Cover Page

Title: Social Inequality in Infant Mortality: What Explains Variation Across Low and Middle Income Countries?

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*Highlights (for review)

Research Highlights

- One of the first comprehensive studies of social inequalities in infant mortality.
- Relative social inequalities in infant mortality were higher in wealthier LMICs.
- Absolute social inequalities in infant mortality were higher in poorer LMICs.
- Reducing teenage pregnancy may mitigate social inequalities in infant mortality.

Social Inequality in Infant Mortality: What Explains Variation Across Low and Middle Income Countries?

Abstract

Growing work demonstrates social gradients in infant mortality within countries. However, few studies have compared the magnitude of these inequalities cross-nationally. Even fewer have assessed the determinants of social inequalities in infant mortality across countries. This study provides a comprehensive and comparative analysis of social inequalities in infant mortality in 53 low-and-middle-income countries (LMICs). We used the most recent nationally representative household samples (n=874,207) collected through the Demographic Health Surveys (DHS) to calculate rates of infant mortality. The relative and absolute concentration indices were used to quantify social inequalities in infant mortality. Additionally, we used meta-regression analyses to examine whether levels of inequality in proximate determinants of infant mortality were associated with social inequalities in infant mortality across countries. Estimates of both the relative and the absolute concentration indices showed a substantial variation in social inequalities in infant mortality among LMICs. Meta-regression analyses showed that, across countries, the relative concentration of teenage pregnancy among poorer households was positively associated with the relative concentration of infant mortality among these groups (beta=0.333, 95% CI=0.115 0.551). Our results demonstrate that the concentration of infant deaths among socioeconomically disadvantaged households in the majority of LMICs remains an important health and social policy concern. The findings suggest that policies designed to reduce the concentration of teenage pregnancy among mothers in lower socioeconomic groups may mitigate social inequalities in infant mortality.

Keywords Infant mortality, socioeconomic inequality, meta-regression analysis, developing country

Introduction

Improving the health outcomes of children has been the central focus of many public health programs (Simon et al., 2001) in the world over the last three decades. To date, there have been several international goals set out to improve child health. The Declaration of Alma Ata (1978) aimed to reduce infant mortality rates (IMR) to less than 50 death per 1000 live-births through a global strategy for "Health for All" by the Year 2000 (World Health Organization, 1981). Subsequently, the 1990 World Summit for Children Programme of Action and the Programme of Action of the International Conference on Population and Development (ICPD, 1994) encouraged countries to reduce infant mortality. Another international effort targeting infant mortality is the fourth goal of the United Nations Millennium Development Goals (MDG 4). The MDG 4 is set to reduce IMRs between 1990 and 2015 by two thirds.

Despite the remarkable improvement in child health over the past three decades, infant mortality still remains a central issue in the global health agenda. There is extremely uneven progress towards reducing infant mortality across countries and regions (World Bank, 2012a; You et al., 2011), Furthermore, there is a growing body of global research demonstrating a social gradient in children's health outcome within countries: children belonging to lower compared to higher socioeconomic status (SES) households have a lower probability of surviving to their first birthday (Adler & Ostrove, 1999; Adler et al., 1994; Arntzen & Nybo Andersen, 2004; Bakketeig et al., 1993; Finch, 2003; Hobcraft et al., 1984; Hosseinpoor et al., 2006). The vast majority of these deaths are preventable and inequitable (Hosseinpoor et al., 2006; WHO/UNICEF, 2012; WHO/World Bank, 2002).

The monitoring of socioeconomic inequalities in child health within and among countries has an important role in gauging progress toward the commitments made by decision makers to reduce inequalities in infant mortality (Cesar G Victora et al., 2003). However, measuring socioeconomic inequalities alone is not enough to secure sustainable changes. Identifying the factors explaining the concentration of infant mortality among children born into lower SES households is essential to implementing effective policies to redress these inequalities (Hosseinpoor et al., 2006; Victora et al., 2003).

Although inequalities in health have recently received substantial attention in the economics and public health literature (Costa-Font & Hernández-Quevedo, 2012; Gwatkin, 2000; Kawachi et al., 2002; Marmot & Wilkinson, 2006; O'Donnell et al., 2008; Wagstaff et al., 1991), few studies (Hosseinpoor et al., 2006; Monteiro et al., 2010; Pradhan & Arokiasamy, 2010; Vapattanawong et al., 2007; Wang, 2003; Zere et al., 2007) have measured socioeconomic inequalities in infant mortality using a summary measure such as the concentration index, which accounts for inequality across the entire socioeconomic distribution. Therefore, this study aimed to provide a comprehensive and comparative analysis of social inequality in infant mortality across 53 low-and-middle-income countries (LMICs) using the most recent nationally representative samples of live births collected through the Demographic Health Surveys (DHS). In addition, following the conceptual framework developed by Houweling & Kunst (2010) we used meta-regression to analyze whether inequalities in proximate risk factors for infant mortality were associated with the magnitude of social inequality in infant mortality across countries.

Methodology

Data

The data for this study were obtained from the Demographic Health Surveys (DHS). The DHS typically are cross-sectional surveys of nationally representative household samples for selected LMICs (Corsi et al., 2012). The DHS surveys collect comparable information concerning a wide range of topics, with a special focus on maternal and child health (Rutstein & Rojas, 2006). These surveys are an important source of comparative population health data in LMICs due to their data quality, coverage, and comparability (Pullum, 2008; Vaessen, 1996; Wirth et al., 2006). DHS respondents are selected by a multistage sampling procedure and most samples are stratified by urban and rural status and/or by country specific administrative or geographic regions (Demographic and Health Survey, 1996). In order to ensure standardisation and comparability of surveys across time and countries, the DHS uses trained and experienced interviewers, standardized measurement techniques and tools, and an identical core set of questions (Demographic and Health Survey, 2006; Subramanian et al., 2011). The DHS have been conducted in more than 85 countries worldwide since 1984 (Corsi et al., 2012). This study uses information from 53 DHS surveys carried out between 2003 and 2011. For countries with more than one DHS for the study period, only the most recent survey was included in the analysis.

Measures

The analysis of infant mortality in each country is based on information on live births over a 5 year period. We examined the outcomes of all births that occurred between 6 years prior to the survey and one year prior to the survey. This observation period allowed us *first* to have a follow-up period of at least one year for each live birth and *second* to provide recent estimates while ensuring adequate births to reduce sampling error in the analysis (Anand et al., 2001; Hosseinpoor et al., 2006).

A constructed wealth index provided in all standard DHS was used as a measure of socioeconomic status of infants. The wealth index is calculated using available information on a household's ownership of selected assets (e.g. bicycle and televisions), type of water source used by household, sanitation facilities and materials used for housing construction. The DHS uses the method suggested by Filmer & Pritchett (2001) to construct the wealth index (Rutstein & Johnson, 2004). The average Gross Domestic Product (GDP) per capita was used as an indicator of country-level socioeconomic status. We calculated the average GDP per capita by using the World Bank's World Development Indicators and Global Development Finance (WDI and GDF) database (World Bank, 2012a). The average GDP per capita was adjusted for purchasing power parity (PPP) and logged to correct for skewness.

In the health literature, several measures have been proposed to examine inequalities, including the index of dissimilarity, the relative index of inequality, the Gini coefficient and the concentration index (Nikolaou & Nikolaou, 2008). We used the concentration index to quantify socioeconomic inequalities in infant mortality. As described by Wagstaff et al., (1991), the concentration index, unlike the commonly used Gini coefficient, satisfies three qualities for a favourable socioeconomic inequality index, namely that: 1) the index should reflect the health inequalities that arise from the socioeconomic characteristics; 2) it should be representative of the whole population; and 3) it should be "sensitive to changes in the distribution of the population across socioeconomic groups". There has been extensive discussion on whether to use absolute or relative measures of inequalities in health (Asada, 2010). We used both relative and absolute measures of the concentration index in our study because there is general agreement on the use of both measures to describe social inequalities in health (Asada, 2010; Harper et al., 2010; King et al., 2010).

The relative concentration index (RC) for infant mortality within each country was calculated with reference to the relative concentration curve, which plots the cumulative percentage of live births, ranked in ascending order of a socioeconomic factor, in this case household wealth, on its x-axis (see Figure 1(a)). The relative concentration curve allows us to determine, for example, the proportion of infant mortality that occurs in a certain wealth quintile, and to make statements such as '15% of total infant mortality occurred among the poorest 10% of infants'. In a special case in which each quintile of live birth, ranked by wealth, has an equal share of infant mortality, the relative concentration curve coincides with the diagonal line representing perfect equality. The RC is computed as twice the area between the relative concentration curve and the line of perfect equality. The index is negative if the relative concentration curve lies above the line of equality, indicating that infant mortality is concentrated among poorer households (and is positive if the curve lies below the line of inequality indicating greater concentration among wealthier households) (World Bank, 2012b). The RC ranges from -1 to 1, with a value of zero representing "perfect equality". Koolman & Van Doorslaer (2004) demonstrated that if we multiply the magnitude of the RC by 75, it will give us the fraction of the health variable that would need to be redistributed from the poorer half of the population towards the wealthier half (in the case that ill health is concentrated among the poor) in order to achieve perfect equality.

The RC is attractive to those who want to examine relative differences in health between SES groups. It is also possible to generalize the concentration curve such that it becomes sensitive to changes in the population mean of the outcome and reflects absolute, rather than relative, differences in health between SES groups. The generalized concentration curve is simply the relative (standard) concentration curve multiplied by the mean level of population health (μ). Thus, it maps the cumulative share of population, ranked according to a SES factor, against the cumulative amount of health (i.e. cumulative contribution of each socioeconomic group to the mean level of population health) (see Figure 1(b)). The absolute concentration index (AC) is defined as twice the area between the perfect equality line (the diagonal) and the generalized concentration curve. The AC is calculated by multiplying the RC by the mean level of population health (i.e. $AC = \mu RC$). The AC ranges from $-\mu$ to μ, with zero representing "no disparity" (Wagstaff et al., 1991)..

<<<Insert Figure 1>>>

Statistical analyses

Our approach involved two steps: First, we measured the relative and absolute (generalized) concentration indices for infant mortality within each country. Second, meta-regression analyses were used to investigate the degree to which levels of inequality in proximate determinants of infant mortality were associated with socioeconomic inequalities in infant mortality, as measured by the concentration indices, across countries.

Measuring Socioeconomic Inequalities: We used the RC and AC indices to quantify social inequalities in infant mortality in each country, using live birth as a unit of analysis. The indices were measured by the "convenient regression" approach suggested by Kakwani et al., (1997), using the Newey-West regression estimator (Newey & West, 1994) to correct for autocorrelation as well as heteroskedasticity (World Bank, 2012b). Additionally, Wagstaff's correction (Wagstaff, 2005) was applied to the measurement of the RC and AC and their standard errors (i.e. multiplying the RC by $1/1-\mu$, where μ is mean infant mortality) because the outcome of interest in this study, infant death, is binary. Ninety-five percent confidence intervals were used to examine statistical difference of the RC and AC indices (with confidence intervals not including the null indicating a departure from perfect equality). We also calculated a summary measure of social inequality in infant mortality across sampled countries by ranking countries according to their GDP per capita and estimating the RC and AC. In addition, Pearson correlations were used to examine the associations between the concentration indices and infant mortality rates, as well as the concentration indices and (log) GDP per capita, across the sampled countries.

Meta-Regression Analysis: We used the calculated RC and AC for infant mortality in each country as the dependent variables in the meta-regression analysis. The explanatory variables included were income inequality (i.e. Gini coefficients) and levels of socioeconomic inequality (i.e. measured by the RC or AC, depending on whether the dependent variable was measured in relative or absolute terms) in proximate determinants of infant mortality. Based on the extant literature, determinants of infant mortality include socioeconomic (e.g. income and education), biological (e.g. mother's age and risky birth interval), nutritional (e.g. breastfeeding) and environmental (e.g. having hygienic toilet) characteristics, as well as antenatal care and vaccination coverage (Foggin et al., 2001; Hosseinpoor et al., 2006; Kembo & Ginneken, 2009; Mturi & Curtis, 1995; Schell et al., 2007). In our analysis, we included socioeconomic inequalities in proximate determinants for infant mortality that have been collected consistently in all DHS surveys included in the analysis. These variables include socioeconomic inequalities in mother's education, mother's age at birth less than 19 years, mother's age at birth greater than 40 years, and birth interval of less than 24 months. As the DHS do not collect information on income or expenditure, the Gini coefficients calculated by the World Bank (2012a) were used as a measure of income inequality for each country in the analysis. We did not include income inequality in the meta-regression analyses of absolute inequalities as our data did not allow us to estimate the generalized Gini coefficients for each country.

First, we performed univariate linear regression analyses regressing social inequalities in infant mortality separately on each explanatory factor to assess unadjusted associations. Second, a multivariate linear regression was performed to assess if the results were consistent with those obtained from the univariate regressions. In order to avoid collinearity in the multivariate regression, we excluded antenatal care (ANC) received from health professionals at least once during pregnancy in our final models because the correlation matrix of the independent variables suggested higher correlations between the RCs for ANC and mother's education attainment (0.55) and between the ACs for ANC and birth interval of less than 24 months (-0.54). This resulted in a total of five and four independent variables in the analyses of the RC and AC for infant death, respectively (see Table 1). The final models satisfied a generally accepted "rule of thumb" of having a minimum of 10 observations per predictor in regression analysis (Peduzzi et al., 1995).

<<<Insert Table 1>>>

A random-effects technique was employed in the analysis because, as argued by Higgins & Thompson (2004) and Thompson & Sharp (1999), fixed-effect meta-regression assumes that all heterogeneity in the outcome can be explained by the included covariates and thus is not usually recommended. All models were weighted by the inverse variance of the RC or AC for infant mortality. All analyses were performed in STATA statistical software version 12.

Results

Infant Mortality

Table 2 reports the sample size, GDP per capita, and overall and gender-specific IMRs for each county. Rates of infant mortality ranged from less than 20 deaths per 1000 births in Moldova, Armenia, Ukraine and Colombia to greater than 100/1000 births in some sub-Saharan African countries, including Chad, Guinea, Mozambique and Mali. Sex differentials in infant mortality varied widely across countries, with rates generally higher for males than females. As illustrated in Figure 2, there were distinct differences in infant mortality levels among the four regions: sub-Saharan Africa, North Africa/West Asia/Europe, Latin America & Caribbean, and South & Southeast Asia. While the total infant mortality rate was 72 deaths per 1000 live births in sub-Saharan African region, the overall infant mortality rates in North Africa/West Asia/Europe and Latin America & Caribbean regions were 24 and 30 per thousand births, respectively. There was a strong negative cross-country correlation (r(51)=-0.73, p<0.01) between (log) per capita GDP and the IMR.

<<<Insert Table 2 and Figure 2>>>

Socioeconomic inequality in infant mortality

Table 3 reports the relative and absolute concentration indices for infant mortality for 53 LMICs. The consistently negative values of the RC and AC indicate that infant mortality was concentrated among infants belonging to lower SES households; for 70% of countries sampled, social inequalities in infant mortality, as measured by the RC, were higher in girls than in boys. There were substantial differences in the magnitudes of social inequalities in infant mortality across regions. According to estimates of the RC, social inequalities in infant mortality were more pronounced among countries in the North Africa/West Asia/Europe region than sub-Saharan Africa, where countries have the highest rates of infant mortality. In contrast to inference based on the RC, comparisons of the AC showed that socioeconomic inequalities in infant mortality were generally higher in sub-Saharan African countries than other regions of the world. Summary measures of social inequality in infant mortality, calculated by ranking countries according to their GDP per capita, indicated that infant mortality was concentrated among poorer countries (RC=-0.135 and AC=-0.766); the concentration of infant mortality among poorer countries was slightly higher in males (RC=-0.152 and AC=-0.909) than in females (RC=-0.131 and AC=-0.702)

<<<Insert Table 3>>>

Figure 3 shows the cross-country correlation between the total IMR and the concentration indices for total infant mortality. There was a positive correlation ($r(51)=0.31$, $p<0.05$) between the IMR and the RC (panel a), indicating that levels of relative social inequality in infant mortality were higher in countries with a lower IMR. This suggests that the relative concentration of infant mortality among socioeconomically disadvantaged households was higher in countries with lower infant mortality rates. Conversely, there was a negative association ($r(51)=-0.34$, $p<0.05$) between the IMR and the AC. This indicates that the absolute concentration of infant mortality among socially disadvantaged households was generally greater in countries with a higher IMR (panel b). In other words, the absolute differences between higher and lower socioeconomic status households in infant death was higher in countries with higher infant mortality.

<<<Insert Figure 3>>>

As shown in Figure 4, there was a negative association ($r(51)=-0.32$, $p<0.05$) between (log) GDP per capita and the RC for total infant mortality (panel a). This suggests that the relative concentration of infant mortality among poorer households was higher in comparatively wealthier countries. Results (panel b) showed a small positive association between the AC and (log) GDP per capita ($r(51)=0.18$, $p=0.21$).

<<<Insert Figure 4>>>

Factors explaining the variation in inequality

We used meta-regression analyses to identify factors associated with levels of social inequality in infant mortality across LMICs (Table 4). In unadjusted linear regression models measuring social inequalities using the RC, the relative concentration among poorer households of births among mothers less than 19 years of age (beta=0.315, 95% CI=0.104 0.526) and births at intervals of less than 24 months (beta=0.349, 95% CI=0.104 0.594) were positively associated with social inequalities in total infant mortality. In multivariable analyses, only the relative concentration among poorer households of births to mothers less than 19 years of age was associated with social inequalities in infant mortality; a 10 percent decrease in the value of the RC for mother's age>19 was associated with a 3 percent reduction in the magnitude of the RC for infant mortality. Social inequalities in risk factors for infant mortality were not consistently associated with social inequalities in infant mortality using absolute measures of inequality.

<<<Insert Table 4>>>

Figures 5 and 6 show bubble plots of the associations between the relative concentration among poorer households of births among mothers less than 19 years of age and births at intervals of less than 24 months, respectively, and the RC for infant mortality; the size of the bubbles in these figures is proportional to the weight of each study in the meta-regression. The positive associations that we found in the meta-regression analysis are also apparent in these two figures.

<<<Insert Figures 5 and 6>>>

Discussion and Conclusion

We measured social inequalities in infant health by estimating wealth-based relative and absolute concentration indices for infant mortality using the most recent nationally representative data from 53 LMICs that participated in the Demographic and Health Surveys. Analyses showed that infant mortality was consistently concentrated among poorer households within countries and, furthermore, that there was substantial variation across countries and regions in the magnitude of these social inequalities. Moreover, meta-regression analyses suggested that the concentration of proximal risk factors for infant mortality, particularly teenage births, among poorer households was positively associated with the levels of relative social inequality in infant mortality across countries.

Measuring relative and absolute social inequalities in infant mortality

Infant mortality was concentrated among poorer households within LMICs, corroborating prior studies assessing equity in child health outcomes (Hosseinpoor et al., 2006; Monteiro et al., 2010; Pradhan & Arokiasamy, 2010; Vapattanawong et al., 2007; Wagstaff, 2000; Wang, 2003; Zere et al., 2007). For example, a review of social inequalities in child health within LMICs concluded that children living in socioeconomically disadvantaged households exhibited systematically lower rates of survival compared to their less disadvantaged counterparts, with much of this inequality arising in the first year of life (Houweling & Kunst, 2010). Our results also indicated that social inequality in infant mortality, as measured by the RC, was higher in girls than boys in the majority of sampled countries. Although girls have a greater chance of living until their first birthday than boys in most regions of the world (see e.g. Table 2), the relative concentration of infant death among the poor is higher in girls than that in boys. Similarly to an earlier study conducted by (Wang (2003), our comparison of *relative* social inequalities in infant mortality, as measured by the RC, indicated that infant mortality was concentrated among poorer households to a greater extent in countries with lower overall levels of infant mortality. Furthermore, we found that the relative concentration of infant mortality among poorer households was lower among poorer countries, as measured by GDP per capita. These results suggest that the relative difference in infant mortality between poorer and wealthier households may widen as LMICs develop economically and experience lower infant mortality rates (see Figure 4). Although longitudinal evidence is sparse, some country-specific evidence supports this theory. A Sri Lankan study using data from the DHS, for example, showed that reductions in under-five mortality between 1987 and 2000 were associated with rising relative inequalities in mortality across educational groups (Houweling et al., 2007). The maldistribution of health services and technologies (Victora et al., 2000) across socioeconomic groups may drive the exacerbation of relative inequalities in infant mortality attendant on economic growth.

Cross-national comparisons of social inequalities in infant mortality depend on whether inequalities are based on relative or absolute differences in mortality between socioeconomic groups (Moser et al., 2007). The RC, while useful for comparing relative social inequalities across countries, is calculated independently of the mean level of infant mortality within a country; thus, a negative association between levels of infant mortality and relative social inequalities in infant mortality may reflect differences in average mortality across countries, and specifically the fact that rates of infant mortality in poorer countries are elevated across the socioeconomic gradient. In contrast to inference based on the relative concentration index, we found that absolute differences in infant mortality between socioeconomic groups were most pronounced in countries with higher infant mortality rates, including those in sub-Saharan Africa. Additionally, there was a negative, albeit insignificant, correlation between GDP per capita and the value of the AC across LMICs. This implies that economic development may be associated with reductions in absolute differences in infant mortality between socioeconomic groups. For example, Vapattanawong et al., (2007) showed that a period of economic growth in Thailand between 1990 and 2000 was accompanied by reductions in both relative and absolute differences in under-five mortality between socioeconomic groups. The opposite associations that we observed between GDP per capita and relative and absolute concentration indices for infant mortality across countries is consistent with overall economic improvement preventing more infant deaths from occurring among lower SES households (in absolute terms) but widening relative differences in infant mortality across socioeconomic groups.

Determinants of social inequalities in infant mortality in LMICs

There is substantial spatio-temporal variation in social inequalities in child mortality, suggesting a potential role for interventions and policies aimed at improving child health equity. Few studies, however, have empirically examined determinants of social inequalities in infant mortality among LMICs, including inequalities in proximate determinants of mortality. An ecological analysis showed that inequalities in the provision of essential child health services were positively associated with social inequalities in under-five mortality (Kruk et al., 2011). We used meta-regression to assess whether inequalities in proximate determinant of infant mortality, including maternal education, maternal age, and birth spacing (Adetunji, 1995; Alam, 2000; Becher et al., 2004; Bicego & Boerma, 1993; Botting et al., 1998; Caldwell, 1979; Desai & Alva, 1998; Foggin et al., 2001; Forste, 1994; Hill & King, 1993; Houweling & Kunst, 2010; Kembo & Ginneken, 2009; Kumar et al., 2012; Mturi & Curtis, 1995; Muller, 2002; Schell et al., 2007), were associated with the magnitude of social inequalities in infant mortality at the country-level. Although results based on the AC were largely null, analyses of relative inequalities implicated the concentration of teenage births among socioeconomically disadvantaged groups as a contributing factor to social inequalities in infant mortality. These findings suggest that the interventions targeting key determinants of teenage pregnancy, including early marriage (World Health Organization, 2011), lower uptake of family planning and maternal health services (Fullerton et al., 2005; Sharma et al., 2001; Shrestha, 2002; World Health Organization, 2011), among socioeconomically disadvantaged groups may reduce relative social inequalities in infant mortality. Additional work utilizing longitudinal data is needed to clarify the causes of social inequalities in child health.

There were several limitations to this study. First, although we analysed infant mortality over the last 5 years, our assessment of socioeconomic status is based on the household wealth index constructed for the survey year. Changes in household wealth usually occur in the long-run, suggesting current measures of household SES are a reasonable proxy for past values. Furthermore, we conducted a sensitivity analysis that showed that recalculation of the RC and AC indices for infant deaths using information on live birth over the last 3 years instead of 5 years yielded very similar results (results are available upon request). Nevertheless, it would have been ideal to have measured SES at the time of each birth, but unfortunately concurrent measures of SES and birth outcomes were not available. This may have introduced error in the measurement of household SES. Additionally, household SES may be endogenous because it may be influenced by birth history; this may bias the association between SES and infant death in either direction. Second, although our data sets are the latest available DHS for each country, countries were surveyed in different years and estimates may have changed since the latest release. Third, inequalities in other determinants of infant mortality (e.g. length of breastfeeding and source of drinking water) may influence levels of social inequality for infant mortality, but were excluded from meta-regression analyses, either because information was not collected for all infants (e.g. length of breastfeeding) or was collected inconsistently across countries (e.g. source of drinking water). Fourth, our analyses were based on cross-sectional data and it was not possible to establish temporality between explanatory factors and socioeconomic inequality in IMR, precluding causal inference. Our results can be interpreted in terms of observed associations between explanatory variables and socioeconomic inequality in IMR. Finally, as the main variable of interest, infant death, in our study is binary, the minimum and maximum of the concentration index are not –1 and 1 and depend on the mean of the variable (Wagstaff, 2005). There is ongoing debate about whether Wagstaff's correction or Erreygers' Index, which implies multiplying the concentration index by 4μ (Erreygers & Van Ourti, 2011; Erreygers, 2009; Wagstaff, 2009, 2011), is a better method for correcting the concentration index when the variable of interest is bounded. Nevertheless, sensitivity analyses using Erreygers' correction in the estimations of the RC and AC informed qualitatively similar inference.

Although reducing infant mortality has been a major objective of national governments and international organizations over the last thirty years, there is a growing call to address not only average population levels, but also inequalities in child health (Reidpath et al., 2009). Caveats considered, we found that the concentration of infant deaths among socioeconomically disadvantaged households in the majority of LMICs remains an important health and social policy concern. Understanding the sources of these inequalities is an important next step. Our results suggest that policies designed to reduce the concentration of teenage pregnancy among mothers in lower socioeconomic groups may mitigate relative social inequalities in infant mortality. Both policies to support completion of secondary education by girls and to reduce early marriage of girls -- two factors disproportionately affecting low-income households -- have been found in other studies to reduce early pregnancy (Gupta et al., 2008; Ikamari, 2005; Smith et al., 2012; UNICEF, 2001). Further studies aimed at identifying factors explaining social inequalities in teenage pregnancy may help to inform appropriate policies to reduce this risk factor among the poor.

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Table 1 Description of variables used in the meta-regression analysis

Outcome variables	The RC[†] for infant death	The AC[‡] for infant death
Explanatory variables	Gini coefficient	-
	The RC for mother's education level (year)	The AC for mother's education level (year)
	The RC for mother's age at birth- less than 19	The AC for mother's age at birth- less than 19
	The RC for mother's age at birth- greater than 40	The AC for mother's age at birth- greater than 40
	The RC for risky birth interval- less than 24 months	The AC for risky birth interval- less than 24 months

† Relative Concentration index
‡ Absolute Concentration index

Table 2 Survey year, sample size, and IMR in 53 low-and-middle-income countries

	Country Code	Survey year	Sample Size (HH)†	GDP Per capita (PPP $)‡	IMR§		
					Total	Male	Female
Sub-Saharan Africa							
Benin	BEN	2006	17511	1264	68.55	72.93	64.07
Burkina Faso	BFA	2010	14424	1088	71.03	78.65	63.09
Burundi	BDI	2010	8596	526	60.96	66.27	55.51
Cameroon	CMR	2004	10462	1659	77.26	81.64	72.93
Chad	TCD	2004	5369	733	105.06	116.76	92.56
Congo Brazzaville	COG	2005	5879	2900	75.02	76.52	73.48
Congo Democratic Republic	COD	2007	8886	247	91.26	101.12	81.92
Ethiopia	ETH	2011	16702	462	61.17	70.68	50.89
Ghana	GHA	2008	11778	1199	50.86	57.95	43.16
Guinea	GIN	2005	6282	619	104.23	116.66	90.84
Kenya	KEN	2008-09	9057	1280	53.07	61.03	44.74
Lesotho	LSO	2009	9391	1284	89.90	107.69	71.34
Liberia	LBR	2007	6824	346	80.24	87.35	72.76
Madagascar	MDG	2008-09	17857	870	48.27	51.21	45.22
Malawi	MWI	2010	24825	721	61.85	70.39	53.58
Mali	MLI	2006	12998	782	106.33	113.13	99.24
Mozambique	MOZ	2003	12315	455	106.37	109.53	103.33
Namibia	NAM	2006-07	9200	4553	41.93	49.31	34.46
Niger	NER	2006	7660	583	87.26	88.55	85.93
Nigeria	NGA	2008	34070	1686	77.66	84.88	70.12
Rwanda	RWA	2010	12540	971	51.62	57.13	45.96
Sao Tome and Principe	STP	2008-09	3536	1444	37.25	57.48	15.96
Senegal	SEN	2010-11	7902	1784	46.66	52.36	40.69
Sierra Leone	SLE	2008	7284	626	96.06	101.24	90.87
Swaziland	SWZ	2006-07	4843	4413	61.17	57.66	64.63
Tanzania	TZA	2010	9623	1150	52.78	54.87	50.72
Uganda	UGA	2011	9033	1112	54.38	61.88	46.82
Zambia	ZMB	2007	7164	1061	69.78	81.45	58.33
Zimbabwe	ZWE	2010-11	9756	421	56.48	67.04	45.62
Total*					71.70	78.87	64.32
North Africa/West Asia/Europe							
Albania	ALB	2008-09	7999	6107	17.90	23.06	12.58
Armenia	ARM	2010	6700	5108	14.73	10.67	19.28
Azerbaijan	AZE	2006	7180	3066	42.59	52.60	30.79
Egypt	EGY	2008	18968	4374	24.65	28.08	21.14
Jordan	JOR	2007	14564	3899	19.45	15.95	23.08
Moldova	MDA	2005	11095	2047	11.75	10.50	13.08
Morocco	MAR	2003-04	11513	2648	39.09	46.59	31.34

Turkey	TUR	2003	10836	8726	31.07	32.31	29.77
Ukraine	UKR	2007	13379	4894	15.15	19.56	10.21
Total*					24.20	26.61	23.74
Latin America & Caribbean							
Bolivia	BOL	2008	19564	3636	51.45	57.75	44.91
Colombia	COL	2010	51447	7842	17.66	18.88	16.35
Dominican Republic	DOM	2007	32431	5803	28.24	28.30	28.17
Guyana	GUY	2009	5632	2675	37.75	43.37	32.14
Haiti	HTI	2005-06	9998	1002	55.60	66.89	44.53
Honduras	HND	2005-06	18683	2744	24.91	29.32	20.26
Total*					29.94	33.54	26.27
South & Southeast Asia							
Bangladesh	BGD	2007	10400	1039	54.08	54.77	53.39
Cambodia	KHM	2010	15667	1786	45.23	48.16	42.07
India	IND	2005-06	109041	1724	59.99	59.76	60.23
Indonesia	IDN	2007	40701	2822	38.07	43.96	31.71
Maldives	MDV	2009	6443	5958	15.62	22.58	8.31
Nepal	NPL	2011	10826	1054	47.21	47.30	47.10
Pakistan	PAK	2006-07	95441	1845	67.00	69.65	64.04
Philippines	PHL	2008	12469	2991	25.90	30.82	20.37
Timor-Leste	TLS	2009-10	11463	1002	46.17	50.06	42.17
Total*					55.54	56.88	54.29
Total Regions*					56.76	59.77	53.62

† HH; Household
‡ The values presented in the table are the average GDP per capita on purchasing power parity (PPP) US$.
§ IMRs represent the proportion of live births that did not survive to age 1 year, multiplied by 1000.
* This is a weighted average. We applied total number of live births during the study period in each country (calculated from the World Bank's WDI and GDF database) as a weight in the calculation.

Table 3 Relative and Absolute Concentration indices for infant mortality in 53 low-and-middle-income countries

	Relative Concentration Index (RC)			Absolute Concentration Index (AC)†		
	Total	**Male**	**Female**	**Total**	**Male**	**Female**
Sub-Saharan Africa						
Benin	**-0.057**	-0.023	**-0.100**	**-0.391**	-0.166	**-0.638**
	(-0.094 -0.021)	(-0.072 0.027)	(-0.152 -0.047)	(-0.641 -0.141)	(-0.527 0.195)	(-0.975 -0.301)
Burkina Faso	**-0.097**	**-0.074**	**-0.129**	**-0.691**	**-0.579**	**-0.811**
	(-0.136 -0.059)	(-0.125 -0.022)	(-0.186 -0.071)	(-0.965 -0.418)	(-0.985 -0.173)	(-1.173 -0.449)
Burundi	**-0.090**	**-0.092**	**-0.092**	**-0.551**	**-0.608**	**-0.508**
	(-0.150 -0.030)	(-0.176 -0.008)	(-0.173 -0.010)	(-0.917 -0.185)	(-1.165 -0.050)	(-0.960 -0.057)
Cameroon	-0.045	-0.027	-0.065	-0.348	-0.224	-0.472
	(-0.096 0.006)	(-0.096 0.041)	(-0.139 0.009)	(-0.741 0.045)	(-0.782 0.333)	(-1.012 0.067)
Chad	0.003	-0.023	0.040	0.029	-0.266	0.370
	(-0.053 0.059)	(-0.098 0.052)	(-0.043 0.123)	(-0.560 0.619)	(-1.140 0.608)	(-0.400 1.140)
Congo Brazzaville	**-0.129**	**-0.130**	**-0.126**	**-0.968**	**-0.994**	**-0.927**
	(-0.205 -0.053)	(-0.235 -0.025)	(-0.227 -0.025)	(-1.537 -0.40)	(-1.800 -0.189)	(-1.67 -0.185)
Congo Democratic	**-0.137**	**-0.135**	**-0.139**	**-1.253**	**-1.361**	**-1.143**
Republic	(-0.192 -0.082)	(-0.209 -0.060)	(-0.222 -0.057)	(-1.756 -0.751)	(-2.118 -0.604)	(-1.815 -0.471)
Ethiopia	**-0.125**	**-0.117**	**-0.136**	**-0.767**	**-0.827**	**-0.691**
	(-0.186 -0.065)	(-0.201 -0.034)	(-0.225 -0.047)	(-1.137 -0.398)	(-1.418 -0.237)	(-1.145 -0.237)
Ghana	-0.049	-0.073	-0.017	-0.247	-0.42	-0.073
	(-0.148 0.051)	(-0.198 0.053)	(-0.180 0.146)	(-0.752 0.258)	(-1.146 0.306)	(-0.776 0.630)
Guinea	**-0.103**	-0.070	**-0.150**	**-1.075**	-0.813	**-1.358**
	(-0.155 -0.051)	(-0.139 0.001)	(-0.228 -0.071)	(-1.620 -0.529)	(-1.627 0.002)	(-2.068 -0.649)
Kenya	-0.059	-0.085	-0.014	-0.312	-0.519	-0.063
	(-0.151 0.033)	(-0.192 0.022)	(-0.173 0.144)	(-0.801 0.178)	(-1.171 0.133)	(-0.772 0.646)
Lesotho	-0.049	0.017	**-0.145**	-0.443	0.184	**-1.035**
	(-0.132 0.034)	(-0.094 0.128)	(-0.267 -0.023)	(-1.189 0.303)	(-1.013 1.382)	(-1.902 -0.167)
Liberia	-0.050	**-0.091**	0.002	-0.401	**-0.796**	0.011
	(-0.117 0.017)	(-0.175 -0.008)	(-0.100 0.103)	(-0.937 0.134)	(-1.525 -0.067)	(-0.728 0.751)
Madagascar	**-0.085**	**-0.093**	-0.074	**-0.408**	**-0.477**	-0.334
	(-0.135 -0.034)	(-0.162 -0.024)	(-0.149 0.002)	(-0.653 -0.164)	(-0.831 -0.124)	(-0.674 0.007)
Malawi	0.031	0.037	0.024	0.193	0.258	0.129
	(-0.013 0.076)	(-0.022 0.095)	(-0.043 0.091)	(-0.083 0.470)	(-0.153 0.670)	(-0.229 0.487)
Mali	**-0.079**	**-0.085**	**-0.074**	**-0.840**	**-0.957**	**-0.737**
	(-0.121 -0.037)	(-0.138 -0.031)	(-0.139 -0.009)	(-1.282 -0.398)	(-1.558 -0.356)	(-1.383 -0.090)
Mozambique	**-0.107**	**-0.072**	**-0.143**	**-1.136**	**-0.790**	**-1.482**
	(-0.151 -0.062)	(-0.135 -0.009)	(-0.206 -0.080)	(-1.609 -0.663)	(-1.477 -0.102)	(-2.133 -0.831)
Namibia	**-0.131**	-0.090	**-0.188**	**-0.548**	-0.446	**-0.649**
	(-0.223 -0.038)	(-0.217 0.037)	(-0.320 -0.057)	(-0.937 -0.159)	(-1.072 0.180)	(-1.101 -0.197)

Niger	-0.041	-0.036	-0.048	-0.357	-0.315	-0.408
	(-0.087 0.006)	(-0.098 0.027)	(-0.115 0.020)	(-0.763 0.049)	(-0.867 0.237)	(-0.988 0.172)
Nigeria	**-0.107**	**-0.100**	**-0.113**	**-0.830**	**-0.851**	**-0.796**
	(-0.134 -0.079)	(-0.137 -0.063)	(-0.155 -0.072)	(-1.044 -0.616)	(-1.165 -0.537)	(-1.085 -0.507)
Rwanda	-0.028	-0.026	-0.032	-0.147	-0.150	-0.148
	(-0.084 0.027)	(-0.101 0.049)	(-0.114 0.050)	(-0.434 0.140)	(-0.579 0.278)	(-0.523 0.228)
Sao Tome and Principe	-0.085	-0.121	-0.022	-0.318	-0.696	-0.034
	(-0.256 0.086)	(-0.311 0.069)	(-0.379 0.336)	(-0.954 0.319)	(-1.786 0.394)	(-0.605 0.536)
Senegal	**-0.086**	-0.080	-0.092	**-0.402**	-0.417	-0.375
	(-0.153 -0.019)	(-0.174 0.015)	(-0.188 0.004)	(-0.713 -0.090)	(-0.913 0.078)	(-0.765 0.015)
Sierra Leone	**-0.071**	-0.066	-0.076	**-0.685**	-0.67	-0.693
	(-0.131 -0.011)	(-0.148 0.016)	(-0.166 0.013)	(-1.261 -0.108)	(-1.499 0.158)	(-1.505 0.119)
Swaziland	0.016	-0.038	0.064	0.098	-0.222	0.415
	(-0.052 0.084)	(-0.132 0.055)	(-0.029 0.157)	(-0.318 0.515)	(-0.763 0.319)	(-0.186 1.017)
Tanzania	-0.003	-0.030	0.025	-0.018	-0.162	0.127
	(-0.066 0.060)	(-0.116 0.057)	(-0.068 0.118)	(-0.350 0.314)	(-0.638 0.314)	(-0.346 0.600)
Uganda	-0.054	-0.036	-0.079	-0.294	-0.22	-0.37
	(-0.121 0.013)	(-0.122 0.051)	(-0.183 0.025)	(-0.658 0.069)	(-0.758 0.317)	(-0.856 0.116)
Zambia	0.034	0.002	0.072	0.235	0.02	0.421
	(-0.032 0.099)	(-0.081 0.086)	(-0.034 0.178)	(-0.222 0.692)	(-0.659 0.699)	(-0.197 1.039)
Zimbabwe	-0.046	-0.039	-0.060	-0.262	-0.259	-0.273
	(-0.124 0.031)	(-0.141 0.064)	(-0.174 0.055)	(-0.699 0.175)	(-0.948 0.431)	(-0.796 0.250)
North Africa/West Asia/Europe						
Albania	-0.048	-0.072	-0.005	-0.086	-0.166	-0.007
	(-0.268 0.172)	(-0.357 0.213)	(-0.342 0.332)	(-0.479 0.308)	(-0.824 0.491)	(-0.430 0.417)
Armenia	-0.046	-0.255	0.074	-0.068	-0.272	0.142
	(-0.359 0.267)	(-0.604 0.095)	(-0.356 0.503)	(-0.529 0.393)	(-0.645 0.101)	(-0.687 0.970)
Azerbaijan	-0.103	-0.100	-0.123	-0.438	-0.528	-0.378
	(-0.239 0.033)	(-0.262 0.061)	(-0.370 0.124)	(-1.016 0.140)	(-1.377 0.322)	(-1.138 0.382)
Egypt	**-0.170**	**-0.159**	**-0.185**	**-0.418**	**-0.448**	**-0.391**
	(-0.252 -0.087)	(-0.272 -0.047)	(-0.304 -0.065)	(-0.620 -0.215)	(-0.763 -0.132)	(-0.643 -0.138)
Jordan	-0.017	-0.100	0.037	-0.033	-0.159	0.086
	(-0.167 0.134)	(-0.308 0.109)	(-0.150 0.225)	(-0.326 0.260)	(-0.492 0.174)	(-0.347 0.520)
Moldova	-0.251	-0.200	-0.297	-0.294	-0.21	-0.389
	(-0.532 0.031)	(-0.659 0.260)	(-0.638 0.044)	(-0.626 0.037)	(-0.692 0.273)	(-0.835 0.057)
Morocco	**-0.240**	**-0.184**	**-0.318**	**-0.937**	**-0.858**	**-0.997**
	(-0.313 -0.166)	(-0.283 -0.086)	(-0.424 -0.213)	(-1.224 -0.649)	(-1.317 -0.399)	(-1.328 -0.667)
Turkey	**-0.322**	**-0.296**	**-0.359**	**-1.002**	**-0.955**	**-1.068**
	(-0.410 -0.235)	(-0.405 -0.187)	(-0.489 -0.229)	(-1.273 -0.731)	(-1.308 -0.603)	(-1.456 -0.681)
Ukraine	**-0.249**	-0.218	**-0.313**	**-0.377**	-0.427	**-0.319**

	(-0.487 -0.011)	(-0.531 0.094)	(-0.621 -0.005)	(-0.738 -0.017)	(-1.038 0.184)	(-0.634 -0.005)
Latin America & Caribbean						
Bolivia	**-0.246**	**-0.215**	**-0.287**	**-1.264**	**-1.242**	**-1.288**
	(-0.308 -0.184)	(-0.302 -0.128)	(-0.373 -0.200)	(-1.583 -0.946)	(-1.746 -0.738)	(-1.676 -0.900)
Colombia	-0.080	0.016	**-0.196**	-0.142	0.030	**-0.321**
	(-0.162 0.001)	(-0.092 0.124)	(-0.314 -0.079)	(-0.285 0.002)	(-0.175 0.234)	(-0.513 -0.129)
Dominican Republic	**-0.134**	**-0.149**	-0.118	**-0.377**	**-0.422**	-0.332
	(-0.239 -0.028)	(-0.280 -0.018)	(-0.287 0.052)	(-0.676 -0.078)	(-0.792 -0.051)	(-0.810 0.146)
Guyana	0.074	0.053	0.110	0.281	0.231	0.352
	(-0.107 0.256)	(-0.228 0.335)	(-0.070 0.290)	(-0.403 0.965)	(-0.990 1.451)	(-0.226 0.931)
Haiti	**-0.089**	-0.070	**-0.123**	**-0.495**	-0.469	**-0.549**
	(-0.170 -0.008)	(-0.185 0.044)	(-0.231 -0.016)	(-0.947 -0.043)	(-1.234 0.296)	(-1.028 -0.070)
Honduras	**-0.209**	**-0.165**	**-0.270**	**-0.52**	**-0.485**	**-0.547**
	(-0.289 -0.129)	(-0.273 -0.058)	(-0.388 -0.152)	(-0.719 -0.320)	(-0.801 -0.169)	(-0.786 -0.308)
South & Southeast Asia						
Bangladesh	**-0.104**	**-0.146**	-0.062	**-0.563**	**-0.799**	-0.33
	(-0.174 -0.035)	(-0.236 -0.056)	(-0.168 0.045)	(-0.938 -0.187)	(-1.291 -0.307)	(-0.898 0.239)
Cambodia	**-0.213**	**-0.228**	**-0.195**	**-0.962**	**-1.098**	**-0.819**
	(-0.280 -0.145)	(-0.316 -0.140)	(-0.297 -0.092)	(-1.268 -0.656)	(-1.523 -0.673)	(-1.250 -0.388)
India	**-0.140**	**-0.122**	**-0.159**	**-0.84**	**-0.731**	**-0.959**
	(-0.163 -0.117)	(-0.154 -0.091)	(-0.191 -0.127)	(-0.976 -0.703)	(-0.919 -0.542)	(-1.153 -0.764)
Indonesia	**-0.144**	**-0.159**	**-0.121**	**-0.549**	**-0.698**	**-0.384**
	(-0.209 -0.080)	(-0.234 -0.084)	(-0.229 -0.013)	(-0.794 -0.305)	(-1.027 -0.369)	(-0.727 -0.040)
Maldives	-0.048	0.075	**-0.372**	-0.074	0.17	**-0.309**
	(-0.246 0.151)	(-0.162 0.313)	(-0.568 -0.175)	(-0.385 0.236)	(-0.367 0.706)	(-0.472 -0.146)
Nepal	-0.076	-0.058	-0.094	-0.358	-0.273	-0.445
	(-0.155 0.004)	(-0.167 0.052)	(-0.210 0.021)	(-0.732 0.017)	(-0.791 0.246)	(-0.990 0.101)
Pakistan	**-0.111**	**-0.104**	**-0.119**	**-0.741**	**-0.725**	**-0.759**
	(-0.163 -0.058)	(-0.178 -0.030)	(-0.192 -0.045)	(-1.094 -0.389)	(-1.240 -0.209)	(-1.232 -0.286)
Philippines	**-0.225**	**-0.191**	**-0.285**	**-0.582**	**-0.587**	**-0.581**
	(-0.315 -0.135)	(-0.306 -0.075)	(-0.430 -0.141)	(-0.815 -0.350)	(-0.942 -0.232)	(-0.876 -0.286)
Timor-Leste	**-0.108**	**-0.101**	**-0.120**	**-0.500**	**-0.504**	**-0.508**
	(-0.165 -0.052)	(-0.172 -0.029)	(-0.210 -0.031)	(-0.760 -0.24)	(-0.860 -0.147)	(-0.887 -0.129)
Total Regions‡	**-0.135**	**-0.152**	**-0.131**	**-0.766**	**-0.909**	**-0.702**
	(-0.188 -0.082)	(-0.211 -0.093)	(-0.192 -0.070)	(-1.070 -0.466)	(-1.260 -0.557)	(-1.028 -0.377)

Note: Bold font indicates statistically significantly different from equality at the five per cent level; 95% confidence intervals in parentheses
†AC is multiplied by 100 for ease of interpretation
‡ We calculated the overall RC/AC by ranking countries based on their GDP per capita. Also, we applied total number of live births during the study period for each country as a weight in the calculation

Table 4 Meta-regression results

	Relative Concentration Index (RC)					Absolute Concentration Index (AC)				
	Univariate Linear Regression Analysis			**Multivariate Linear Regression Analysis**		**Univariate Linear Regression Analysis**			**Multivariate Linear Regression Analysis**	
	Coefficients	P-value	Adjusted R^2	Coefficients	P-value	Coefficients	P-value	Adjusted R^2	Coefficients	P-value
Gini coefficient	-0.011 (-0.272 0.250)	0.933	-2.74%	-0.083 (-0.338 0.173)	0.518	--	--	--	--	--
The RC or AC† for mother's education level (year)	-0.0375 (-0.172 0.097)	0.578	-2.00%	-0.104 (-0.231 0.023)	0.105	**-0.002** (-0.005 -0.001)	0.045	9.95%	-0.003 (-0.006 0.001)	0.118
The RC or AC for mother's age at birth- less than 19	**0.3153** (0.104 0.526)	0.004	22.66%	**0.333** (0.115 0.551)	0.004	-0.007 (0-.100 0.086)	0.881	-2.96%	-0.067 (-0.180 0.047)	0.243
The RC or AC for mother's age at birth- greater than 40	0.1359 (-0.08 0.351)	0.211	1.86%	0.131 (-0.070 0.331)	0.196	0.148 (-0.050 0.346)	0.140	4.34%	0.021 (-0.220 0.264)	0.858
The RC or AC for risky birth interval- less than 24 months	**0.3486** (0.104 0.594)	0.006	15.12%	0.245 (-0.008 0.500)	0.057	0.051 (-0.018 0.120)	0.143	5.42%	0.030 (-0.046 0.106)	0.429
N=53				Adjusted R^2	32.57%				Adjusted R^2	2.5%

Note: Bold font indicates statistically significantly different from zero at the five per cent level; 95% confidence intervals in parentheses
† RC or AC, depending on whether the dependent variable was measured in relative or absolute terms.

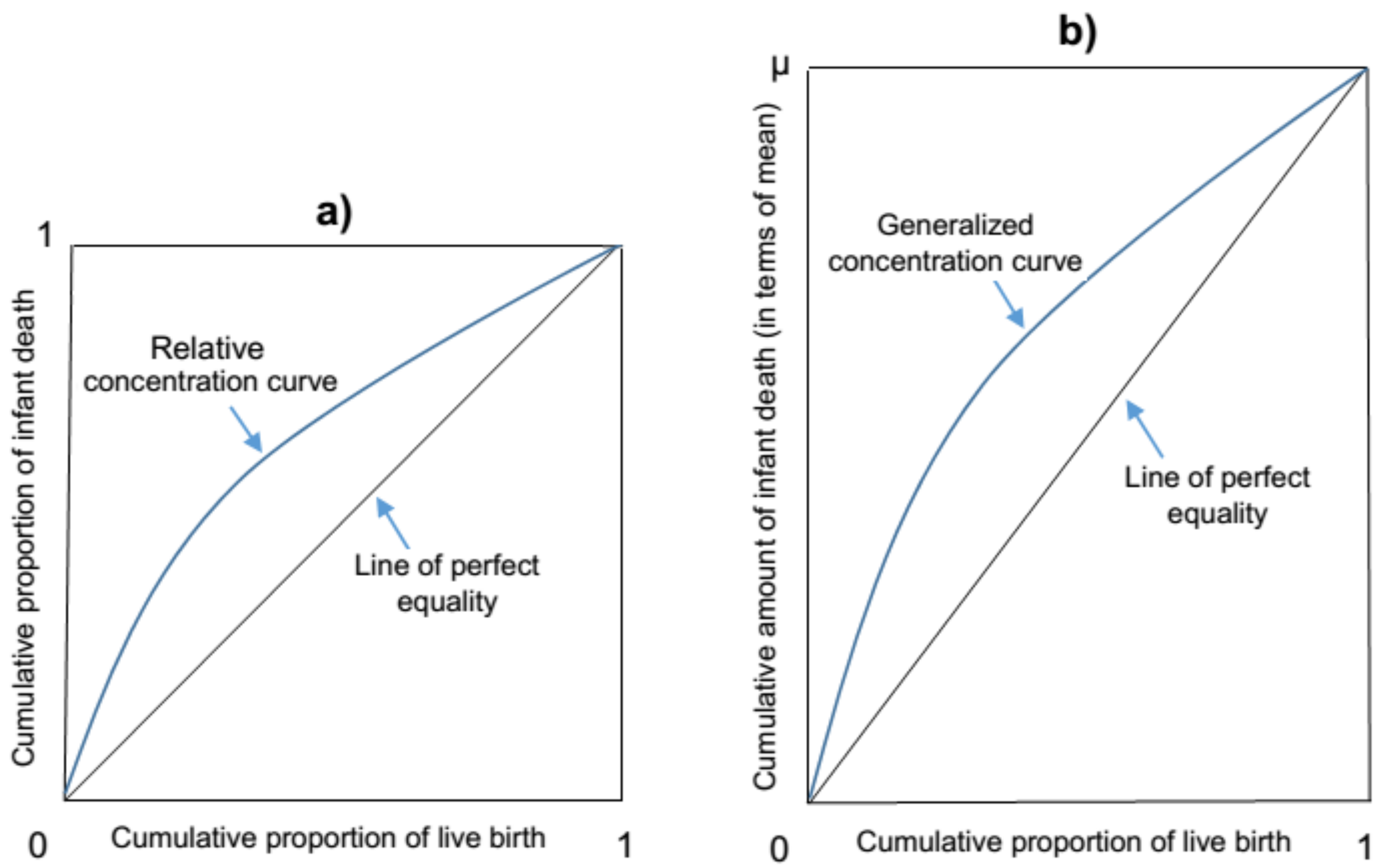


Figure 1 Relative and generalized concentration curves

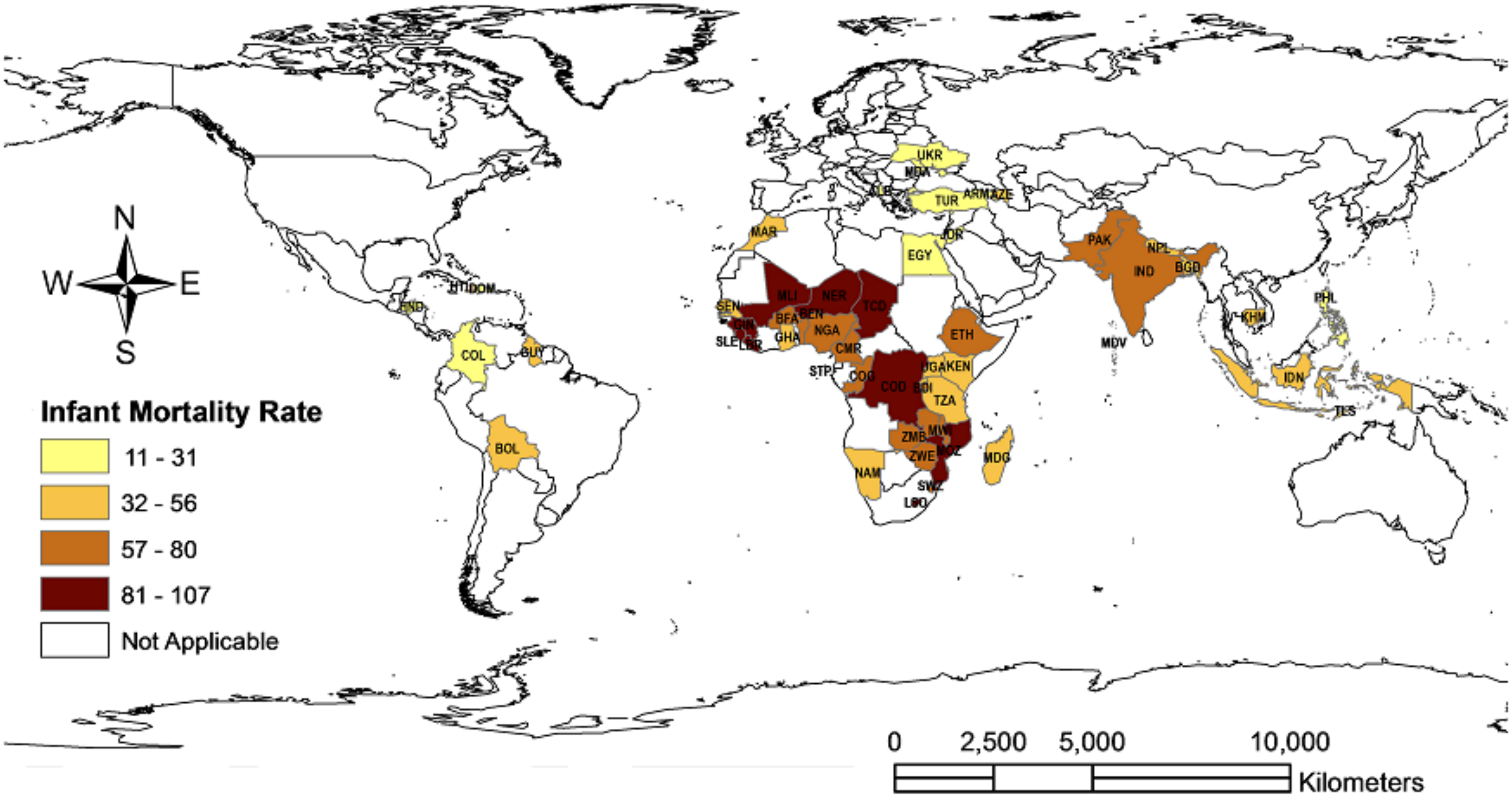
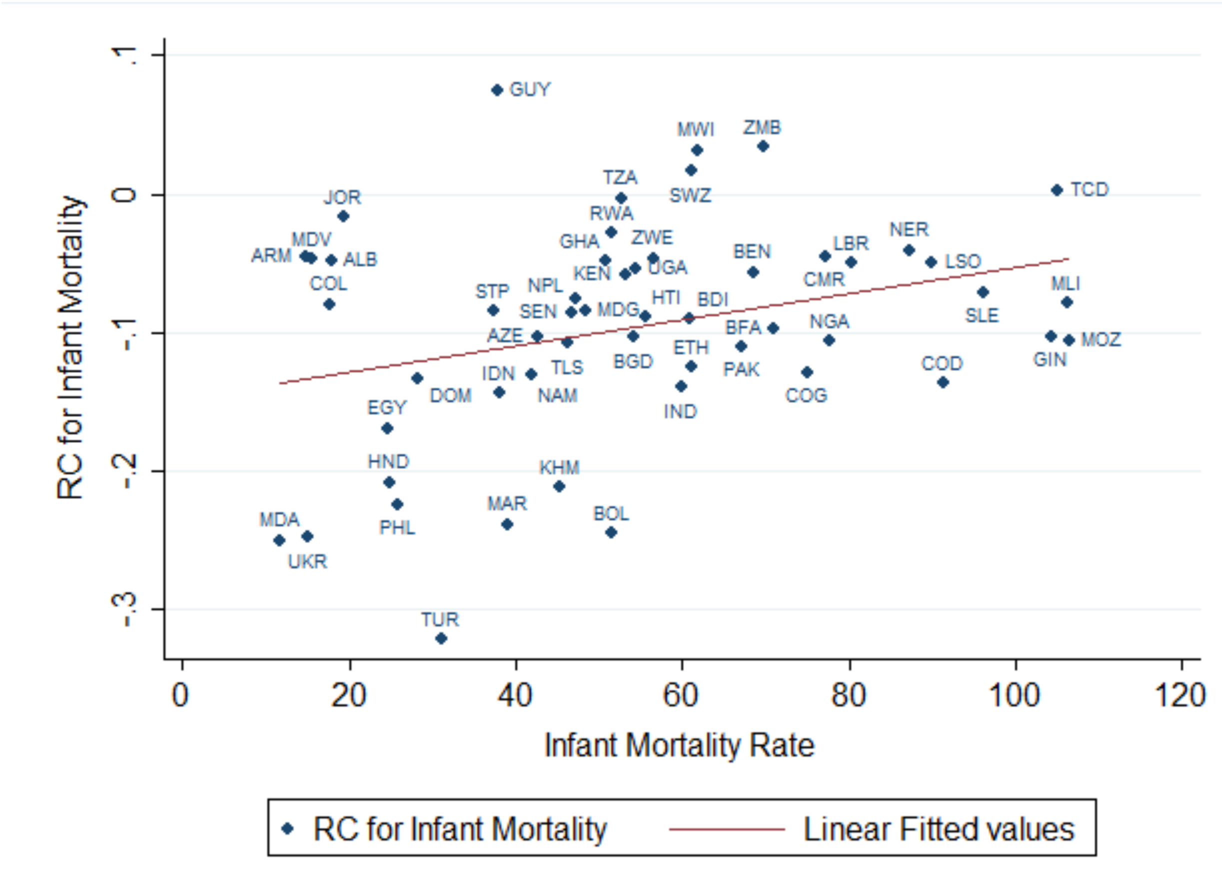


Figure 2 Total IMR among 53 low-and-middle-income countries

a)



RC for Infant Mortality
.1
0
-.1
-.2
-.3
0
20
40
60
80
100
120
Infant Mortality Rate
GUY
MWI
ZMB
TZA
SWZ
JOR
TCD
RWA
NER
MDV
GHA
ZWE
LBR
ARM
ALB
BEN
LSO
KEN
UGA
CMR
COL
STP
NPL
MLI
HTI
BDI
SEN
MDG
SLE
NGA
AZE
BFA
MOZ
ETH
GIN
TLS
BGD
PAK
COD
IDN
NAM
COG
DOM
IND
EGY
HND
KHM
MAR
PHL
MDA
BOL
UKR
TUR
RC for Infant Mortality
Linear Fitted values

b)

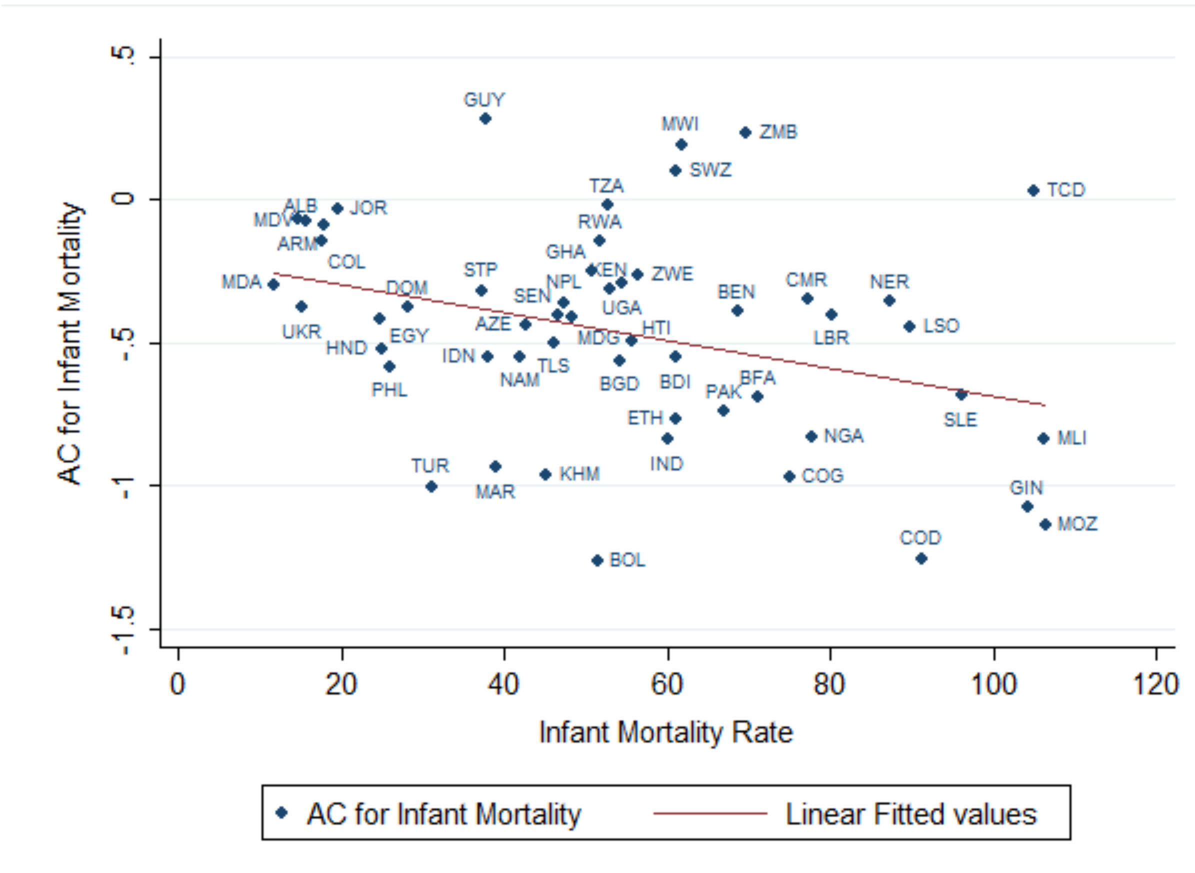
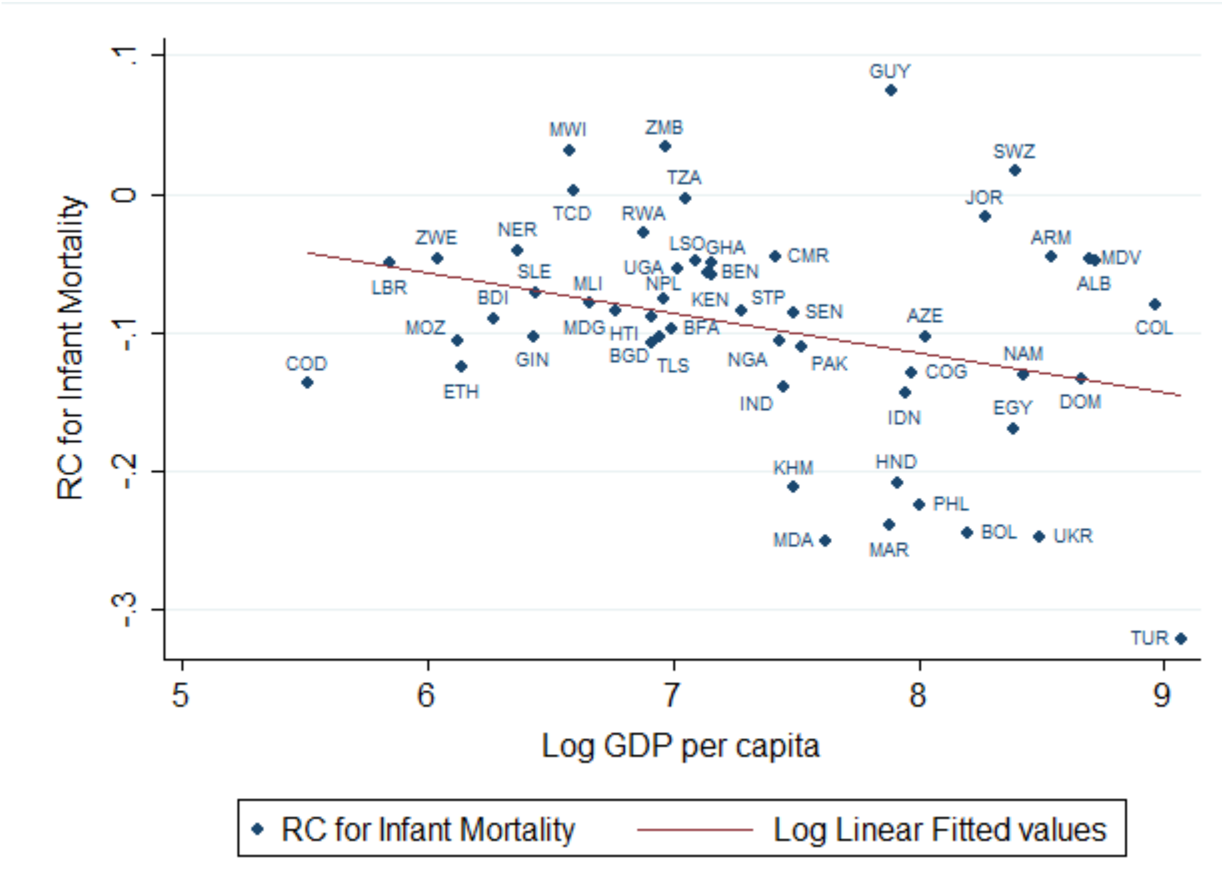


Figure 3 Cross-country correlation between Absolute and Relative Concentration indices for infant mortality and total IMR

a)


RC for Infant Mortality
Log GDP per capita
.1
0
-.1
-.2
-.3
5
6
7
8
9
GUY
MWI
ZMB
SWZ
TZA
JOR
TCD
RWA
ZWE
NER
ARM
LSO
GHA
CMR
MDV
LBR
SLE
UGA
BEN
ALB
MLI
NPL
BDI
KEN
STP
SEN
AZE
COL
MOZ
MDG
HTI
BFA
GIN
BGD
TLS
NGA
PAK
NAM
COD
COG
ETH
IND
DOM
EGY
IDN
KHM
HND
PHL
BOL
UKR
MDA
MAR
TUR
RC for Infant Mortality
Log Linear Fitted values

b)

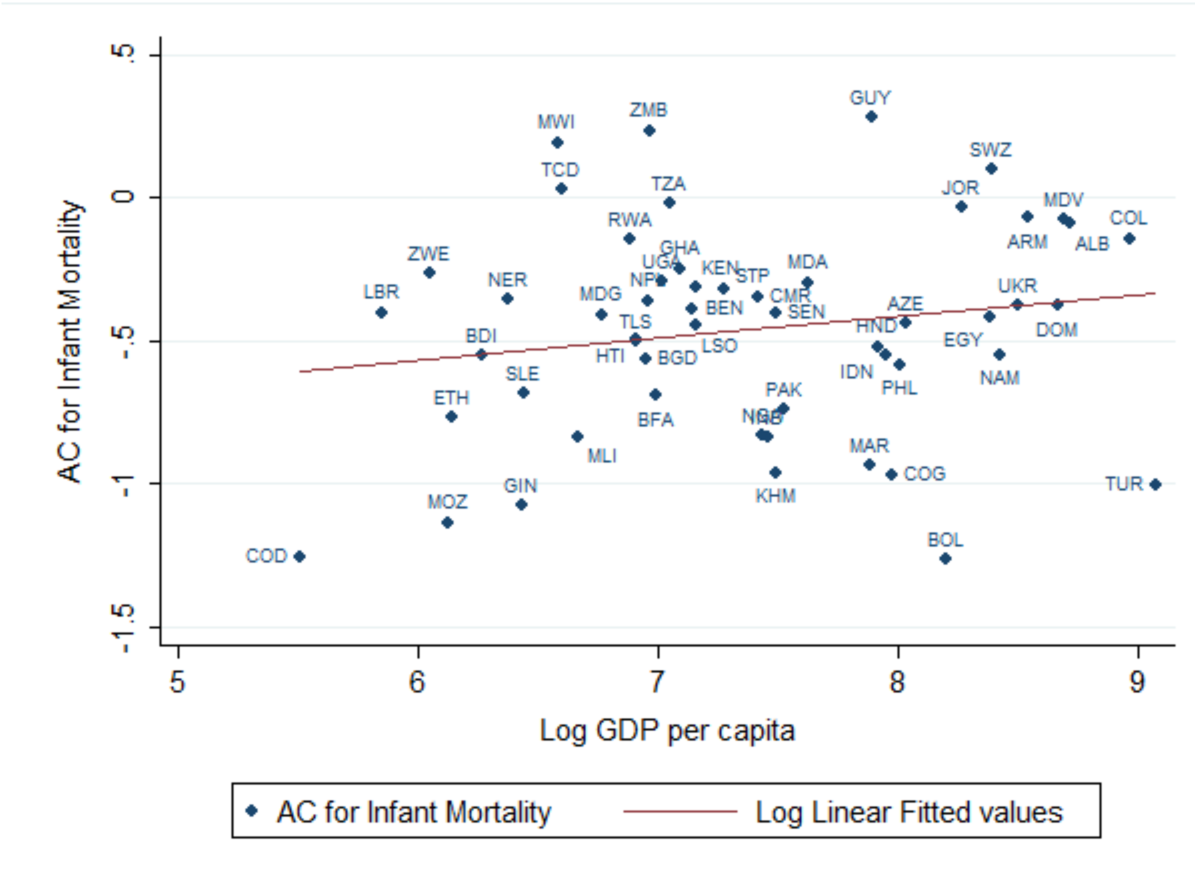


Figure 4 Cross-country correlation between Absolute and Relative Concentration indices for infant mortality and log GDP per capita

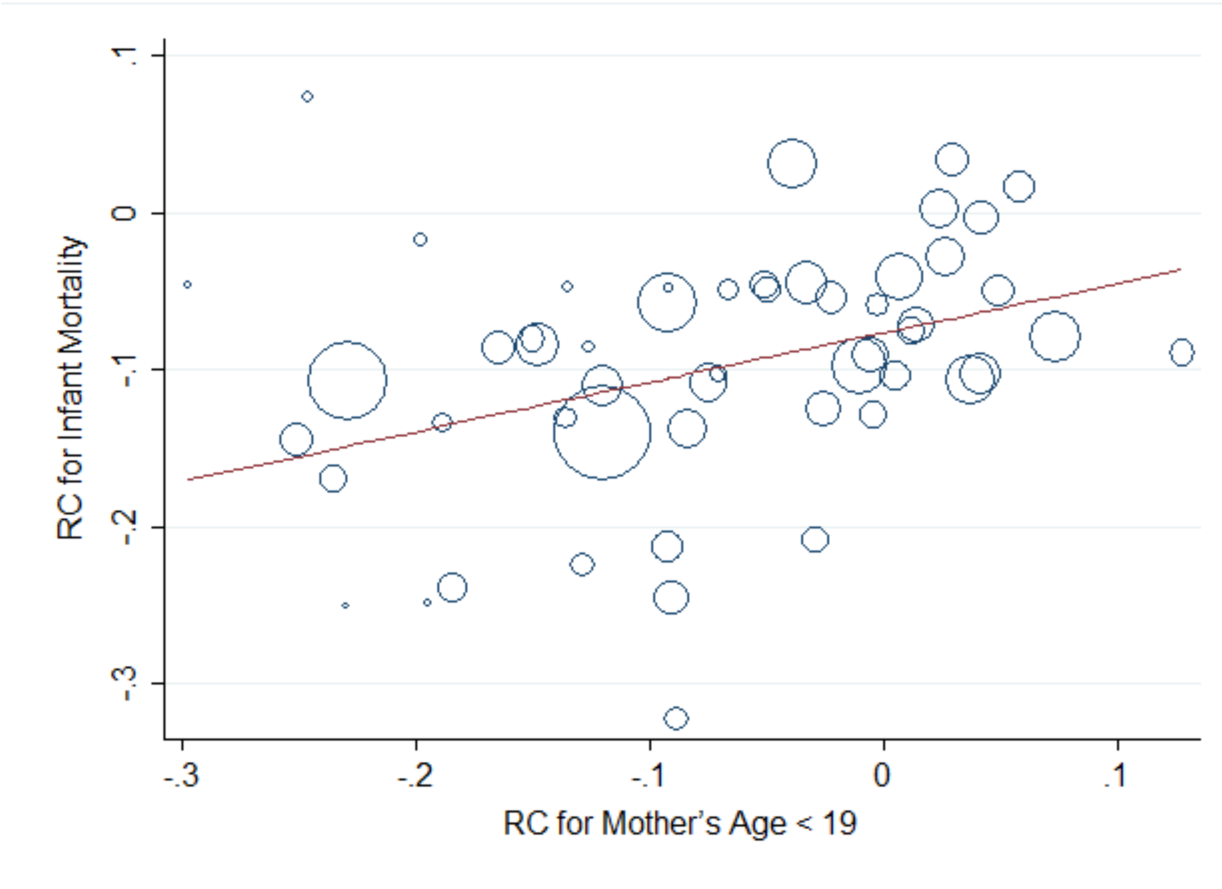


Figure 5 Bubble-plot of the association between the RC indices for infant mortality and mother's age less than 19

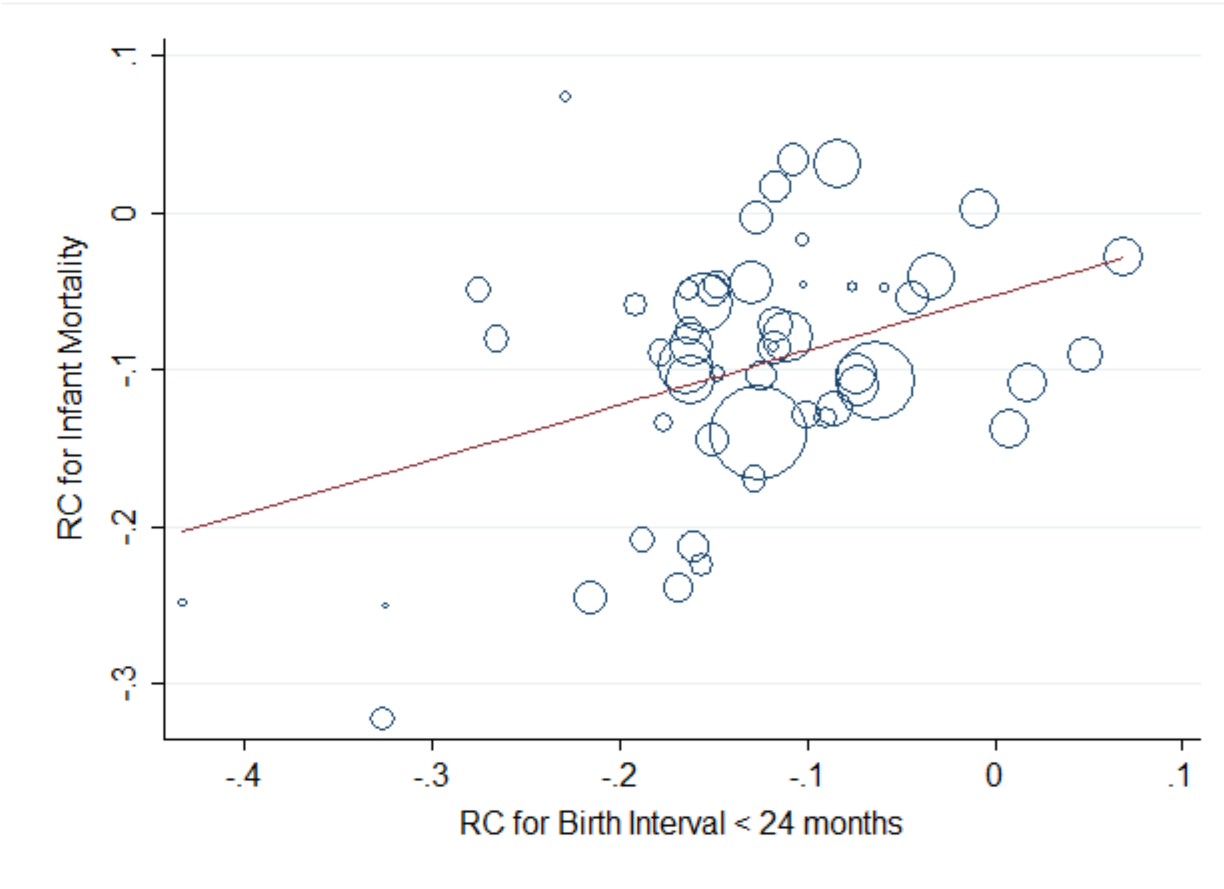


Figure 6 Bubble-plot of the association between the RC indices for infant mortality and risky birth interval (< 24 months)