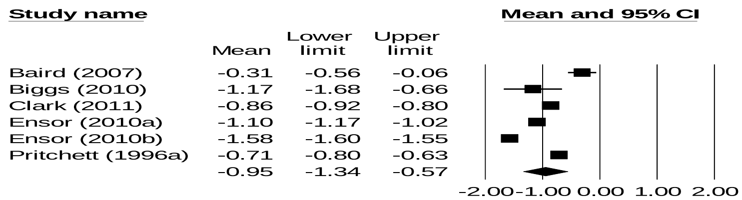
Heterogeneity
Q value – 820, df – 5, p <0.01, I^2 – 93%</td><td>
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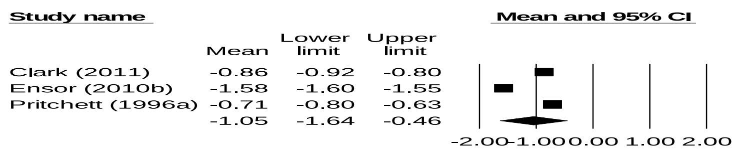
<tr><td>Income levels</td><td></td></tr>
<tr><td>Pooled elasticity of the log IMR on the unadjusted log of income for estimates which included HIC, MIC and LIC

Heterogeneity
Q - 709, df – 2, p < 0.01, I^2 - 99%</td><td>
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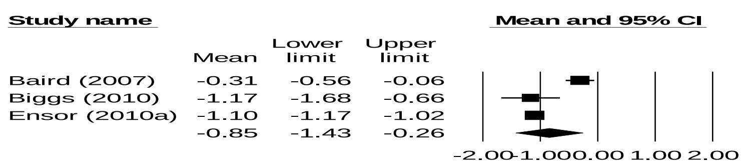
<tr><td>Pooled elasticity of the log IMR on the unadjusted log of income for estimates which included only MIC and LIC or MIC or LIC

Heterogeneity
Q - 36, df – 2, p < 0.01, I^2 - 94%</td><td>
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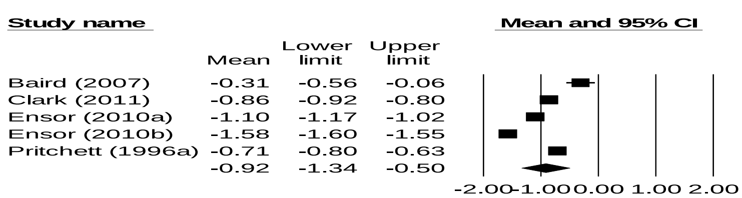
<tr><td>Regions</td><td></td></tr>
<tr><td>Pooled elasticity of the log IMR on the unadjusted log of income for estimates which included all regions

Heterogeneity
Q - 820, df - 4, p <0.01, I^2 - 99%</td><td>
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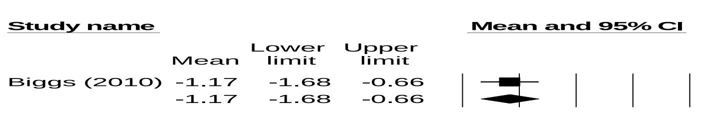
<tr><td>Pooled elasticity of the log IMR on the unadjusted log of income for studies which only included LAC</td><td>
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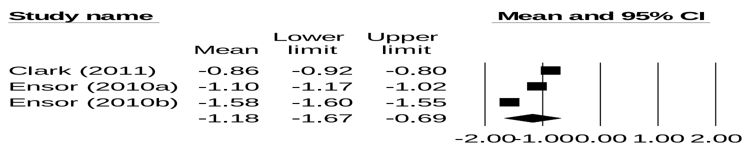
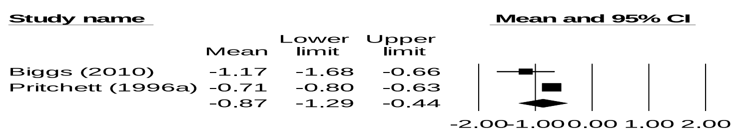
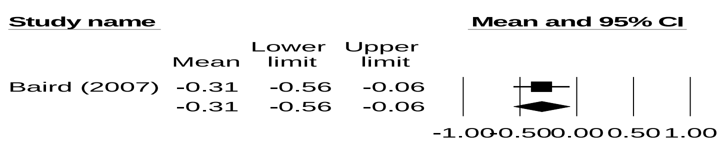
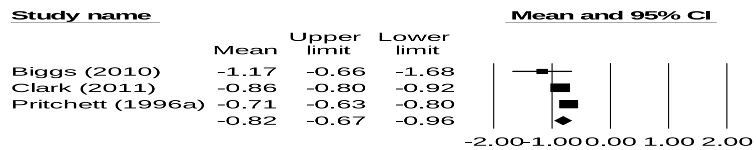
Pooled elasticity of the log IMR on the unadjusted log of income - SSA	No estimates
Time period	
Pooled elasticity of the log IMR on the unadjusted log of income for studies where the time period of the studies includes the 1950s **Heterogeneity** Q – 522, df – 2, p <0.01, I^2 - 99	
Pooled elasticity of the log IMR on the unadjusted log of income for studies where the time period of the included studies started in the 1960s **Heterogeneity** Q – 3, df – 1, p - 0.083, I^2 - 66%	
Pooled elasticity of the log IMR on the unadjusted log of income for studies where the time period of the included studies started in the 1970s	
Pooled elasticity of the log IMR on the unadjusted log of income for studies where the time period of the included studies started in the 1980s or 1990s	No estimates
Reverse causation	There were no cross sectional estimates of unadj IMR

Longitudinal, no lagging

Heterogeneity
Q -9.7, df -2, p < 0.01, I^2 - 79%



Longitudinal, with lagging

Heterogeneity
Q- 255, df -2, p<0.01, I^2 - 99%

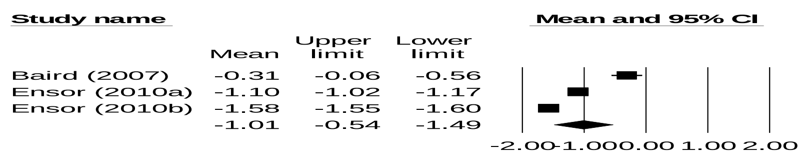
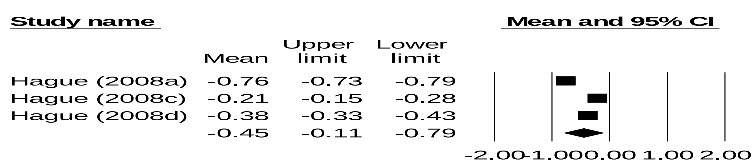


Table 3	**U5M and Unadjusted Income**

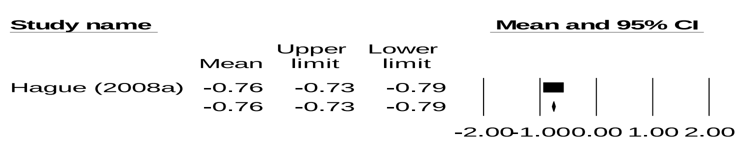
Pooled elasticity of the log U5M on the unadjusted log of income. All estimates used longitudinal and lagged data

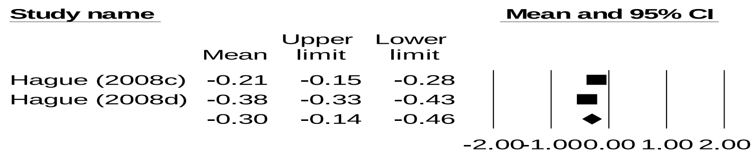
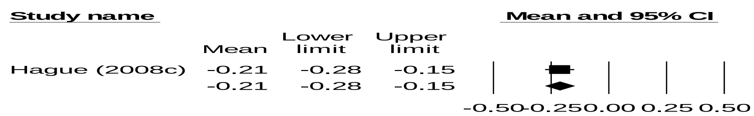
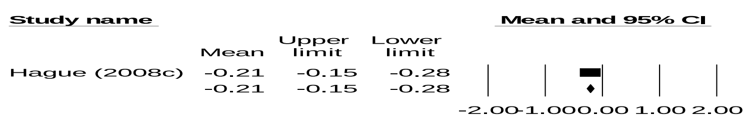
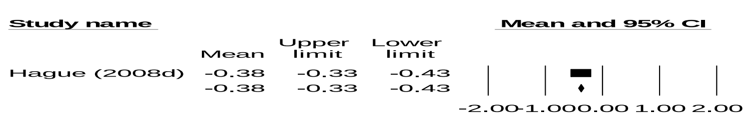
Heterogeneity
Q – 362, df – 2, p <0.01,
I^2 – 99%



Income level

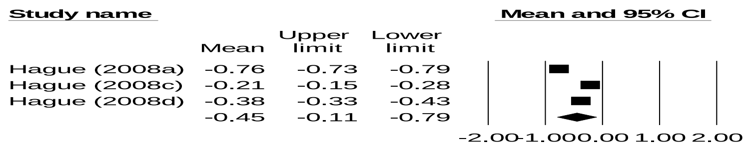
Pooled elasticity of the log U5M on the unadjusted log of income for estimates which included HIC, MIC and LIC



Pooled elasticity of the log U5M on the unadjusted log of income for estimates which included only MIC and LIC **Heterogeneity** Q – 17, df – 1, p <0.01, I^2 – 94%	
Pooled elasticity of the log U5M on the adjusted log of income for estimates which included only LIC	
Regions	
Pooled elasticity of the log U5M on the unadjusted log of income for estimates which included all regions	
LAC only	No estimates
Pooled elasticity of the log U5M on the unadjusted log of income for estimates which only included SSA	
Time period	
1950s	No estimates

<table>
<tr><td>Pooled elasticity of the log U5M on the unadjusted log of income for studies where the time period began in the 1960s

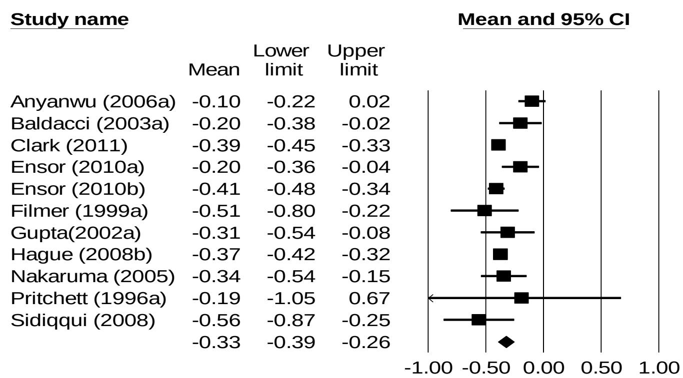
Heterogeneity
Q - 362, df - 2, p <0.01, I^2 -99%</td><td>



</td></tr>
<tr><td>1970s, 1980s, 1990s</td><td>No estimates</td></tr>
</table>

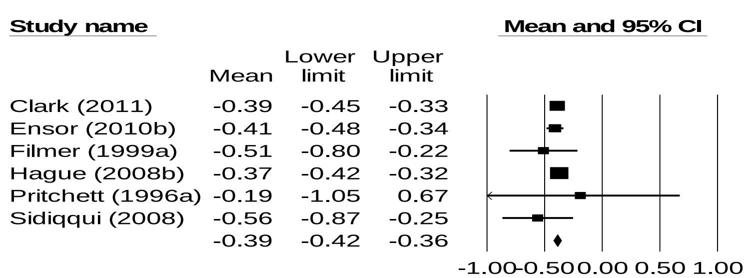
<table>
<tr><td>Table 4</td><td>IMR and adjusted Income</td></tr>
<tr><td>Pooled elasticity of the log IMR on the adjusted log of income

Heterogeneity
Q -32, df – 10, p <0.01, I^2 – 68%</td><td>



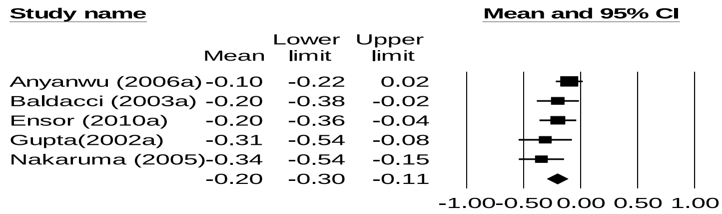
</td></tr>
<tr><td>Pooled elasticity of the log IMR on the adjusted log of income for estimates which included HIC, MIC and LIC

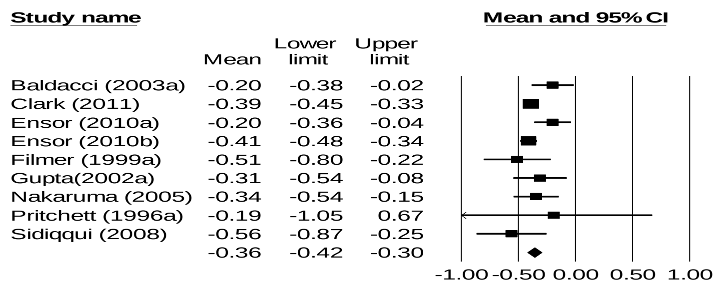
Heterogeneity
Q – 2.78, df – 5, p -0.733, I^2 – 0</td><td>

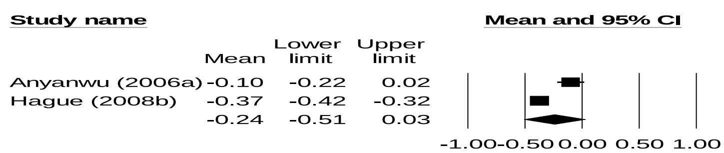


</td></tr>
</table>

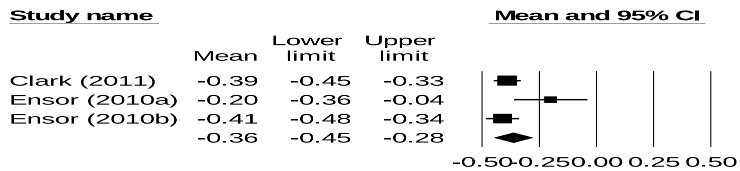
<table>
<tr><td>Pooled elasticity of the log IMR on the adjusted log of income for estimates which included MIC and LIC only

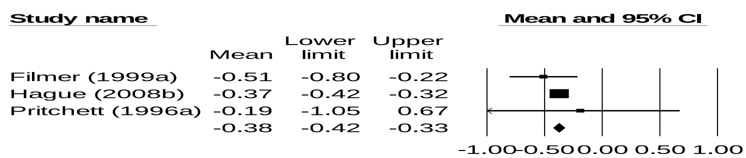
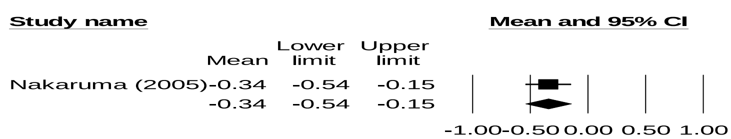
Heterogeneity
Q – 5.6, df – 5, p -0.23, I^2 –29</td><td>
</td></tr>
<tr><td>**Region**</td><td></td></tr>
<tr><td>Pooled elasticity of the log IMR on the adjusted log of income for estimates which included all regions

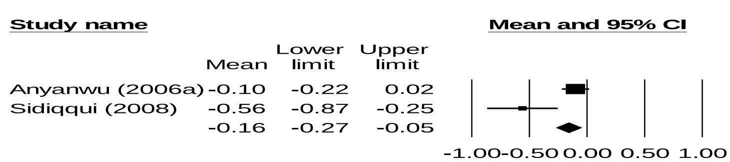
Heterogeneity
Q – 12, df – 8, p -0.153, I^2 –33</td><td>
</td></tr>
<tr><td>Pooled elasticity of the log IMR on the adjusted log of income for estimates which included SSA only

Heterogeneity
Q – 18, df – 1, p <0.01, I^2 –94</td><td>
</td></tr>
<tr><td>**Time period**</td><td></td></tr>
</table>

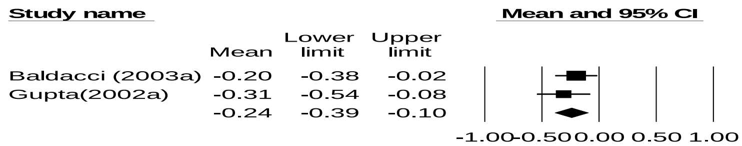
<table>
<tr><td>Pooled elasticity of the log IMR on the adjusted log of income for estimates which start or included the 1950s

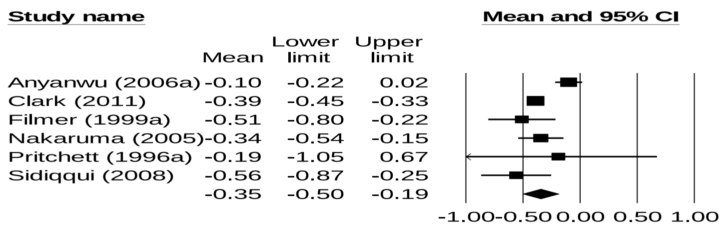
Heterogeneity
Q– 6, df – 2, p – 0.062, I^2 – 64</td><td>
</td></tr>
<tr><td>Pooled elasticity of the log IMR on the adjusted log of income for estimates which started in the 1960s

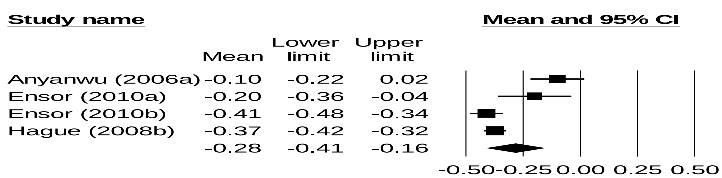
Heterogeneity
Q – 1, df – 2, p – 0.61, I^2 – 0</td><td>
</td></tr>
<tr><td>Pooled elasticity of the log IMR on the adjusted log of income for estimates which started in the 1970s</td><td>
</td></tr>
<tr><td>Pooled elasticity of the log IMR on the adjusted log of income for estimates which started in the 1990s

Heterogeneity
Q – 7.5, df – 1, p – 0.006, I^2 – 87</td><td>
</td></tr>
<tr><td>Reverse causation</td><td></td></tr>
</table>

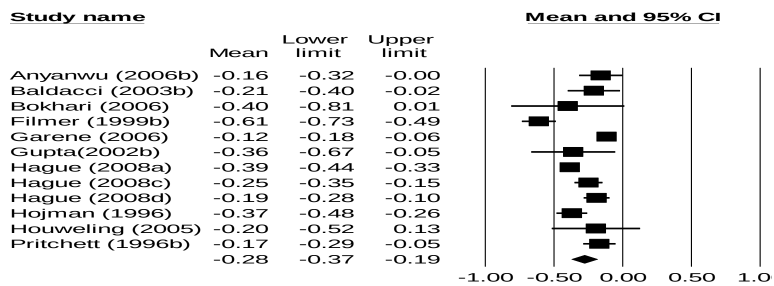
<table>
<tr>
<td>Pooled elasticity of the log IMR on the adjusted log of income for estimates which were cross sectional

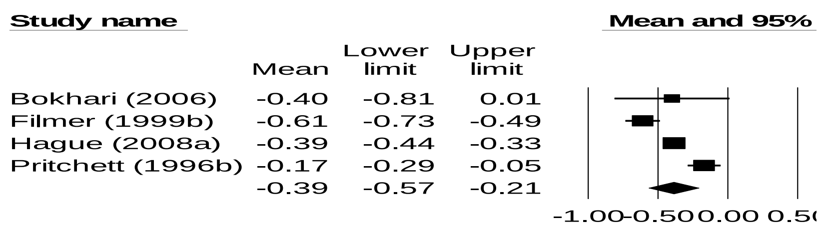
Heterogeneity
Q value – 0.5, df – 1, p – 0.46, I^2 – 0</td>
<td>
</td>
</tr>
<tr>
<td>Pooled elasticity of the log IMR on the adjusted log of income for estimates which were longitudinal but not lagged

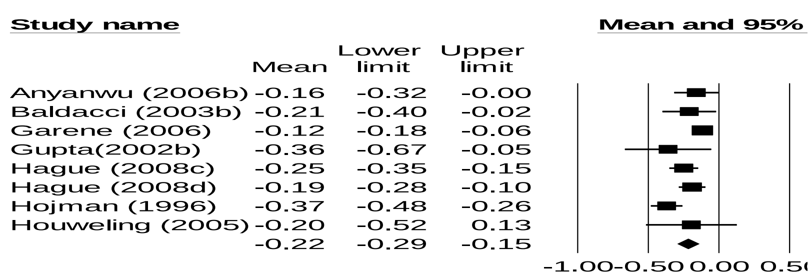
Heterogeneity
Q – 22, df – 5, p <0.01. I^2 – 77</td>
<td>
</td>
</tr>
<tr>
<td>Pooled elasticity of the log IMR on the adjusted log of income for estimates which were longitudinal and lagged

Heterogeneity
Q – 24, df – 3, p <0.01, I^2 – 87</td>
<td>
</td>
</tr>
</table>

<table>
<tr><th>Table 5</th><th>U5M and adjusted income</th></tr>
<tr><td>Pooled elasticity of the log U5M on the adjusted log of income

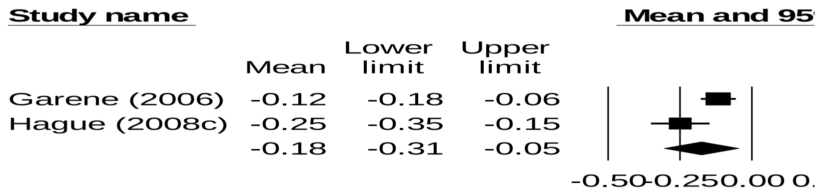
Heterogeneity
Q -85, df – 11, p <0.01, I I^2 - 87%</td><td>
</td></tr>
<tr><td>Pooled elasticity of the log U5M on the adjusted log of income for estimates which included HIC, MIC and LIC

Heterogeneity
Q -26, df – 3, p <0.01, I^2 -88%</td><td>
</td></tr>
<tr><td>Pooled elasticity of the log U5M on the adjusted log of income for estimates which included MIC and LIC

Heterogeneity
Q -18, df – 7, p -0.011, I^2 - 61%</td><td>
</td></tr>
</table>

Pooled elasticity of the log U5M on the adjusted log of income for estimates which included only LIC

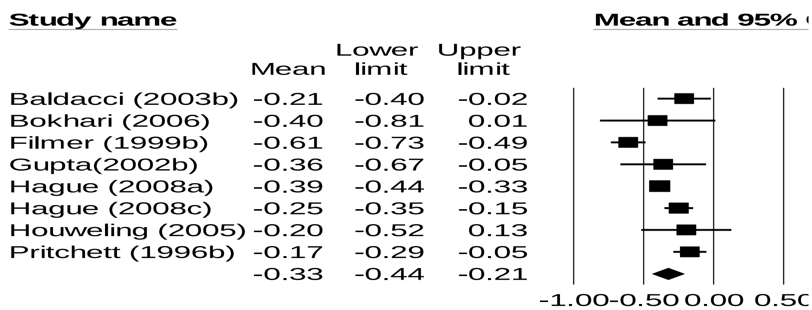
Heterogeneity
Q – 4, df – 1, p -0.029, I^2 - 79%



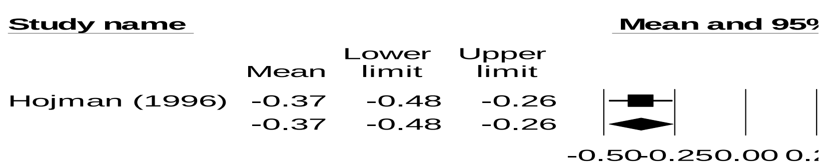
Regions

Pooled elasticity of the log U5M on the adjusted log of income for estimates which included all regions

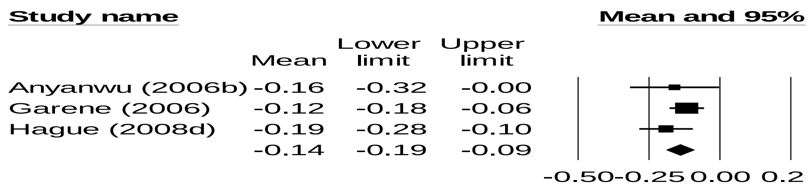
Heterogeneity
Q -35, df – 7, p <0.01 , I^2 – 79%



Pooled elasticity of the log U5M on the adjusted log of income for estimates which included only LAC

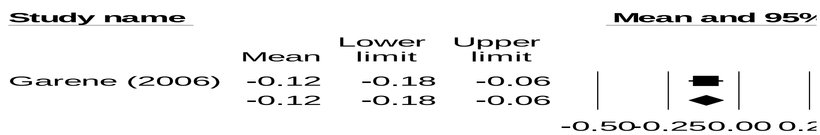


Pooled elasticity of the log U5M on the adjusted log of income for SSA estimates **Heterogeneity** Q -1.68**,** df – 2**,** p -0.428**,** I^2 – 00



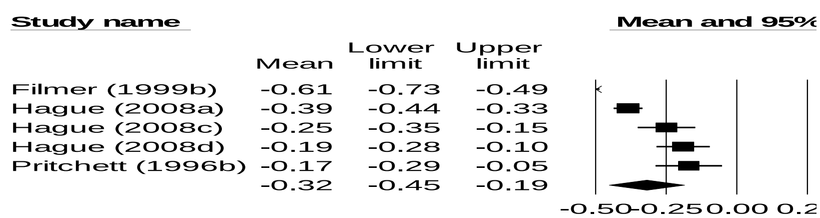
Time period

Pooled elasticity of the log U5M on the adjusted log of income for estimates which began with or included the 1950s



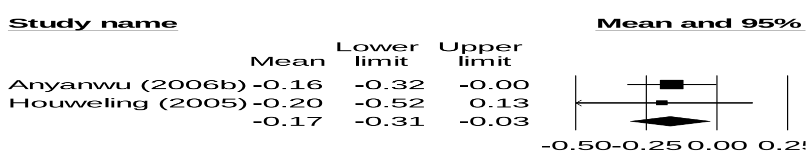
Pooled elasticity of the log U5M on the adjusted log of income for estimates which began with the 1960s

Heterogeneity
Q -42**,** df – 4**,** p <0.01**,** I^2 -90



Pooled elasticity of the log U5M on the adjusted log of income for estimates which began with the 1990s

Heterogeneity
Q - 04, df – 1, p <0.848, I^2 – 0



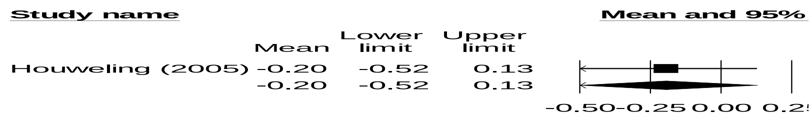
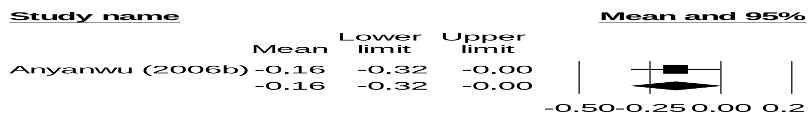
Pooled elasticity of the log U5M on the adjusted log of income for longitudinal estimates without lagging	
Pooled elasticity of the log U5M on the adjusted log of income for longitudinal estimates with lagging	

Table 6: Estimations on elasticity

Study	**Study**	Income level	Region	Yrs covered	Measure of mortality	log.log adjusted	SE	log.log unadjusted	SE
1	Amouzou 2004 (14)	LIC,MIC	SSA	1960-2000	U5M	-0.17	NR	-0.29	NR
2	Ando 2006a (15)	LIC,MIC	SSA	1990	IMR	-0.012	NR	NA	
3	Ando 2006b (15)	LIC,MIC	SSA	2000	IMR	-0.294	NR	NA	
4	Anyanwu 2006a (16)	LIC,MIC	SSA	1999-2004	IMR	-0.1	0.06	NA	
5	Anyanwu 2006b (16)	LIC,MIC	SSA	1999-2004	U5M	-0.16	0.08	NA	
6	Baird 2007 (17)	LIC,MIC	All regions	1975-2004	IMR	-13.72 Lin.log	7.97	-0.31	0.126
7	Baldacci 2003a (18)	LIC,MIC	All regions	1996-1998	IMR	-0.20	0.094	NA	
8	Baldacci 2003b (18)	LIC,MIC	All regions	1996-1998	U5M	-0.21	0.097	NA	
9	Biggs 2010 (10)	LIC,MIC	LAC	1960 - 2007	IMR	NR	NR	-1.17	0.26
10	Birchenall 2007 (13)	HIC,MIC,LIC	All regions	1950 - 2003	IMR	-17.95 Lin.log	1.53	NA	
11	Bokhari 2006 (19)	HIC,MIC,LIC	All regions	2000	U5M	-0.4	0.21	NA	
12	Clark 2011 (20)	HIC,MIC,LIC	All regions	1950 - 2005	IMR	-0.39	0.03	-0.86	0.03
13	Ensor 2010a (21)	LIC, MIC	All regions	1936 – 2005	IMR	-0.20	0.082	-1.099	0.038
14	Ensor 2010b (21)	HIC	All regions	1936 – 2005	IMR	-0.41	0.037	-1.575	0.015
15	Filmer 1999a (22)	HIC,MIC,LIC	All regions	1960 – 1985	IMR	-0.51	0.15	NA	
16	Filmer 1999b (22)	HIC,MIC,LIC	All regions	1960 – 1985	U5M	-0.61	0.063	NA	
17	Garene 2006 (23)	LIC	Zambia	1950-2000	U5M	-0.117	0.031	NA	
18	Gupta 2002a (24)	LIC,MIC	All regions	1990 -1999	IMR	-0.31	0.119	NA	
19	Gupta 2002b (24)	LIC,MIC	All regions	1990 -1999	U5M	-0.36	0.156	NA	
20	Hague 2008a (25)	HIC, MIC, LIC	All regions	1965 –2005	U5M	-0.385	0.026	-0.76	0.014
21	Hague 2008b (25)	HIC, MIC, LIC	SSA	1965 –2005	IMR	-0.373	0.025	NA	
22	Hague 2008c (25)	LIC	All regions	1965 –2005	U5M	-0.249	0.052	-0.213	0.032
23	Hague 2008d (25)	LIC, MIC	SSA	1965 –2005	U5M	-0.190	0.048	-0.378	0.024
24	Hanmer 2000a (26)	LIC, MIC	All regions	1990-1999	IMR	-20.42	5.61		
25	Hanmer 2000b (26)	LIC, MIC	All regions	1990-1999	U5M	-37.86 Lin.log	13.19		
26	Hojman 1996 (27)	LIC,MIC	LAC	1992	U5M	-0.37	0.057	NA	
27	Houweling 2005 (28)	LIC,MIC	All regions	1990-1999	U5M	-0.195	0.164	-0.441	

28	Klasen 2006 (29)	LIC,MIC	All regions	1990-2000	U5M	-31.58 Lin.log	3.805		
29	Mogford 2004 (30)	LIC,MIC	SSA	1970 –1997	U5M	-1.42 Lin.log	14.36		
30	Nakamura 2005 (31)	LIC,MIC	All regions	1970-2001	IMR	-0.344	0.101	NA	
31	Pritchett 1996a (32)	HIC, MIC, LIC	All regions	1960 – 1980	IMR	-0.19	0.44	-0.713	0.043
32	Pritchett 1996b (32)	HIC, MIC, LIC	All regions	1960 – 1980	U5M	-0.17	0.06	NA	
33	Schell 2007a (9)	HIC, MIC, LIC	All regions	2003	IMR	-0.48		-0.91	
34	Schell 2007b (9)	LIC	All regions	2003	IMR	-0.46		-0.56	
35	Schell 2007c (9)	MIC	All regions	2003	IMR	-0.56		-0.49	
36	Sidiqqui 2008 (33)	HIC, MIC, LIC	All regions	1996-2004	IMR	-0.56	0.156	NA	
37	Wang 2002a (1)	LIC	All regions	1990-1999	IMR	-17.473 Lin.log	6.354	NA	
38	Wang 2002b (1)	LIC	All regions	1990-1999	U5M	-37.33 Lin.log	12.74	NA	

Table 7 Summary of covariates and methods used to measure by the 24 included studies

Covariate category	Number of papers which included this as a covariate	Number of different measures of this covariate	The measures used for this
Education	22	12	Adult literacy, dummy for primary school education, female literacy rates, gross female secondary school attendance, gross female secondary school enrolment, parents education dummy, population illiteracy rates, primary school enrolment rates, public expenditure on education as % GDP, spending per pupil, women 15+ illiterate, years of female schooling.
Health Expenditure	15	3	Health education as % GDP, Government health expenditure per capita, total health expenditure and government expenditure per capita
Urbanisation	12	3	Population living in urban areas, population living in rural areas, rural urban dummy
Region/country specific effects	13	4	Regional dummy, tropics dummy, state dummy (India), country specific effects
Health intervention	12	8	Births attended by skilled personnel/ health professional, vaccination coverage, number of physicians per 1000/ per 100,000/ per capita, imports of medicinal products, number of hospital beds per 1000, population per nurse, knowledge of ORT
Water/sanitation	9	3	Access to sanitation, access to safe water, access to sanitation and safe water
Inequality	8	1	GINI index
HIV	7	4	Adult HIV prevalence, adult and child HIV prevalence, prevalence among pregnant women, prevalence among women
Time dummy	6	5	Time, year, linear dummies
Miscellaneous	22		Fertility rates, democratization, capital formation, rain shocks, state specific controls(poverty, the ratio of agricultural to non-agricultural income, technological progress, , mother-specific characteristics (age ethnicity, religion), child specific effects (sex, birth-month), aid PPP, asset index, access to electricity, crude birth rate, ethnolinguistic fractionalization, religion dummy, foreign aid, inflation, openness to trade, policy index, institutional quality, financial depth, land rights, infrastructure (paved roads per unit area), donor funding, investment per capita, malnutrition, debt-GDP ratio, mother's age, birth-specific characteristics, political stability, population growth, infrastructure (% of paved roads), poverty gap index, inflation, GDP shocks, maternal age at birth, religion, poverty rates, spending on meat and fat, alcohol and tobacco use, malaria prevalence, wealth quintiles.