Kingdom of Cambodia

# Assessing Trends in Inequalities in Maternal and Child Health and Health Care in Cambodia

## Further Analysis of the Cambodia Demographic and Health Surveys

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# Assessing Trends in Inequalities in Maternal and Child Health and Health Care in Cambodia

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This report presents findings from a further analysis study undertaken as part of the follow-up to the 2010 Cambodia Demographic and Health Survey (CDHS). ICF International provided technical assistance for the project. This report is part of the MEASURE DHS program, which is designed to collect, analyze, and disseminate data on fertility, family planning, maternal and child health, nutrition, and HIV/AIDS. Funding was provided by the U.S. Agency for International Development (USAID) through the MEASURE DHS project (#GPO-C-00-03-00002-00). The opinions expressed herein are those of the authors and do not necessarily reflect the views of the USAID and other cooperating agencies.

Additional information about the survey may be obtained from the National Institute of Statistics (NIS) of Cambodia, (#386, Monivong Blvd, Phnom Penh, Cambodia. Telephone/Fax: 855-23-213-650, Email: hdarith@nis.gov.kh, internet: http://www.nis.gov.kh/). Additional information about the DHS project may be obtained from ICF International, 11785 Beltsville Drive, Calverton, MD 20705, USA; Telephone: 301-572-0200, Fax: 301-572-0999, Email: reports@measuredhs.com, Internet: http://www.measuredhs.com.

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## EXECUTIVE SUMMARY

**Background:** Cambodia has achieved remarkable progress in improving maternal and child health in the last few decades. However, little is known about how this progress has been shared among different economic groups. This study uses data from three consecutive Demographic and Health Surveys (DHS) conducted in 2000, 2005, and 2010 in Cambodia to assess trends in inequalities for a range of indicators of maternal and child health and health care.

**Methods:** The maternal and child health and health care indicators analyzed are globally recognized as important for monitoring and evaluating maternal and child health status. These include infant mortality and under-five mortality, as well as underweight status, stunting, prevalence of anemia, and prevalence of diarrhea. Health care indicators include antenatal care, skilled birth attendance, delivery in health facilities, contraceptive prevalence, full immunization coverage, and medical treatment for child's diarrhea.

Two measurements of inequalities are used—a ratio that measures disparity in health or health care outcomes between the wealthiest and the poorest household quintiles, and a concentration index using data on all five wealth quintiles that provides a comprehensive picture of inequalities in the population. Lorenz curves provide a visual demonstration of inequality and its changes over the survey period.

**Results:** The results suggest remarkable improvement in most health and health care indicators between 2000 and 2010 in Cambodia. The increases are universal in the population, from the poorest to the wealthiest. For some indicators—under-five mortality, prevalence of anemia, use of skilled birth attendants, and use of any antenatal care—the absolute percentage point changes (or mortality rate changes) between 2000 and 2010 among the poorest quintile of households are at least twice that of the wealthiest quintile. However, substantial inequalities continue to exist between the wealthy and the poor, for most of the indicators studied. Infant mortality and under-five mortality are the least equitable—rates among the poorest quintile are at least three times higher than among the wealthiest.

Analysis of trends in health outcomes did not find significant changes in inequalities between 2000 and 2010, except for prevalence of diarrhea, which showed a statistically significant increase in inequality. In contrast, for a number of health care indicators inequalities decreased over the three surveys.

**Conclusion:** Faster progress in use of health services among the poor than the wealthy in Cambodia would potentially result in more rapid improvement in health among the poor, and eventually could lead to the elimination of inequalities between the poor and the wealthy in maternal and child health status. Intervention programs should focus on the poor but not forget the wealthy segments of the population.

## 1. INTRODUCTION

In the past two decades Cambodia has made remarkable progress toward achieving the Millennium Development Goals (MDGs) and is well on track to meet the goals of reducing poverty and achieving universal primary education, for both boys and girls (UNFPA, UNICEF et al. 2012). On health, Cambodia has reduced the adult HIV prevalence rate from 2 percent in 2008 to 0.8 percent in 2011 and has stopped the spread of tuberculosis (National Center for HIV/AIDS Dermatology and STD 2012). The progress is even more remarkable in improving child health. According to data from the Cambodia Demographic and Health Surveys (CDHS), under-five mortality has dramatically declined, from 124 deaths per 1,000 live births in 2000 to 54 per 1,000 in 2010. Infant mortality also has declined during this period, from 95 deaths per 1,000 live births to 45 per 1,000. Full immunization coverage in 2010 has reached 79 percent nationwide and 86 percent in urban areas, a remarkable increase from 2000, when only 40 percent of children were fully vaccinated (National Institute of Statistics, Directorate General for Health [Cambodia] et al. 2001, National Institute of Public Health, National Institute of Statistics et al. 2006, National Institute of Statistics, Directorate General for Health et al. 2011).

Despite these improvements in the national averages, it is unknown whether they have been achieved equally for the poor and the wealthy. That is, to what extent have economic-related inequalities in health and health care changed over time in Cambodia?

Inequalities in health and health care in developing countries have drawn more attention since the late 1990s. Early efforts to focus on these issues include a number of multi-country research programs on equity, poverty, and health supported by the World Bank and several other donors (Carr, Gwatkin et al. 1999, Gwatkin 2002). The international community has recognized the importance of addressing health needs of the poor as a key part of improving world health (World Health Organization 1999, Gwatkin 2000).

Evidence shows that economic-related inequalities in health and utilization of health services remain prevalent in developing countries. A recent study using population-based survey data in 35 low- and middle-income countries indicated that pro-wealthy inequalities are common in coverage of maternal and child health interventions, and these inequalities have increased in many countries (Victora, Barros et al. 2012). The study suggested that a fast national increase in intervention coverage was primarily driven by increases among the poorest groups.

In an effort to track within-country inequalities in maternal, newborn and child health interventions, Barros and colleagues analyzed data for a dozen indicators in 54 countries and found that inequalities exist and vary by interventions and countries (Barros, Ronsmans et al. 2012). The study found that having skilled birth attendance and making four or more antenatal care visits were the two least equitable interventions. Investigations in individual countries also confirmed the presence of varying degrees of inequalities in health and health care.

A study in South Africa based on four rounds of household survey data indicated that several major ill-health conditions (e.g., psychological disorder, tuberculosis, HIV/AIDS, diarrhea, etc.) were heavily concentrated among the poorest economic group (Ataguba, Akazili et al. 2011). The negative relationship between economic status and ill-health/disabilities was persistent through the surveys. Also, in Malawi, based on data from three consecutive Demographic and Health Surveys (DHS), Zere and colleagues found that pro-wealthy inequalities existed in most of the health indicators studied and that the inequalities widened during the observation period (Zere, Moeti et al. 2007). This study also revealed that wealthy people had a lower burden from child illness but received more medical care, whereas the poor suffered more from ill health but used health services less.

Research on health inequalities in Cambodia is limited. Most studies on health inequalities in Cambodia have focused on a single health indicator, and none have assessed the trends in inequalities. Using data from the 2000 Cambodia DHS, Hong and Mishra analyzed the inequalities in child stunting and estimated the effect of household wealth on moderate and severe child stunting (Hong and Mishra 2006). The study found that household economic wellbeing played an important role in childhood under-nutrition. Hong and Them analyzed data from the 2005 Cambodia DHS data and confirmed the presence of inequalities in receiving skilled delivery care. Women from the poorer households were more likely to be attended by unskilled birth attendants (Hong and Them 2011).

The present analysis uses data from three Cambodia DHS surveys, conducted in 2000, 2005, and 2010, to assess the trends in inequalities for a range of indicators of maternal and child health and health care. Monitoring the levels and changes in inequalities in health status and use of health services is important for intervention programs to allocate scarce public resources to those who are disadvantaged and have greater needs.

## 2. COUNTRY PROFILE

Cambodia, located in Southeast Asia, has an area of about 181,035 square kilometers and a total population of 13.4 million. Over 80 percent of the population lives in rural areas. Cambodia is one of the poorest countries in Asia. The GDP per capita is US$558 (in constant year 2000 US dollars), estimated in 2010, and 28 percent of the total population lives under the national poverty line. The average adult literacy rate is 78 percent, with a much lower literacy rate among women than men—71 percent versus 85 percent. As of 2010, life expectancy was 60 years for males and 65 years for females. Table 1 shows selected development and health indicators of the country.

**Table 1. Population, health, and development indicators in Cambodia**

| Indicators | |
|---|---|
| Total population (millions) | 14.1 |
| Annual population growth rate | 1.14% |
| Adult literacy rate (2009) | 78% |
| GDP per capita (constant 2000 US$) | 558 |
| Annual GDP growth | 5.96% |
| % of population with access to improved sanitation facilities | 35.4% |
| % of population with access to improved water source | 64.0% |
| Life expectancy at birth (years) | 62.5 |
| Total fertility rate | 3.0 |
| Infant mortality rate (per 1000 live births) | 45 |
| Under-five mortality rate (per 1000 live births) | 54 |
| Maternal mortality ratio (per 100,000 live births) | 206 |
| Adult (age 15–49) HIV prevalence rate | 0.5% |
| Per capita total expenditure on health (PPP int. $) | 17 |
| Per capita government expenditure on health (PPP int. $) | 45 |
| Govt. expenditure on health as a percentage of total health expenditure | 22.4% |
| Private expenditure on health as a percentage of total health expenditure | 77.6% |
| Hospital beds (per 1,000 people) | 0.84 |
| Physicians (per 100,000 population) | 0.23 |
| Density of pharmaceutical personnel (per 10,000 population) | 0.38 |

Data sources include 2010 CDHS, UNESCO, WHO, the World Bank;
all data are as of 2010 unless noted otherwise

The health service delivery system in Cambodia includes public and private sectors (Ministry of Health Cambodia and WHO 2012). The public sector has two levels of health facilities: health centers and referral hospitals. Health centers primarily provide the minimum package of services, including initial consultation, primary diagnosis, maternal and child care (antenatal care, normal delivery, vaccination, etc.), contraception, and other basic health services. Referral hospitals are classified into three levels: national, provincial, and district referral hospitals, according to number of staff, beds, medicines, equipment, and clinical activities. Private providers include independent practitioners, workplace care, and international NGOs, which deliver a limited range of services.

Utilization of the public sector for general health services is low. The 2010 CDHS shows that among people who sought treatment for illness or injury, less than one-third went to a public facility for

their first treatment. The private sector in Cambodia, comprising private hospitals, clinics, private doctors, nurses, and trained health workers, plays an important role in delivering general health services. Over 60 percent of people who sought care for their recent illness or injury went to a private provider.

Cambodia's health financing system has gone through reforms in the past decade. In addition to the traditional user-fee system, the government has implemented several other models to meet different financing and service delivery goals, including Health Equity Funds (HEFs), community-based health insurance (CBHI), performance-based contracting for services, and voucher mechanism. HEFs and CBHI are intended to improve access to health care for the poor. However, the coverage of health insurance is limited. As of 2010, about 10 percent of the population was covered by HEFs or CBHI.

Cambodia's total health spending as a percentage of GDP was 5.6 percent in 2010, higher than most countries in Southeast Asia. Private health expenditures contribute to 78 percent of the total health spending, and the government's share is about 22 percent. Close to 20 percent of the total health expenditure in Cambodia is for preventive and public health, one of the highest levels in the region.

## 3. DATA AND METHODS

### 3.1. Data

This study uses data from three Cambodia Demographic and Health Surveys (CDHS), conducted in 2000, 2005, and 2010, which obtained comparable nationally representative samples of women age 15-49 and men age 15-49. The DHS sample typically is selected in two stages. The first stage involves selecting clusters with probability proportional to size from a national master sample frame. At the second stage a systematic sample of households is drawn from a listing of households in each of the DHS clusters. All women age 15-49 in the sampled households are eligible for individual interview. In the three CDHS surveys women's response rates were 98 percent or higher, and the number of women interviewed was 15,351, 16,823, and 18,754 in 2000, 2005, and 2010, respectively.

### 3.2. Measurements

Indicators analyzed are in two categories. The first category includes maternal and child health indicators, including three MDG indicators: infant mortality rate, under-five mortality rate, and child underweight. Other health indicators in this category are stunting in children under age 5, prevalence of anemia, and prevalence of diarrhea in children. The second category includes indicators of use of health services: antenatal care, skilled birth attendance, delivery in health facilities, full immunization coverage, medical treatment for child's diarrhea, and contraceptive prevalence rate. The definition and data for each indicator are described below.

***Maternal and child health indicators***

Infant mortality and under-five mortality rates

Infant and child mortality rates are calculated based on the full birth history data collected from interviewed women. For each child born alive, data are collected on date of birth, current survival status, age of child (for surviving children), and age at death (for dead children). The direct estimation based on a synthetic cohort life table is used to calculate the infant and under-five mortality rates (Rutstein and Rojas 2006).

Underweight and stunting in children

In all three CDHS surveys, in a subsample of households selected, all children under age 5 were measured for height and weight. Comparing these measurements with the 2006 WHO Child Growth Standards (WHO Multicentre Growth Reference Study Group 2006), two malnutrition indicators—underweight and stunting—are defined. Underweight is defined as child's weight-for-age Z-score below two standard deviations from the mean of the reference population. Stunting is defined as child's height-for-age Z-score below two standard deviations from the mean of the reference population. Whereas stunting represents the effects of long-term malnutrition, underweight reflects the combination of short- and long-term malnutrition.

Prevalence of anemia in children age 6-59 months

In a subsample of the households selected, blood-drop specimens were collected for all children age 6-59 months. Hemoglobin analysis was carried out using Hemocue equipment in the field. Anemia is defined according to the level of hemoglobin. The measured hemoglobin level is adjusted to sea-level

equivalents, given that hemoglobin requirements substantially vary with altitude. A child is considered anemic if her/his adjusted hemoglobin level is below 10.9 g/dl.

Prevalence of diarrhea in children under age 5

The prevalence of diarrhea is estimated by asking mothers whether their children under age 5 had diarrhea in the two weeks preceding the survey.

***Indicators of the use of maternal and child health services***

Antenatal care

In the CDHS, sampled women were asked to provide information on antenatal care (e.g. number of visits, timing and content of care) during pregnancy for the last live birth in the five years preceding the survey. Based on these data, two indicators are calculated to measure the extent of antenatal care coverage. One is the proportion of women who received any antenatal care for the most recent birth in the five years preceding the survey. Given the WHO recommendation of a minimum of four antenatal care visits, we also calculate the proportion of women who had four or more antenatal care visits during pregnancy for the most recent birth.

Skilled birth attendance and delivery in health facilities

Data on delivery care were collected for all live births during the five years preceding the interview. According to the WHO definition, skilled birth attendance is delivery assistance provided by a doctor, nurse, or medically trained midwife. In this study we analyze skilled birth attendance for all live births in the five years preceding the survey. In addition, women were also asked where they delivered each birth. The proportion of births in the five years preceding the survey that occurred in health facilities (i.e., public hospitals, health centers, private hospitals, and private clinics) is calculated on the basis of the responses.

Full immunization coverage in children age 12-23 months

Full immunization refers to having a vaccination against tuberculosis (BCG), three doses each of the diphtheria, pertussis and tetanus (DPT), and polio vaccines, and a measles vaccination by the age of 12 months. The full immunization rate is calculated based on vaccination data collected from mothers for all live children under age 5.

Medical treatment for diarrhea in children

Mothers whose children under age 5 had diarrhea were asked whether and where they sought advice or treatment for diarrhea. The proportion of children who had diarrhea and were taken to a health facility is calculated on the basis of the responses.

Contraceptive prevalence rate among married women

In the CDHS, women age 15-49 were asked about their current use of any contraception. The contraceptive prevalence rate among married and cohabitating women is analyzed in this study.

***Measurements of inequalities***

To measure economic-related inequalities in health and health service utilization, we first classify individuals into different economic groups. Given the difficulty of collecting income and expenditure data in developing countries, DHS surveys collect data on household ownership of consumer goods, dwelling materials, sources of drinking water, types of sanitation facilities, and other characteristics that relate to economic status. With these data, an index score is computed for each household, using principal component analysis. The entire sample is then ranked according to this score and is divided into quintiles, from the first quintile ($Q_1$)—the poorest 20 percent of the household population—to the fifth quintile ($Q_5$)—the wealthiest 20 percent (Rutstein and Johnson 2004). Wealth quintile ranking indicates relative rather than absolute economic status of the household. The bottom 20 percent measured in the 2000 CDHS may not have the same absolute level of wealth as the bottom 20 percent measured in the 2005 CDHS. In another words, wealth status is not comparable across surveys and countries. This study, however, is not affected by this limitation because it focuses on the disparities in health and health care indicators between the wealthy and the poor only within each survey.

We calculate two inequality indicators—the ratio between $Q_5$ and $Q_1$ (ratio of $Q_1$ to $Q_5$ for health indicators and ratio of $Q_5$ to $Q_1$ for indicators of health care) and the concentration index. The ratio indicator compares the level of health or use of health services between the wealthiest and the poorest quintiles. To some extent, this indicator provides information on the disparities between the wealthy and the poor. However, it is only based on the information of the two extremes among the wealth groups but ignores the other three quintiles between the top and bottom, and therefore cannot provide a picture of inequalities across the entire population.

The second indicator, the concentration index, quantifies the degree of economic inequality using information from all five quintiles. Therefore, it is a composite summary of inequality across the entire population. The concentration index is calculated in reference to the Lorenz curve. On a Lorenz curve, the x-axis represents the cumulative percentage of the sample, ranked by wealth status from low to high (i.e. from the poorest to the wealthiest); the y-axis plots the cumulative percentage of the outcome variable (i.e. health or healthcare variable) corresponding to each wealth group.

The Lorenz curve provides a visual comparison of inequalities. If everyone has the same value of the outcome variable, irrespective of individual wealth status, the Lorenz curve will be the 45 degree diagonal line, which is called the line of equality. If an outcome, for example the infant mortality rate, has higher values among poorer people and lower values among wealthier people, the Lorenz curve will lie above the line of equality. For a variable with higher values among the wealthier population, for example, an indicator of using a type of health service, the Lorenz curve will lie below the line of equality. The area between the Lorenz curve and the line of equality indicates the magnitude of the inequality. The further the curve is from the line of equality, the greater the inequality. If the Lorenz curves for the same variable at different time points are plotted on the same graph, temporal changes in inequalities can be assessed. In this study, we plot the Lorenz curves for each indicator from the three surveys on the same graph to assess the trends.

The concentration index is defined in reference to the Lorenz curve. Its value is equal to twice the area between the Lorenz curve and the line of equality. The index ranges from -1 to +1. Its magnitude reflects the degree of the inequality. It is zero when the Lorenz curve coincides with the line of equality. Its negative sign indicates that the outcome is concentrated among the poor and the corresponding Lorenz curve lies above the line of equality. When it is positive, the wealthy have the higher values of the outcome and the curve lies below the line of equality.

In this analysis we calculate concentration indices based on grouped data. Table 2 gives an example of calculation using child stunting data from the 2010 CDHS. We first estimate the number of children interviewed and number of children stunted in each wealth quintile. We then calculate cumulative percent of children interviewed and cumulative percent of children stunted. With these data, the concentration index for stunting can be calculated using the following formula (Fuller and Lury 1977):

$$C= (P_1L_2-P_2L_1) + (P_2L_3-P_3L_2) +\ldots + (P_{T-1}\, L_T-P_TL_{T-1})$$

Where $P_t$ is the cumulative percent of the sample ranked by wealth status in group *t*, $L_t$ is the corresponding Lorenz curve ordinate, and T is the total number of wealth groups, which is five in this analysis.

**Table 2. Calculation of the concentration index for child stunting based on the 2010 Cambodia DHS data**

| Wealth group | No. of children | Rel % children | Cumul % children | % stunting | No. of children stunted | Rel % stunted children | Cumul % of stunted children | Conc. Index |
|---|---|---|---|---|---|---|---|---|
| Poorest | 1,041 | 26% | 26% | 51% | 532 | 34% | 34% | -0.0090 |
| $2_{nd}$ | 811 | 20% | 47% | 44% | 360 | 23% | 56% | -0.0194 |
| Middle | 744 | 19% | 65% | 39% | 292 | 18% | 75% | -0.0355 |
| $4_{th}$ | 754 | 19% | 84% | 34% | 258 | 16% | 91% | -0.0662 |
| Wealthiest | 625 | 16% | 100% | 23% | 144 | 9% | 100% | 0.0000 |
| Total | 3,975 | | | | 1,587 | | | -0.1300 |

Standard errors are calculated for concentration indices using the formula suggested by Kakwani and colleagues (Kakwani et al. 1997). Statistical tests are performed to assess if the concentration indices are significantly different from zero and if the changes between any two of the surveys are statistically significant.

## 4. RESULTS

This section first describes the findings on maternal and child health outcomes, then the results on the indicators of health services utilization.

### 4.1. Inequalities in Maternal and Child Health

Table 3 shows the health indicators at the population level and by wealth quintile from the three surveys.

Overall, improvements are observed for all the indicators between 2000 and 2010. The greatest progress was made in reducing infant mortality and under-five mortality, with more reduction occurring between 2005 and 2010 than between 2000 and 2005. The infant mortality rate declined from 93 deaths per 1,000 live births in 2000 to 88 per 1,000 in 2005, and further to 58 per 1,000 in 2010. The under-five mortality rate decreased even more, by 13 percent (from 122 to 106 per 1,000) between 2000 and 2005 and by 36 percent (from 106 to 68 per 1,000) between 2005 and 2010.

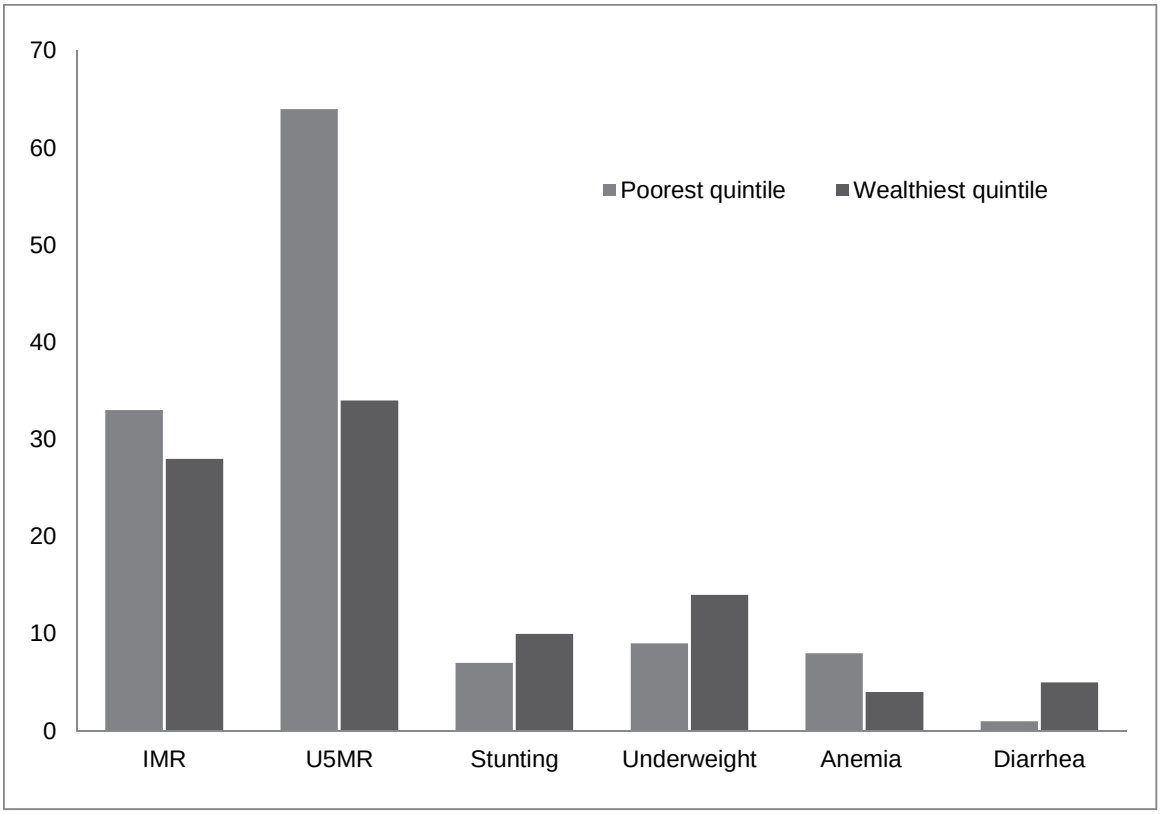
**Table 3. Maternal and child health indicators by household wealth quintile in 2000, 2005, and 2010**

| | | Wealth quintile | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Health indicators** | | **Lowest** | **Second** | **Middle** | **Fourth** | **Highest** | **Total** | **Low/high ratio** |
| Infant mortality rate (per 1000 live births) | 2000 | 109.7 | 108.2 | 88.2 | 88.7 | 50.3 | 92.7 | 2.2 |
| | 2005 | 100.6 | 108.6 | 97.8 | 77.8 | 34.3 | 88.1 | 2.9 |
| | 2010 | 76.7 | 70.6 | 61.7 | 39.1 | 22.6 | 57.7 | 3.4 |
| Under-five mortality rate (per 1000 live births) | 2000 | 154.8 | 136.5 | 115.3 | 113.3 | 63.6 | 121.6 | 2.4 |
| | 2005 | 127.1 | 128.8 | 114.1 | 92.0 | 43.0 | 106.3 | 3.0 |
| | 2010 | 90.3 | 82.8 | 68.4 | 48.5 | 30.0 | 68.0 | 3.0 |
| Stunting among children under age five (%) | 2000 | 58.0 | 53.0 | 47.9 | 48.6 | 32.8 | 49.8 | 1.8 |
| | 2005 | 52.1 | 48.5 | 44.1 | 38.2 | 24.4 | 42.7 | 2.1 |
| | 2010 | 51.1 | 44.4 | 39.3 | 34.2 | 23.1 | 39.9 | 2.2 |
| Underweight among children under age five (%) | 2000 | 44.2 | 40.7 | 37.4 | 35.1 | 30.0 | 38.5 | 1.5 |
| | 2005 | 34.6 | 32.3 | 26.6 | 27.2 | 15.8 | 28.1 | 2.2 |
| | 2010 | 35.4 | 32.6 | 27.8 | 24.6 | 15.9 | 28.3 | 2.2 |
| Anemia among children under age five (%) | 2000 | 68.1 | 66.8 | 63.0 | 62.8 | 47.6 | 63.4 | 1.4 |
| | 2005 | 69.4 | 65.9 | 61.3 | 55.9 | 51.0 | 61.9 | 1.4 |
| | 2010 | 59.6 | 58.8 | 57.4 | 52.2 | 43.4 | 55.1 | 1.4 |
| Diarrhea among children under age five (%) | 2000 | 19.5 | 20.1 | 18.1 | 19.6 | 16.0 | 18.9 | 1.2 |
| | 2005 | 22.4 | 20.8 | 19.8 | 18.3 | 14.1 | 19.5 | 1.6 |
| | 2010 | 18.4 | 15.8 | 15.1 | 12.0 | 10.7 | 14.9 | 1.7 |

Children's nutritional status also improved over the decade. In 2010, 40 percent of under-five children were stunted compared with 50 percent in 2000. The percentage of children who were underweight decreased from 39 percent in 2000 to 28 percent in 2005 and stayed the same in 2010. Prevalence of child anemia declined more sharply between 2005 and 2010 than between 2000 and 2005. However, still more than half of under-five children were anemic in 2010. The change in the average prevalence of diarrhea, from 19 percent in 2000 to 15 percent in 2010, was less remarkable compared with other health indicators.

All five wealth quintiles improved in almost all health indicators studied. Comparing the poorest quintile with the wealthiest quintile (Figure 1), we see more reductions among the poorest than the wealthiest in the infant mortality rate, under-five mortality rate, and prevalence of anemia. The reduction in under-five mortality among the poorest group—an absolute decline of 64 deaths per 1,000 live births from 2000 to 2010—is particularly remarkable, almost twice the reduction among the wealthiest group. For prevalence of stunting, underweight, and diarrhea, however, the poorest quintile showed less improvement than the wealthiest group between 2000 and 2010.

**Figure 1. Absolute changes in mortality rates and prevalence rates in child malnutrition and illness between 2000 and 2010**




Despite the greater reductions in some health indicators among the poorest group, a large gap remains between the poorest and wealthiest quintiles in almost all indicators studied. Table 3 shows the ratios of the poorest to the wealthiest for each health indicator from the three surveys. The ratios for all the indicators studied from all three surveys are greater than 1, indicating the presence of inequalities that favor the wealthy over the poor. For most indicators, the quintile ratios increased over time, which implies a widening of inequalities between the poorest and the wealthiest. The largest ratios are found in

infant mortality and under-five mortality, and they have increased between 2000 and 2010. For example, the infant mortality rate among the poorest is twice as high compared with the wealthiest in 2000, and over three times higher in 2010. A similar pattern is observed for under-five mortality.

The ratios of the poorest to the wealthiest for the two malnutrition indicators also increased during the study period. In 2010, children living in the poorest households were twice as likely to be stunted compared with children in the wealthiest households. Prevalence of anemia among children under age 5 is an exception: the ratios between the two wealth quintiles remained the same between 2000 and 2010, at 1.4. For prevalence of diarrhea, the quintile ratios were smaller compared with the other health indicators, but they also increased between 2000 and 2010.

As discussed earlier, the quintile ratio is based only on the information of the two extremes of wealth—the poorest and the wealthiest—and ignores the middle three groups. For this reason, we use the concentration indices along with Lorenz curves to assess the overall inequalities in health indicators and their changes among the population.

Figures 2a-2f graph the Lorenz curves for the six health indicators. All the Lorenz curves lie above the line of equality, which implies inequality in all the indicators by household wealth, and the wealthy households have lower values of the outcomes than the poor households. The areas between the curve and the line of inequality appear greater for infant mortality and under-five mortality rate compared with the other health indicators.

Trends in inequalities can be assessed by comparing Lorenz curves for a given health indicator at different time points. The inequality narrows if the curve moves towards the line of equality; otherwise, the inequality worsens.

**Figure 2a. Infant mortality rate**

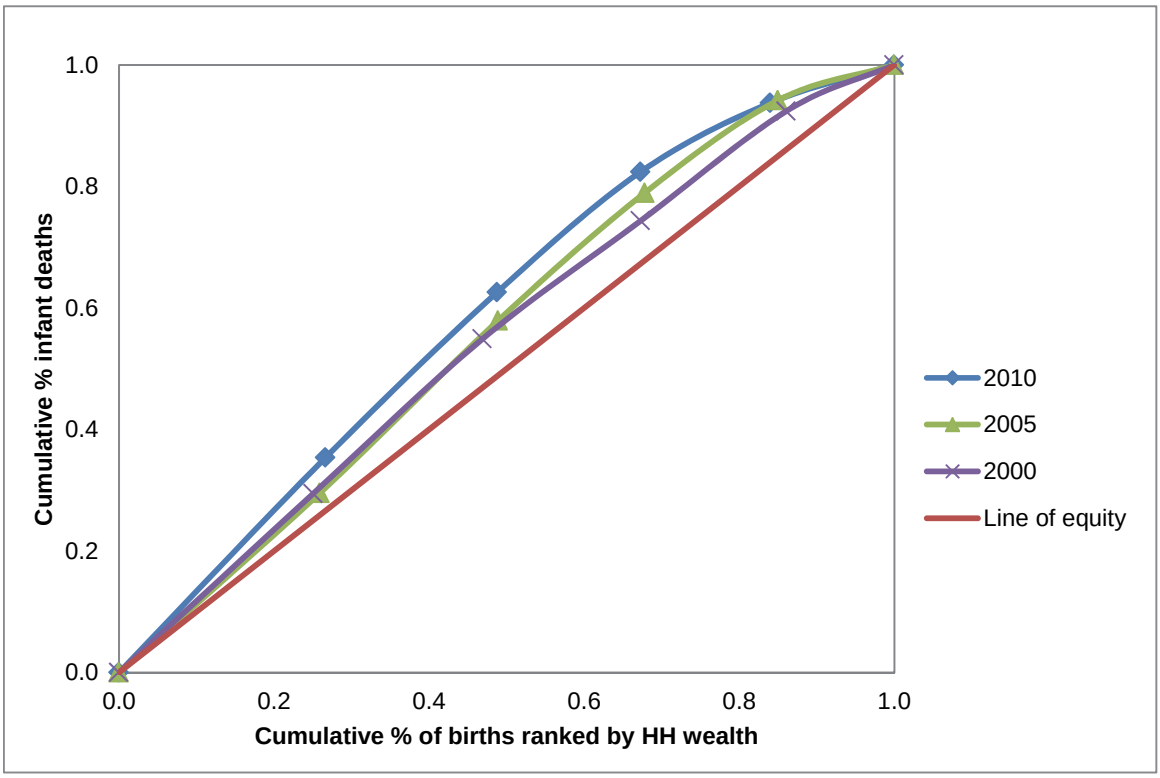



**Figure 2b. Under-five mortality rate**

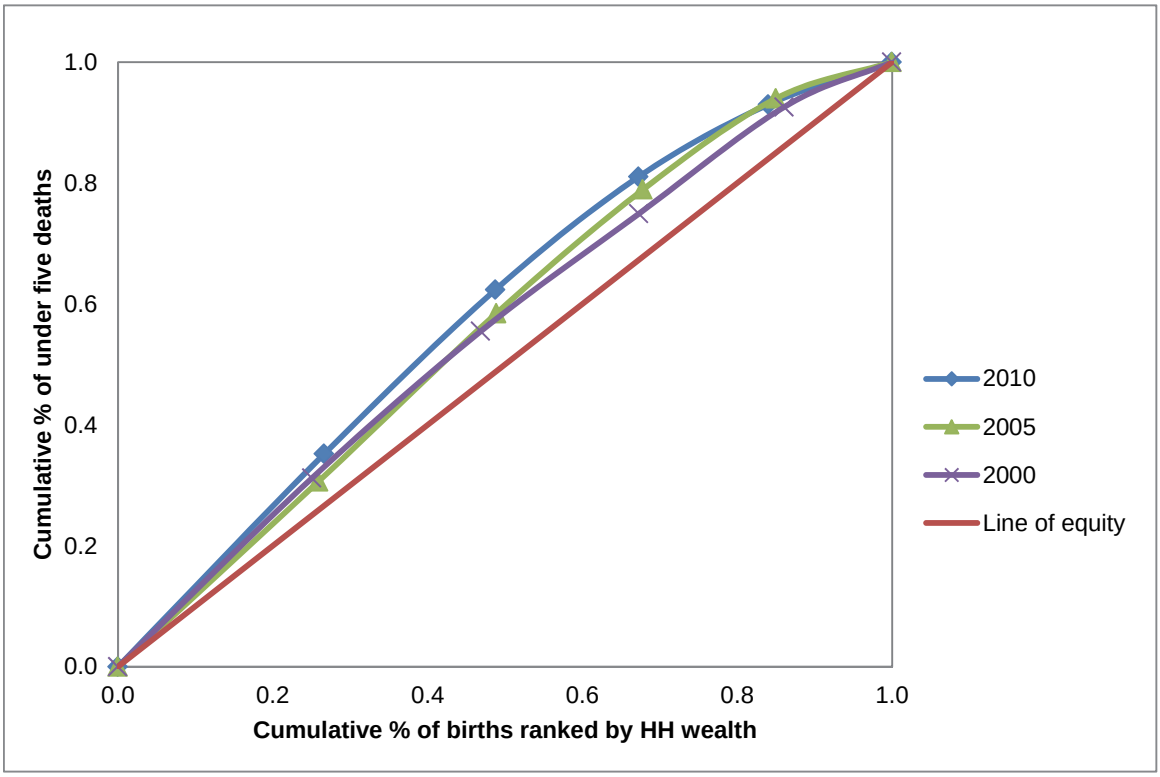


**Figure 2c. Stunting among children under age 5**

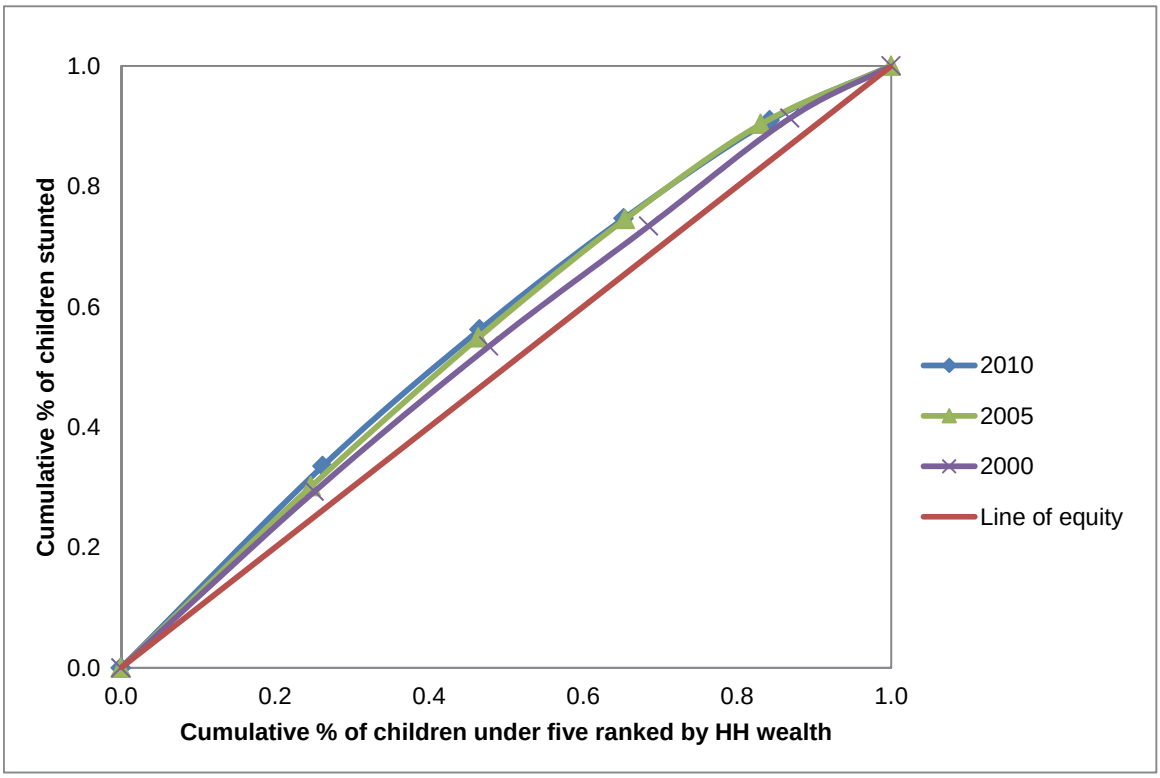



**Figure 2d. Underweight among children under age 5**

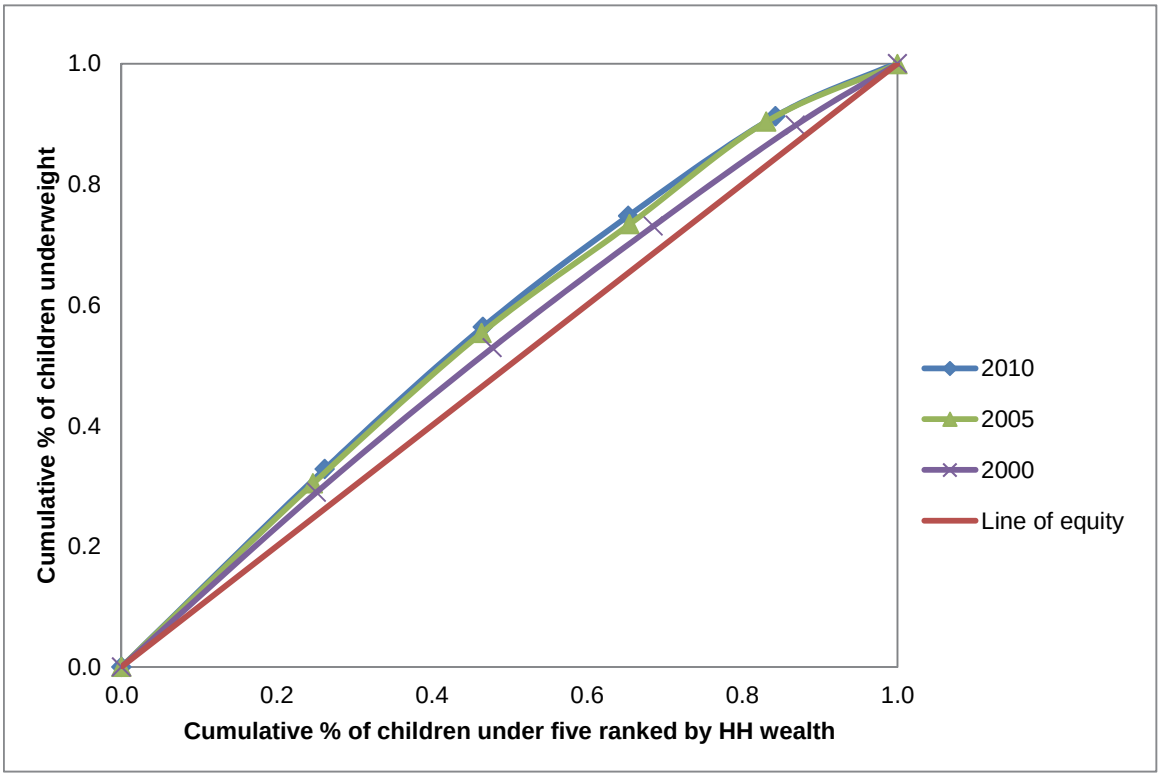


**Figure 2e. Anemia among children under age 5**

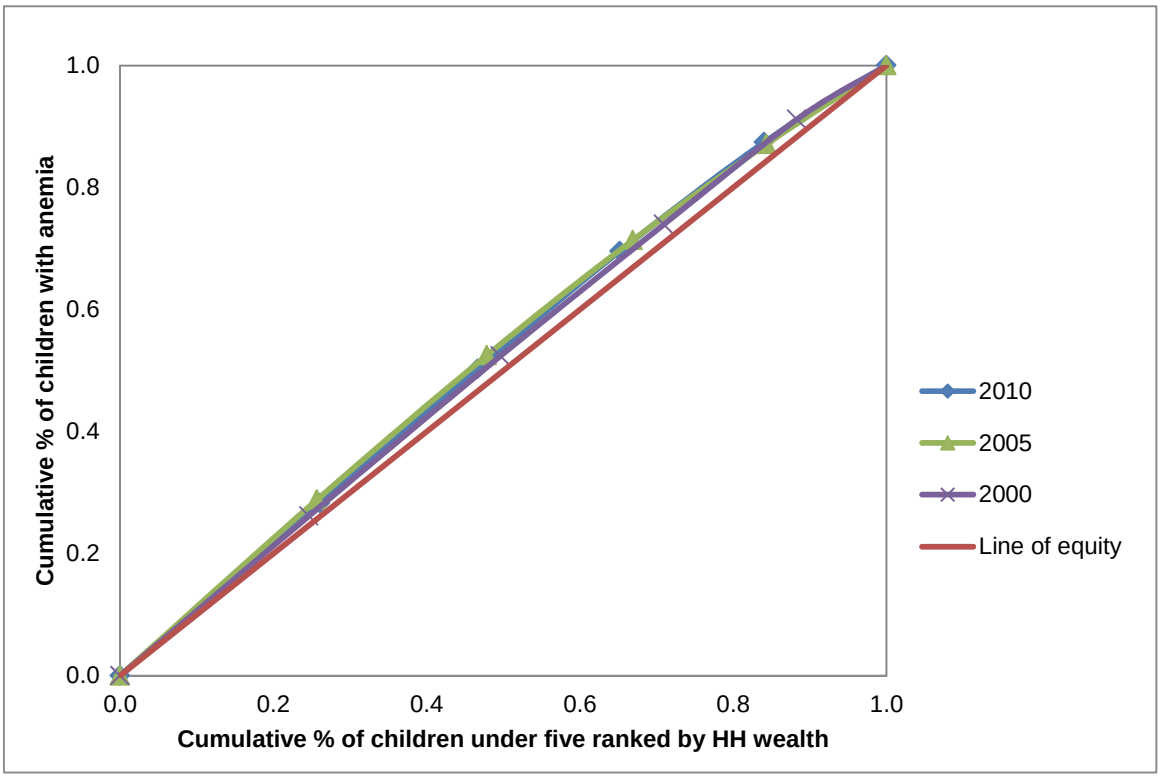
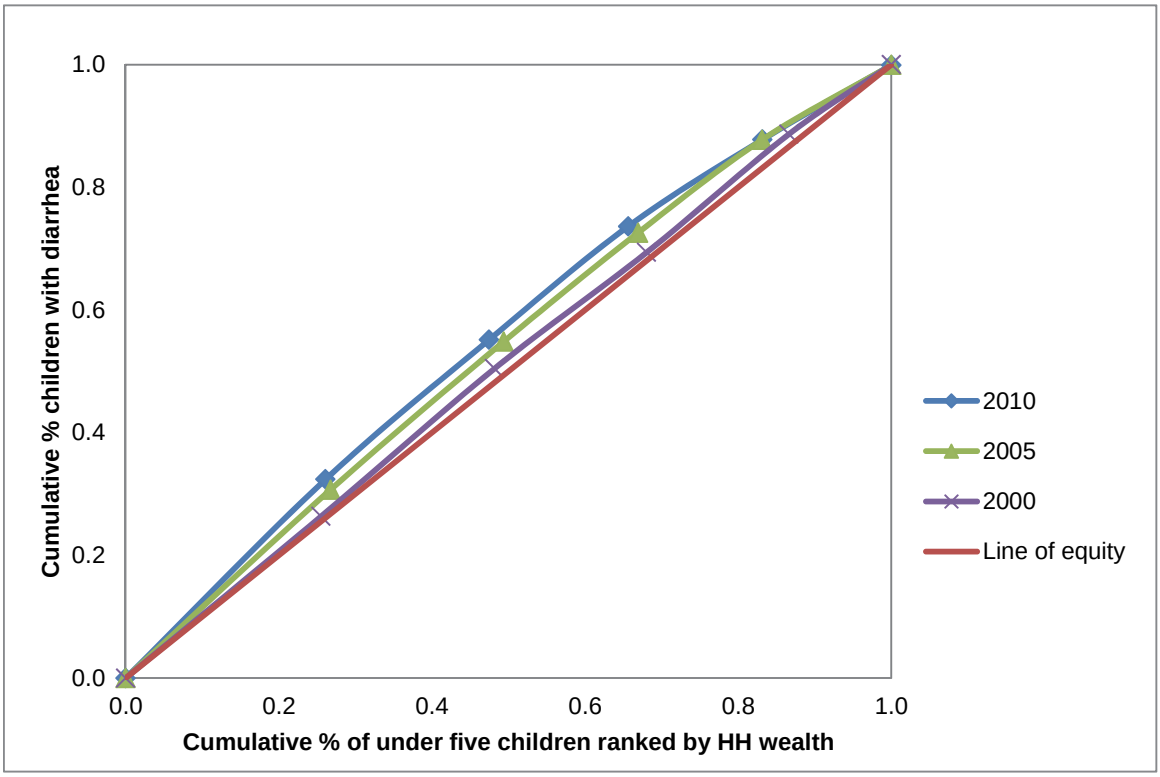



**Figure 2f. Diarrhea among children under age 5**



For infant mortality and under-five mortality rates from 2000 to 2010, the Lorenz curves move further away from the line of equality, implying widening of the inequality in these two indicators. It is noted that two curves for 2000 and 2005 intersect each other in the middle, which introduces difficulty for assessing inequalities purely based on curves. The trends in stunting and underweight are not explicit. The Lorenz curves in 2010 and 2005 largely overlap and also intersect with the 2000 curve. For prevalence of anemia, three curves almost overlap, indicating the similar inequalities in three surveys. For prevalence of diarrhea, the 2000 curve is closest to the line of equality, and the other two curves are further from the line of equality.

Concentration indices presented in Table 4 provide information on the amount of inequality. Quantifying inequalities using these indices is particularly useful when the Lorenz curves intersect. Also, as the data are from survey samples, we assess the precision of the estimate by calculating standard errors and 95% confidence intervals.

**Table 4. Concentration indices, standard errors, 95% confidence intervals, and t-statistics for comparisons between two surveys**

| Health indicators | Survey year | Conc. Index (CI) | SE (CI) | 95% Confidence interval | | t-statistics | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Low | High | 2000-2005 | 2005-2010 | 2000-2010 |
| Infant mortality rate | 2000 | -0.105 | 0.053 | -0.209 | -0.001 | | | |
| | 2005 | -0.126 | 0.085 | -0.292 | 0.041 | -0.207 | -0.507 | -0.842 |
| | 2010 | -0.184 | 0.077 | -0.335 | -0.033 | | | |
| Under-five mortality rate | 2000 | -0.124 | 0.053 | -0.228 | -0.019 | | | |
| | 2005 | -0.136 | 0.079 | -0.290 | 0.019 | -0.125 | -0.391 | -0.615 |
| | 2010 | -0.176 | 0.066 | -0.304 | -0.047 | | | |
| Stunting among children under age five | 2000 | -0.067 | 0.034 | -0.134 | 0.000 | | | |
| | 2005 | -0.118 | 0.050 | -0.216 | -0.020 | -0.839 | -0.182 | -1.137 |
| | 2010 | -0.130 | 0.043 | -0.215 | -0.045 | | | |
| Underweight among children under age five | 2000 | -0.067 | 0.019 | -0.104 | -0.029 | | | |
| | 2005 | -0.118 | 0.051 | -0.219 | -0.017 | -0.934 | -0.142 | -1.206 |
| | 2010 | -0.128 | 0.047 | -0.220 | -0.036 | | | |
| Anemia among children under age five | 2000 | -0.040 | 0.026 | -0.090 | 0.011 | | | |
| | 2005 | -0.059 | 0.016 | -0.091 | -0.028 | -0.643 | 0.259 | -0.347 |
| | 2010 | -0.052 | 0.024 | -0.098 | -0.006 | | | |
| Diarrhea among children under age five | 2000 | -0.026 | 0.019 | -0.064 | 0.012 | | | |
| | 2005 | -0.076 | 0.030 | -0.135 | -0.017 | -1.577 | -0.737 | -2.491 |
| | 2010 | -0.105 | 0.025 | -0.154 | -0.056 | | | |

The concentration indices for all the health indicators are negative and most are statistically significant, suggesting that the poor are disproportionally affected by ill health. However, a few indicators for some surveys have non-significant concentration indices—child stunting in 2000, prevalence of anemia among under-five children in 2000, diarrhea prevalence in 2000, the infant mortality rate in 2005,

and the under-five mortality rate in 2005. A non-significant index implies that there is no inequality for these indicators, or that the survey samples are too small to detect inequality with 95% certainty.

Significance testing is necessary to verify which of the apparent changes in inequalities are statistically significant. Table 4 also shows the results of t-tests for differences between 2000 and 2005, 2005 and 2010, and 2000 and 2010. Although for almost all the indicators, the absolute values of concentration indices were greater in later surveys than in early surveys, the differences between any two of the three surveys were not statistically significant. Therefore, the apparent differences between the curves/indices may be purely due to the sample variation. The only exception is the prevalence of diarrhea, showing a statistically significant increase in inequality between 2000 and 2010. In summary, except for prevalence of diarrhea among children under age 5, the likelihood of changes in inequality between 2000 and 2010 in the studied maternal and child health indicators cannot be assured.

## 4.2. Inequalities in the Use of Maternal and Child Health Services

Table 5 provides information on population averages, wealth quintile-specific levels, and ratios of the wealthiest to the poorest for seven indicators of the use of maternal and child health services.

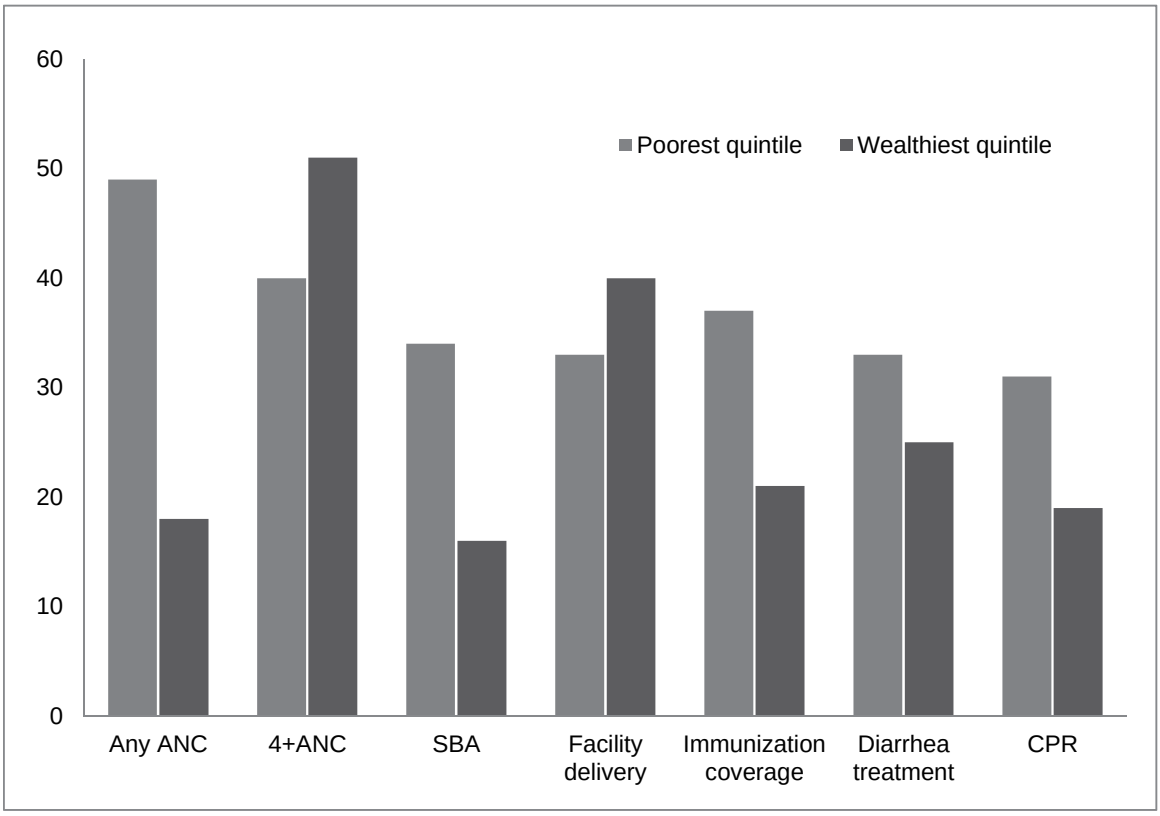
**Table 5. Maternal and child health service indicators by household wealth quintile in 2000, 2005 and 2010**

| Health services use | Survey year | Wealth quintile | | | | | Total | High/low ratio |
|---|---|---|---|---|---|---|---|---|
| | | Lowest | Second | Middle | Fourth | Highest | | |
| % of women had 1+ ANC visit | 2000 | 30.5 | 34.3 | 39.0 | 47.9 | 80.3 | 43.4 | 2.6 |
| | 2005 | 58.5 | 67.2 | 70.9 | 78.9 | 89.9 | 71.5 | 1.5 |
| | 2010 | 79.8 | 85.6 | 92.0 | 94.7 | 98.4 | 89.2 | 1.2 |
| % of women had 4 + ANC visits | 2000 | 2.9 | 5.6 | 4.8 | 8.1 | 31.4 | 8.9 | 10.8 |
| | 2005 | 15.1 | 19.0 | 22.5 | 30.6 | 56.8 | 27.0 | 3.8 |
| | 2010 | 42.8 | 51.4 | 57.9 | 70.6 | 82.5 | 59.4 | 1.9 |
| % of births assisted by skilled birth attendant | 2000 | 14.7 | 21.3 | 27.4 | 40.7 | 81.2 | 31.8 | 5.5 |
| | 2005 | 20.7 | 29.0 | 39.6 | 61.9 | 89.9 | 43.8 | 4.3 |
| | 2010 | 48.7 | 63.7 | 74.5 | 86.5 | 96.7 | 71.0 | 2.0 |
| % of births delivered in a health facility | 2000 | 1.8 | 3.2 | 5.4 | 9.6 | 47.1 | 9.9 | 26.2 |
| | 2005 | 6.5 | 10.0 | 14.1 | 25.5 | 67.4 | 21.5 | 10.4 |
| | 2010 | 34.5 | 43.8 | 51.9 | 65.8 | 87.5 | 53.8 | 2.5 |
| % of children 12-23 months fully immunized | 2000 | 28.6 | 34.7 | 38.4 | 45.4 | 67.7 | 39.9 | 2.4 |
| | 2005 | 56.1 | 65.8 | 66.6 | 74.4 | 76.4 | 66.6 | 1.4 |
| | 2010 | 65.3 | 77.4 | 83.6 | 84.3 | 88.2 | 78.8 | 1.4 |
| % of children under age five with diarrhea had medical treatment | 2000 | 20.6 | 16.0 | 20.8 | 24.4 | 34.3 | 21.8 | 1.7 |
| | 2005 | 35.0 | 40.5 | 47.5 | 40.1 | 49.5 | 41.1 | 1.4 |
| | 2010 | 53.3 | 59.4 | 67.3 | 59.3 | 59.7 | 58.9 | 1.1 |
| Contraceptive prevalence rate (%) | 2000 | 14.4 | 17.9 | 23.8 | 24.6 | 37.5 | 23.8 | 2.6 |
| | 2005 | 30.7 | 34.3 | 38.7 | 41.3 | 54.0 | 40.0 | 1.8 |
| | 2010 | 45.2 | 47.5 | 51.3 | 52.6 | 56.0 | 50.5 | 1.2 |

At the population level, steady and substantial increases are observed for all the indicators of service use between 2000 and 2010. For example, the percentage of women who had four or more antenatal visits increased from less than 10 percent in 2000 to almost 60 percent in 2010. The level of skilled birth attendance more than doubled between 2000 and 2010, from 32 percent to 71 percent. Moreover, increases in use of health services are universal across the wealth quintiles for all the indicators.

Figure 3 shows the comparisons between the poorest and wealthiest quintiles in the changes between 2000 and 2010. Except for making four or more antenatal care visits and giving birth in health facilities, the absolute increases are greater among the poorest than the wealthiest, for all other indicators. The increases for the poorest group are twice the increases for the wealthiest group, for receiving any antenatal care and having skilled birth attendants at delivery.

**Figure 3. Absolute percentage point changes in use of health services between 2000 and 2010**




Despite substantial improvement in use of health services among the poorest households, Table 5 shows that inequalities still exist, reflected by ratios greater than 1, showing more health service use among the wealthiest than the poorest. However, the ratios declined over time for all the indicators, meaning the gaps between the wealthiest and the poorest narrowed and faster progress in use of health services was made among the poorest than among the wealthiest. In 2000, for example, only 3 percent of women from the poorest households reported making the recommended four or more antenatal visits compared with 31 percent of women in the wealthiest group. In 2010, both groups had substantially higher proportions of women making four or more visits (43 percent of the poorest and 83 percent of the wealthiest), while the ratio between them fell from 10.8 in 2000 to 1.9 in 2010. A similar pattern is

observed for facility delivery, where the quintile ratio dramatically dropped from 26.2 in 2000 to 2.5 in 2010.

For maternal and child care indicators, similar to health status indicators, we use the Lorenz curve and index to assess the degree of the inequality and changes over time by incorporating the information from all five wealth quintile groups. For the two indicators of antenatal care, the Lorenz curves lie under the line of equality, which means more use of antenatal care among the wealthy than the poor. The concentration indices presented in Table 6 are positive and statistically significant, which means that in all three surveys wealthy people have significantly more use of antenatal care—both any care and making four or more visits—than the poor. Over time, the Lorenz curves move closer to the line of equality, indicating potential narrowing in inequalities in antenatal care access. Testing differences between two of the three surveys show that the decrease between 2000 and 2010 is statistically significant, while the differences are not significant between 2000 and 2005 and between 2005 and 2010, although the concentration index has a smaller value in 2005 and 2010 compared with the 2000 survey.

**Table 6. Concentration indices, standard errors, 95% confidence intervals, and t-statistics for comparisons between two surveys**

| Health services use | Survey year | Conc. index (CI) | SE (CI) | 95% Confidence interval Low | 95% Confidence interval High | t-statistics 2000-2005 | t-statistics 2005-2010 | t-statistics 2000-2010 |
|---|---|---|---|---|---|---|---|---|
| Any ANC visit | 2000 | 0.180 | 0.063 | 0.057 | 0.304 | | | |
| | 2005 | 0.082 | 0.019 | 0.045 | 0.120 | 1.485 | 1.906 | 2.169 |
| | 2010 | 0.043 | 0.008 | 0.027 | 0.058 | | | |
| Four or more ANC visits | 2000 | 0.436 | 0.113 | 0.216 | 0.657 | | | |
| | 2005 | 0.263 | 0.063 | 0.139 | 0.386 | 1.348 | 1.941 | 2.648 |
| | 2010 | 0.132 | 0.024 | 0.084 | 0.179 | | | |
| Skilled birth attendance | 2000 | 0.317 | 0.082 | 0.156 | 0.477 | | | |
| | 2005 | 0.296 | 0.046 | 0.207 | 0.386 | 0.218 | 3.006 | 2.083 |
| | 2010 | 0.137 | 0.027 | 0.083 | 0.190 | | | |
| Delivery in health facilities | 2000 | 0.586 | 0.086 | 0.417 | 0.755 | | | |
| | 2005 | 0.459 | 0.065 | 0.332 | 0.586 | 1.182 | 3.682 | 4.280 |
| | 2010 | 0.184 | 0.037 | 0.112 | 0.257 | | | |
| Full immunization coverage | 2000 | 0.146 | 0.054 | 0.041 | 0.252 | | | |
| | 2005 | 0.064 | 0.010 | 0.044 | 0.083 | 1.515 | 0.290 | 1.552 |
| | 2010 | 0.057 | 0.021 | 0.015 | 0.098 | | | |
| Diarrhea-medical treatment | 2000 | 0.094 | 0.058 | -0.020 | 0.208 | | | |
| | 2005 | 0.059 | 0.025 | 0.009 | 0.108 | 0.562 | 0.907 | 1.055 |
| | 2010 | 0.029 | 0.020 | -0.010 | 0.069 | | | |
| Contraceptive use | 2000 | 0.181 | 0.043 | 0.096 | 0.266 | | | |
| | 2005 | 0.109 | 0.027 | 0.055 | 0.162 | 1.407 | 2.286 | 3.119 |
| | 2010 | 0.042 | 0.010 | 0.023 | 0.061 | | | |

For the two delivery care indicators, inequalities also exist and are significant, implying that births in wealthy households are more likely to be attended by skilled health personnel and are more likely to be delivered at a health facility. Comparing Lorenz curves from the three surveys, the 2000 curve lies furthest from the diagonal line, and the areas between the Lorenz curve and the diagonal line decreased over the survey period, with a greater reduction between 2005 and 2010 than between 2000 and 2005. The concentration index was 0.317 in 2000, 0.296 in 2005, and 0.137 in 2010. The decreases in inequality between 2005 and 2010 and between 2000 and 2010 are statistically significant, but the decrease between 2000 and 2005 is not.

For full immunization, the Lorenz curves also lie under the line of equality, and the corresponding concentration indices are statistically significant. These results imply the existence of inequalities in full immunization coverage in all three surveys. The t-test results, however, show that the differences between any two surveys are not statistically significant. Therefore, inequality in immunization coverage since 2000 cannot be shown to a 95% certainty.

**Figure 4a. Any ANC visit**

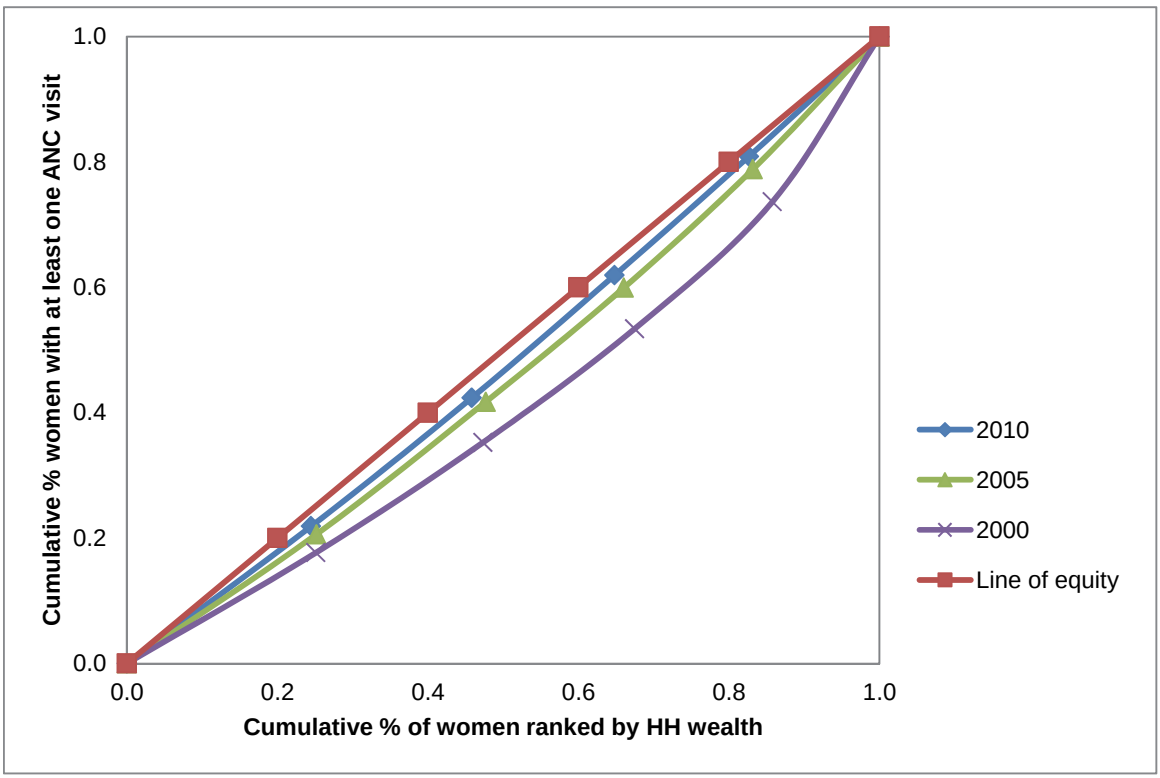


**Figure 4b. Four or more ANC visits**

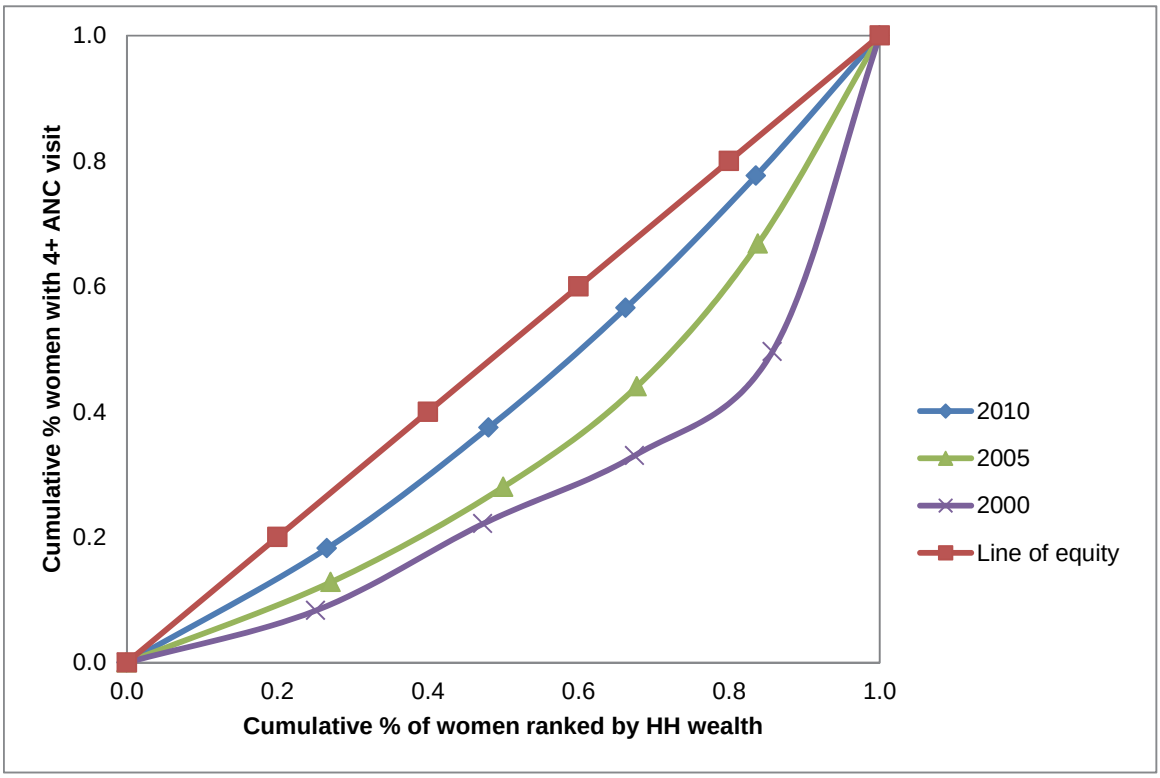



**Figure 4c. Skilled birth attendant**

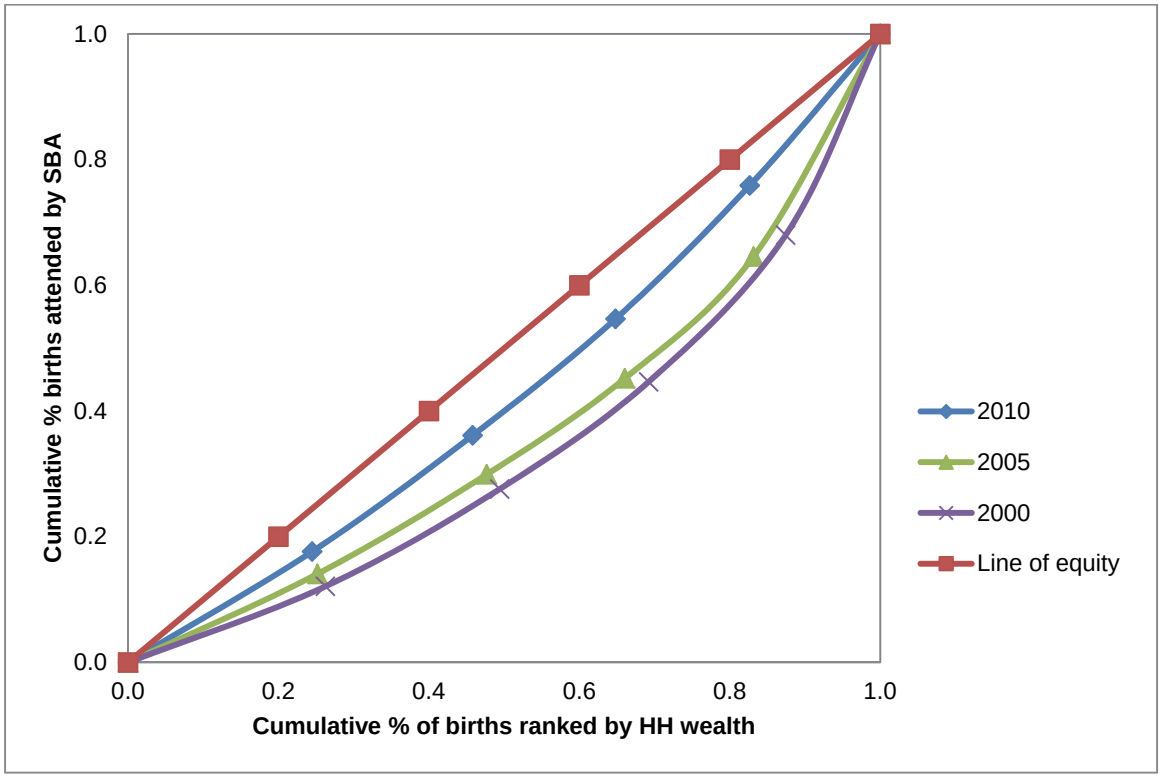


**Figure 4d. Facility delivery**

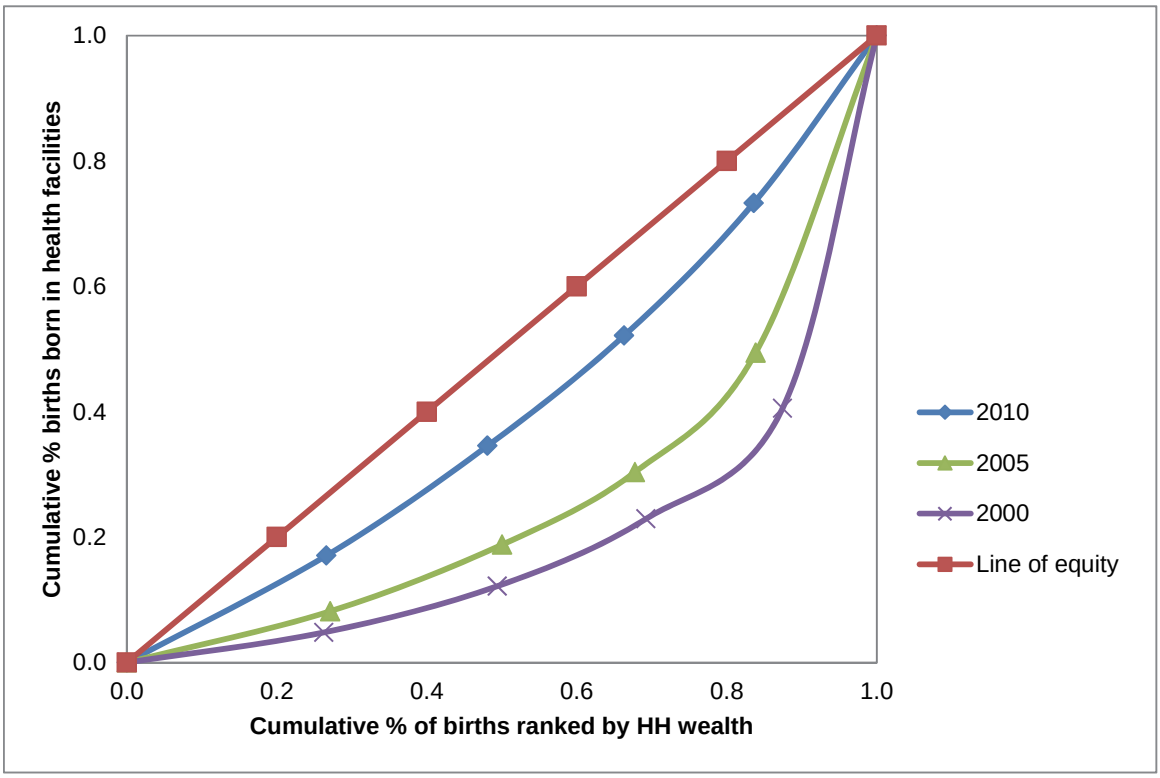



**Figure 4e. Full immunization coverage**

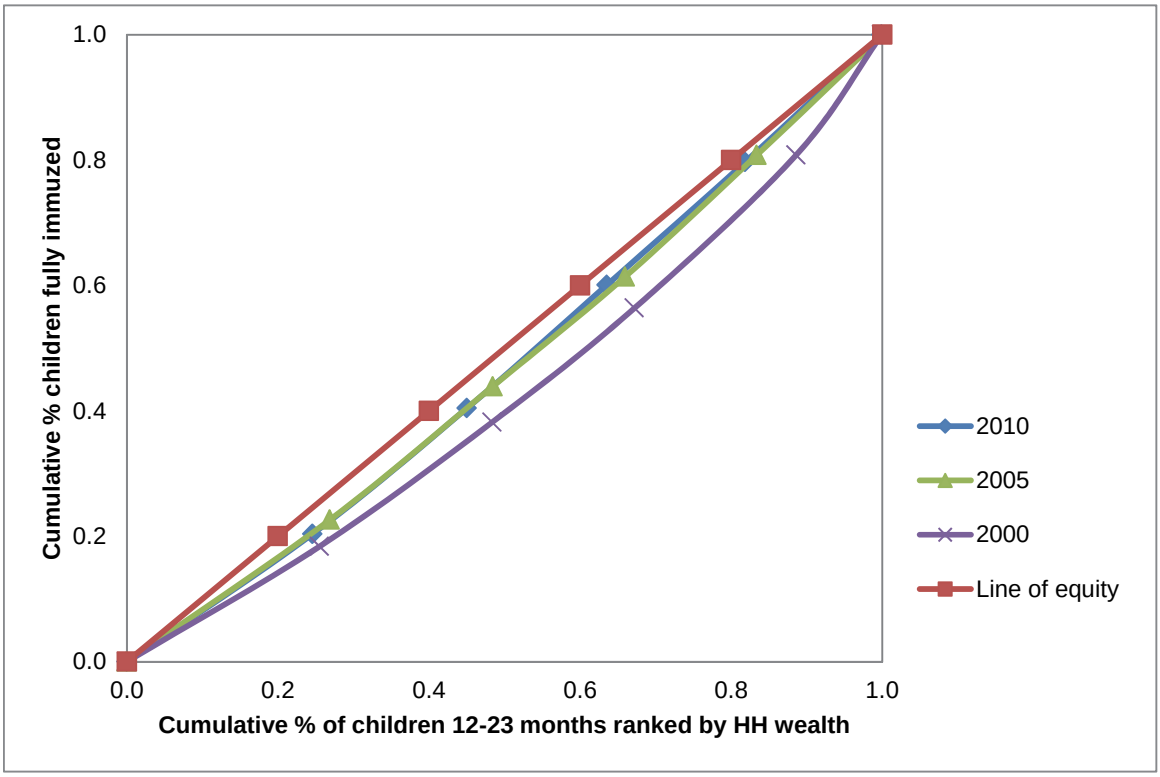


**Figure 4f. Diarrhea-medical treatment**

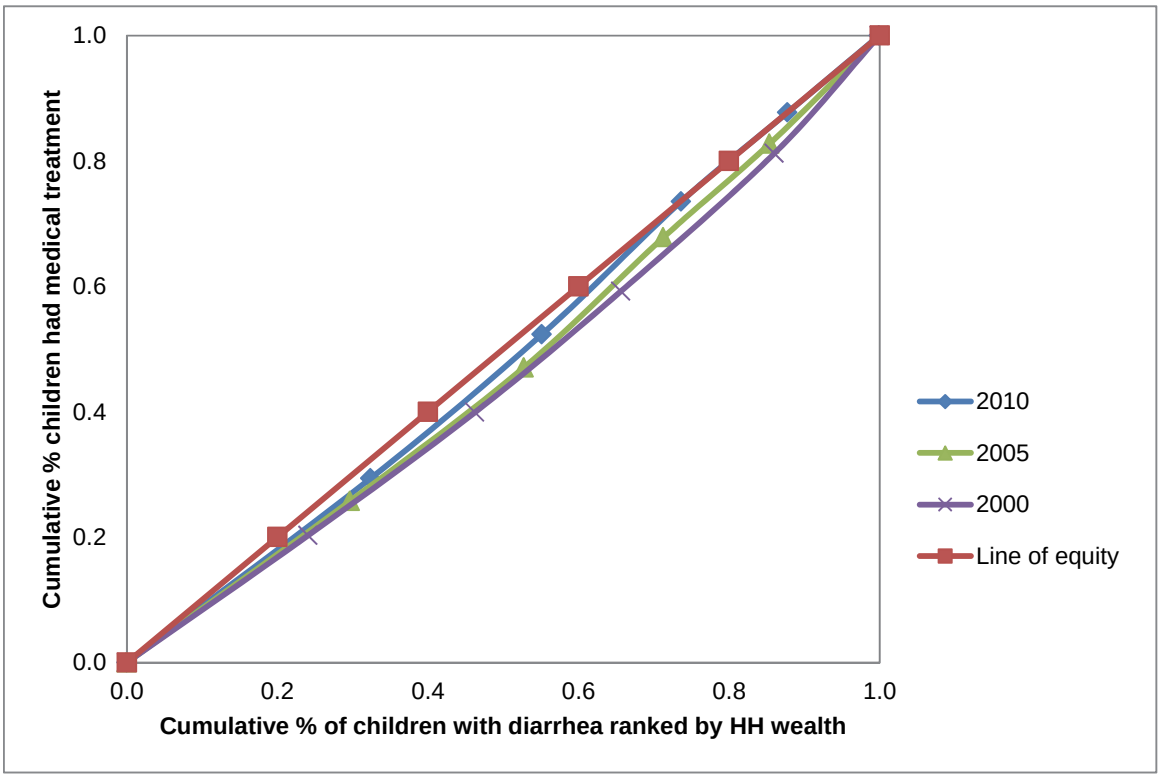
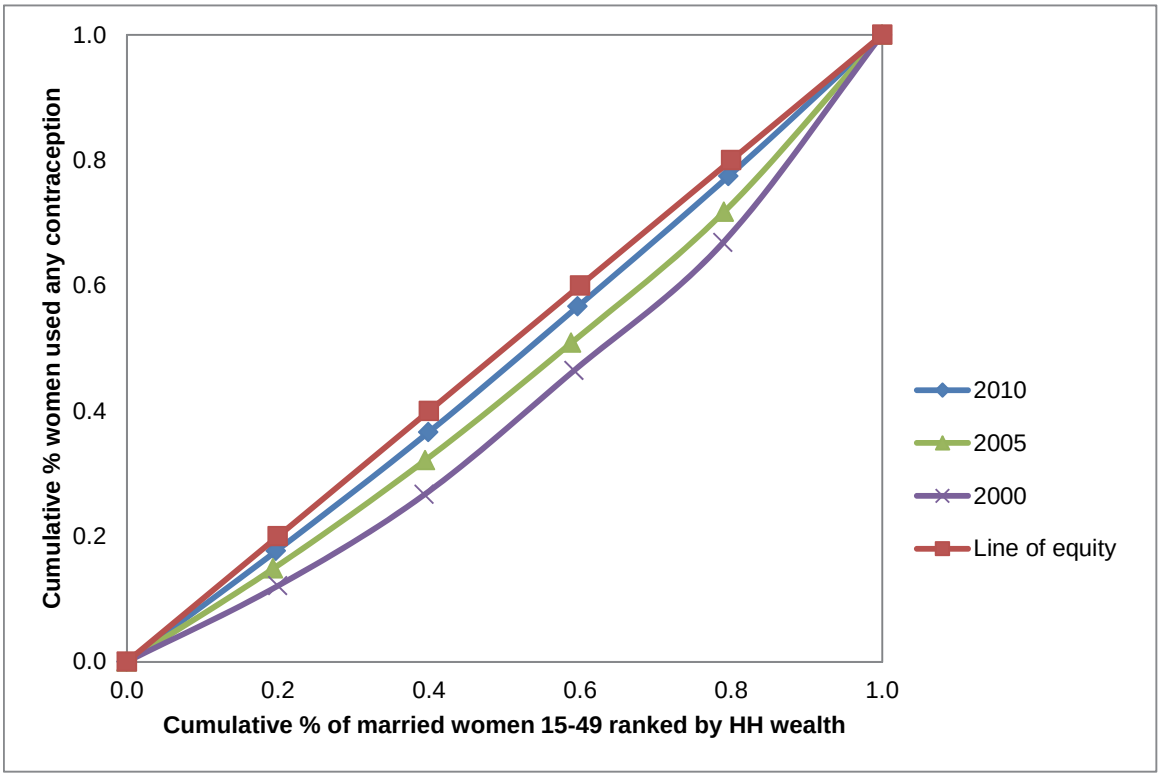



**Figure 4g. Use of contraception**



It is not easy to tell about the changes in inequalities in prevalence of diarrhea from the Lorenz curves, since the curves largely overlap. The concentration indices and the significance test indicate that the inequality is statistically significant in 2005 but not in 2000 and 2010. Although indices decreased over time, the differences in inequality between the surveys are not statistically significant.

Contraceptive prevalence shows a pattern similar to the delivery care indicators. The inequalities in contraceptive prevalence are significant in all three surveys. Over time, the inequality narrows but is only significant between 2005 and 2010 and between 2000 and 2010.

## 5. CONCLUSION

Analyzing data from the three DHS surveys in Cambodia between 2000 and 2010, we assessed the levels and trends of inequalities in maternal and child health and in service use, using two measurements: the ratio between the wealthiest and the poorest, and the concentration index. The study evaluated a wide range of indicators, including six MDG indicators.

The results suggest remarkable improvement in most health and health care indicators between 2000 and 2010 in Cambodia. The increases are universal in the population, from the poorest to the wealthiest. For some indicators—under-five mortality rates, prevalence of anemia, use of skilled birth attendants, and any antenatal care—the absolute percentage point changes (or mortality rate changes) between 2000 and 2010 among the poorest are at least twice the levels among the wealthiest.

Cambodia fares better compared with many other developing countries that show increasing inequalities over time in key maternal and child health indicators (Zere, Moeti et al. 2007, Victora, Barros et al. 2012). Nevertheless, substantial inequalities remain in health and health care between the wealthy and the poor in Cambodia.

For the health outcomes, the infant mortality rate and under-five mortality rate are the least equitable indicators, reflected by the highest quintile ratios and concentration indices. In 2010, the poorest 20 percent of the population suffered infant mortality and under-five mortality rates at least three times higher than the wealthiest 20 percent. Inequalities, although to a smaller degree, are also evident in child stunting and underweight. The trends analysis on health outcomes shows that inequalities have not changed from 2000 to 2010, except for the prevalence of child diarrhea, which shows a statistically significant increase in inequality.

On the use of key maternal and health services, a promising trend is observed. Inequalities are decreasing for five indicators: any antenatal care visit, four or more antenatal care visits, skilled birth attendants, facility delivery, and contraceptive prevalence rate. The decrease is particularly noteworthy for four or more antenatal visits and facility delivery. This is encouraging, although the pro-wealthy inequalities still exist for all of these indicators. Utilization of medical treatment for children's diarrhea and contraceptive prevalence demonstrate the least inequality. Indeed, in 2010, similar proportions of children in all five quintile groups received medical treatment for diarrhea.

The findings of this study can inform policies and programs in Cambodia in increasing mothers' and children's access to and utilization of health services, and eventually improving health outcomes. The faster the progress in using health services among the poor, the greater the potential for improvement in maternal and child health outcomes, which could eventually lead to the elimination of inequalities in maternal and child health status between the poor and the wealthy. Intervention programs should focus on serving the poor but not forget the wealthier groups in the population. At the same time, continuing efforts to monitor changes in inequalities are necessary.

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