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Does Areas of Child Residence and Consumption of Child Health Inputs Matter? An Analysis of Child Health Care Inequality in Tanzania

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Abstract

This study examines inequalities in child health with focus on inequalities in areas of child residence as well as inequalities in other health input variables that affect child health—such as the use of vaccination services, vitamin A supplementation and breastfeeding—on child health. The study used both concentration curves and concentration indices to measure inequalities in child health among households as ranked by living standard measures, such as wealth index and real per capita incomes. The analysis is based on data from the 2010 Tanzania Demographic and Health Survey (TDHS). The survey is nationally representative, and is conducted to measure levels, patterns and trends in demographic and health indicators. The results show that inequalities in all categories of child health were more concentrated among the poor; and that they were also statistically significant. But when inequalities were compared between urban and rural areas, it was found that inequalities in child health are more pronounced in rural areas; with computed coefficients being statistically significant as well. In terms of policy relevance, the findings suggest that policies aimed at combating child health inequalities should aim to reduce both inequalities in areas such as the quality and availability of health services; as well as the accessibility of health services especially in rural areas where inequalities are more pronounced.

1. Introduction and Background

Issues pertaining to access and quality of health care have emerged to be key determinants of child health outcomes in developing countries. One of the key areas of concern in this regard is with respect to poor quality and access to health care services by new-borns and maternal health. In particular, health care inequality issues over the recent past have dominated research (Markova, 2006) and policy-making in various developing countries (Wagstaff, 2002). In fact, it has emerged as an urgent policy priority in health sector reforms in most of these countries, including Tanzania. But, more importantly, inequality in health has been recognized by policy makers as an important objective of health systems, and has received greater attention in terms of initiatives to address them in international organizations (Wagstaff, 2000). In line with these policy objectives of achieving the goal of health for all, as outlined in the World Health Organization (WHO) Alma Ata Conference held in 1978, health equity has been an important policy issue. Thus, reforms in the health sector to achieve equity have received a fillip by the growing needs for the assessments of progress towards the targets of earlier United Nations Millennium Development Goals (MDGs), as well as the current

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Sustainable Development Goals (SDGs) as they are directly related to health (UNECA, 2008; UN, 2017). The report suggests that progress will remain slow in the absence of explicit policies and programmes that are driven by, and promote health equity. Health MDGs on infant mortality, maternal mortality, and HIV/AIDS and SDG; and the SDG goal number three that focuses on ensuring healthy lives and the promotion of well-being for all at all ages: both focus on ensuring health equalities. According to the UN (2017) assessments of SDGs in most countries, some progress has been achieved towards having health SDGs. However, the rate of progress has to be sustained to reach health targets by 2030. Inequities in health care have been advanced as one of the issues that needs to be addressed closely towards achieving this outcome.

According to O'Donnell and Doorslaer (2008), the general public attaches greater importance to the achievement of equity than to efficiency in matters of health and health care. They further argue that whether this is true or not is a matter of debate, but even if it is not given primary importance, health equity is certainly a goal that attracts strong support in many countries. Reducing health inequality is now a public health priority in many developing countries, including Tanzania. The 1990 National Health Policy and the revised National Health Policy in 2003 recognizes equity in health and healthcare as an issue of high priority (URT, 1990; 2003). The overall objective of the health policy in Tanzania is to improve the health and well-being of all Tanzanians, with a focus on those most at risk, and to encourage the health system to be more responsive to the needs of the people. The specific objectives of the policy are two pronged. First, is to reduce infant and maternal morbidity and mortality with the view to increasing life expectancy through the provision of adequate and equitable maternal and child health services, promotion of adequate nutrition, control of communicable diseases and treatment of common conditions. Secondly, is to ensure that health services are available and accessible to all people, thereby addressing equity issues wherever they are in the country, whether in urban or rural areas.

This study's focus on maternal and child health is primarily motivated by the fact that child mortality is one of the most commonly used indicators for measuring average population health, as well as a society's level of development (UNICEF, 2007). Reducing child mortality—and in particular under-five mortality—by two-thirds is one of the agreed Millennium Development Goals. Child mortality has been used to measure differences in health between the rich and poor for a very large number of low-income countries using the demographic and health surveys (Gwatkin et al, 2000; 2007). Available data on selected health indicators for Tanzania in Table 1 show that the country is making progress in most of the indicators, while efforts are needed in others. For instance, efforts are needed to scale up the proportion of personnel attended by skilled personnel beyond the regional average as this has a bearing on other indicators such as maternal and child mortality. However, Tanzania is doing well some indicators such as those of child health (both neonatal and under-five mortality ratio), life expectancy, and DTP3 immunization coverage when compared with regional averages for Africa.

Table 1: A Comparison of Selected Tanzania and Africa Health Indicators

Indicator		Year	Tanzania	Africa
Life Expectancy at Birth	Male	2015	59.9	58.2
	Female	2015	63.8	61.7
Infant Mortality Ratio[1]		2015	18.8	28.0
Under-Five Mortality Ratio[2]		2015	48.7	81.3
Proportion of Personnel Attended by Skilled Personnel		2015	46.0	53.0
HIV Prevalence among Adults (15-49)		2015	2.11	2.72
DTP3 Immunization coverage		2015	98.0	76.0

Note:

1. Results from the Tanzania Demographic and Health Survey 2010 infant mortality declined from 68 deaths per thousand live births in 2004/05 to 51 in 2010.
2. The same survey also showed that under-five mortality declined from 112 per thousand live births in 2004/05 to 81 in 2010. In essence, Tanzania has made significant progress in the two indicators compared to the regional average

Source: World Health Organization (2017)

In view of this, the study is concerned with social inequalities in child health in Tanzania using data from the Demographic and Health Surveys of 2010. Health-related inequality may be viewed from three perspectives: (i) inequity in health outcomes; (ii) inequity in health service delivery/access; and (iii) equity in health financing. Since the focus of this paper is with respect to the first two perspectives, this section provides their operational definitions for analytical purposes.

Equity in health is defined as minimizing avoidable inequalities in health and its determinants including—but not limited to—health care between groups of people who have different levels of underlying social advantages or privileges. Inequities exist when there are disparities in health and its determinants that are deemed to be avoidable, unfair and unjust. In other words, health inequalities exist when there are avoidable differences in health status between individuals or groups of individuals in a population. As such, not all health inequalities between population groups are regarded as inequities. Specifically, inequities in health refer to disparities between groups of people related to their social position as measured by such characteristics as income/wealth, occupation, education, geographic location, gender and race/ethnicity. Health inequalities due to inevitable and unavoidable conditions (e.g. biological/genetic variations) do not constitute inequities.

Essentially, the focus of equity in healthcare provision is to ensure that all people have access to a minimum standard of healthcare according to needs, and not any other criteria such as the ability to pay. Therefore, in regard equity may be defined as equal access for equal need, where access refers to the absence of barriers (mainly geographical and financial); and need refers to the capacity to benefit or severity of illness. Equity in service provision takes two forms: horizontal and vertical. While horizontal equity implies equal treatment for equal need, vertical equity implies that individuals with unequal needs should be treated unequally according to their differential needs. In health care, most attention is given to "… equal treatment for equal medical need irrespective of income, race, and so forth." (Zere et al., 2007).

2. Literature Review

There is a large body of literature on inequalities and health outcome with a focus on different socioeconomic attributes and groups. For instance, Wagstaff (2001, 2002) finds that poverty and ill-health are correlated in the sense that poor countries (less developed countries) tend to have worse health outcomes than better-off countries (developed countries). Within countries, poor people have worse health outcomes than better-off people; while inequalities in health are almost always to the disadvantage of the poor. The poor tend to die earlier and to have higher levels of morbidity than the better-off. It is likely that this association reflects causality running in both directions: that poverty breeds ill-health, and ill-health keeps poor people poor. It has to be noted, however, that in some cases inequalities have been shown to be more pronounced for objective indicators of ill-health—such as anthropometric measures of malnutrition and mortality—than for subjective indicators; the latter sometimes producing perverse gradients in developing countries with the better-off reporting worse health than the poor. However, this tends to occur with indicators that are highly subject to the influence of transitory factors such as whether or not a respondent in a study has experienced illness in the previous two weeks.

Wagstaff (2001, 2002) conclude that there are large variations in the extent of health inequalities across countries, although these variations themselves vary with the indicators of health and socioeconomic status used. For example, Latin America appears to have higher inequalities in child health between poor and non-poor than other parts of the developing world, whatever health indicator is used; and socioeconomic inequalities in health seem to be widening rather than narrowing. Likewise, Arokiasamy et al. (2012) attempt to assess the relative contribution of socioeconomic factors to child health inequalities between less developed states and more developed South Indian states in urban India using data from the 2005–06 National Family Health Survey. Their analysis of socioeconomic inequalities in child health are examined first using Concentration Indices (CIs), and, thereafter derive the contributions of socioeconomic factors to the CIs of health variables. The results reveal, in order of importance, pronounced contributions of household economic status, parent's illiteracy and caste to urban child health inequalities in the South Indian states. On the contrary, parent's illiteracy, poor economic status, being Muslim and childbirth order 3 or more are the major contributors to health inequalities among urban children in the less developed states. From the policy perspective, the results suggest the need to adopt different health policy interventions in accordance with the pattern of varying contributions of socioeconomic factors to child health inequalities between the more developed South Indian states and less developed EAG states.

Yiengprugsawan et al. (2007) set out to explain the sources of inequalities in health by looking at the measures of socioeconomic inequalities in self-reported morbidity and self-assessed health in Thailand, as well as to assess the contributions of different population subgroups to those inequalities. The study uses the Health and Welfare Survey 2003 data collected by the Thai National Statistical Office. In

this study socioeconomic status is measured by adult-equivalent monthly income per household member, while using the concentration index (CI) of ill-health as a measure of socioeconomic health inequalities, which is subsequently decomposed into contributing factors. The study findings show that the CIs reveal that inequality tend to be more disadvantageous to the poor for both self-reported morbidity and self-assessed health in Thailand; while their magnitudes were higher for the self-assessed health outcomes than for the self-reported morbidity outcomes. It also revealed that having a low socioeconomic status as measured by income quintile, low education is associated with both poverty and low health status. Finally, a decomposition analysis shows that inequalities in health status are associated with particular demographic, socioeconomic and geographic population subgroups.

A study by Wagstaff and Watanabe (1999) set out to shed light on the extent of inequalities in malnutrition between poor and non-poor children in 20 countries in the developing world. The study findings reveal that inequalities in malnutrition almost always disfavour the poor. In almost all countries, the poorest quintile has the highest rate of malnutrition. However, inequalities in malnutrition is less clear in the case of wasting than in the cases of stunting and underweight, although it is evident there too.

The study also found that inequalities in stunting and underweight, as measured by the concentration index, seem to be statistically significant in all countries, with the exception of Egypt (both indicators) and Russia (underweight). Intuitively, the findings imply that the tendency of poorer children to have higher rates of stunting and underweight is not due to chance or sampling variability. Lastly, the study shows that the picture is rather different in the case of wasting, with only eight countries having statistically significant concentration indices; and that the rate of malnutrition declines continuously with rising living standards, although not always monotonically.

Along the same line, Wagstaff (2002) analyses health inequalities taking into account policymakers' attitudes toward inequality, using health indicators such as under-five mortality and child malnutrition. The analysis employs grouped data from 44 developing countries, taken from demographic and health surveys (DHSs). The results show that health inequalities are mainly inclined to the disadvantage of the poor, and are evident in all three health indicators. They are especially pronounced for malnutrition, where the average value of the concentration index is equal to -0.1475. The extent of pro-rich inequalities varies across countries, with the values of the concentration index ranging from –0.2590 (Brazil) to 0.0020 (Kazakhstan) in the case of under-five mortality rate. The index ranged from -0.4167 (Dominican Republic) to -0.0487 (Niger) in the case of malnutrition. These results imply that the levels of inequality and the rankings of countries can both be sensitive to how far one deviates from the implicit value judgments underlying the concentration index.

In countries where the health of the poor is worse than that of the rest of the population, increase in measured inequality can be quite marked when one weighs more highly the health of the poor. This suggests that if it is indeed a concern of the international development community to ensure that improvements in health are disproportionately concentrated amongst the world's poor, it would make sense to move away from the use of population averages toward the use of an index of achievement. The case in point could be an index such as that proposed here that captures both average health levels and the often-large inequalities in health between the poor and better off. A synthesis of the literature entails that an analysis of the association between socioeconomic status (SES) and health outcomes is important in the study of inequalities in health. Regardless of the SES measure employed, or the health outcome measured, the link between SES and health status is evident in most empirical studies (Humphries & van Doorslaer, 2000). Studies covering issues pertaining to child health inequality using DHS data in Tanzania are scanty. Therefore, there is a need to measure inequality of child health as per different health use. Owing to recent trends in child health outcomes in Tanzania, particularly when measured by child mortality, this association needs to be analysed at country level to know the extent of inequalities that exist with a focus on the rural urban divide, and with the use of health inputs.

3. Empirical and Analytical Framework:

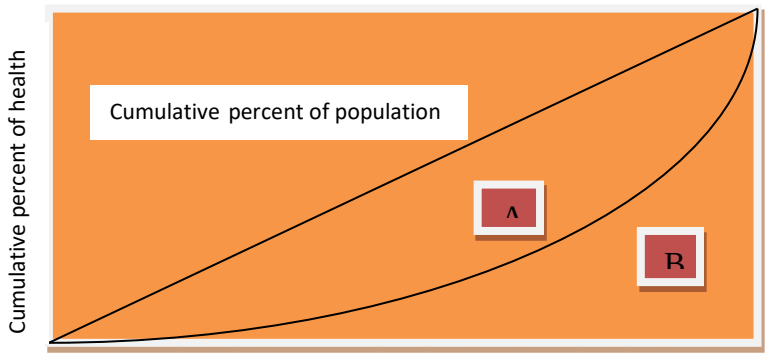
3.1 Measuring Inequalities in Child Health

We follow the methodology proposed by Wagstaff (2002), whose main focus is on the measurement of health inequalities using concentration curves and indices. The concentration curves were first used in health research by Wagstaff and Van Doorslaer (1989). For analytical and applicability purposes of this approach to typical health indicators, the health variable can be construed as ill-health or as good health, depending on the approach one chooses. According to Wagstaff (2002) it might be an index based on, say, a self-assessed health question; it might be an anthropometric measure of malnutrition; or it might be a binary variable capturing death prior to a certain age. The approach is easily modified for health measures that are increasing in good health. Therefore, we present the basics of the concentration curve and concentration index, and then show how the concentration index can be used to assess inequities in health care.

Summary measures of population health are measures that combine information on mortality and non-fatal health outcomes to represent population health in a single number. Following Molla et al. (2003), summary measures of population health can be categorized into two major groups. The first group is called health expectancy (HE), and includes measures such as disability-free life expectancy (DFLE), and healthy life expectancy (HLE). The second group, which measures health gaps, includes health measures such as disability-adjusted life expectancy (DALY). They noted that, although summary measures that indicate years of healthy and non-healthy life derived from these two general approaches—amid their myriad variations—may look similar, in essence summary measures currently in use are based on a variety of health outcomes, assumptions, and methods.

Depending on the nature of the problem at hand, a health measure is developed to suit the purpose. For instance, Regidor (2004) advocates four types of measures if one wants to measure inequality in health among populations. One of such measures of inequality in health in the strict sense, is the one that embodies measures of socioeconomic inequality in health, namely measures of association, measures of potential impact, and measures based on the ranking of the socioeconomic variables. These types of measures have more often been used by economists looking at income inequality, but more recently they are increasingly becoming popular and applicable to health inequality. More specifically, Wagstaff (2002) noted that the literature on health inequality measurement has benefited substantially from cross-fertilization, both within the discipline of economics—particularly from the literature on income inequality measurement—to the literature on health inequality measurement, and between the disciplines of economics, epidemiology, and public health.

Summary measures are generally derived to cover the whole distribution of a resource, and compare the cumulative proportion of a resource with the cumulative population amongst which that resource is shared, where the population is ordered by the command over the resource in question. Examples in this category include the Lorenz curve upon which the Gini Coefficient can be derived. With respect to the measurement of health inequality, the Lorenz curve is used as follows. First, the Lorenz curve is derived by plotting cumulative health share against a cumulative population share, where the values are ranked in order of rate. As shown in Figure 1, the Gini Coefficient (G) is given by the formula *A/(A+B)*. If resources were equally distributed throughout a population, then the bottom 20 percent of the population would have 20 percent of the resource, 40 percent of the population would have 40 percent of the resources and so on. This is represented by the diagonal line on the Lorenz curve. In the advent of unequal distributions, we will have a curve that is curved, while when a curve is nearer to the diagonal the greater the degree of equality; and when it is further away, the more the inequality.



Gini = *A/ (A+B)*

Figure 1: ***Lorenz curve and Gini Coefficient***

4. The Case of Concentration Curve and Concentration Index

4.1 Concentration Curve

This is a variant of the Gini Coefficient and Lorenz curve where we plot cumulative health share against cumulative population, but the values are ranked by an external variable usually indicating deprivation or socioeconomic status. In other words, according to van Doorslaer and Gerdtham (2002), we call this index *health concentration index*[1] as our measure of *relative* income-related health inequality CI can take values between -1 and +1. In essence, this index summarises the socio-economic (SE) gradient in the health measure of interest. A value of -1 indicates that all the health/ ill-health is concentrated in the worst-off; +1 shows an inverse SE gradient, and 0 shows no SE gradient. We thus opted to use the concentration index because the index quantitatively measures the degree of income-related inequality or any other health outcome. Unlike the Gini coefficient, the concentration index meets all three important criteria that a good measure of inequality is expected to fulfil (Uthman, 2009). These are: (i) it takes account of the socio-economic dimension of inequality in health; (ii) it reflects the experience of the entire population rather than two extreme groups on the socio-economic scale (e.g. income quintile 5 versus income quintile 1) as is the case in range measures (e.g. rate-ratios); and (iii) it is sensitive to changes in the population across socio-economic groups. The concentration index has proved to be a useful tool for measuring inequalities in the health sector, and has been used extensively in public health in studies of socioeconomic inequality in self-rated health and child mortality, to mention just a few.

The concentration index (*CI*) and the related concentration curve denoted by L_p provide a means of quantifying the degree of income-related inequality in a specific health variable, where p is the cumulative proportion of people ranked by income. In other words, according to Wang (2003), a concentration curve is constructed by plotting the cumulative proportion of child deaths (on the y-axis) against the cumulative proportion of children (on the x-axis), ranked by economic positions (income or other measures of welfare) of the household to which they belong. In practice, inequalities are represented by concentration curves that are relatively easier to understand compared to concentration indices. For instance, it can be used to show the degree to which child mortality is more unequally distributed to the disadvantage of poor children in one country than the other, or the extent to which inequalities in adult health are more pronounced in some countries than others.

The concentration curve plots the cumulative proportion of the individuals under consideration ranked by wealth/living standard measure or by socioeconomic status.

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[1]The HCI is derived from the Gini but differs, as the ranking variable and the variable of interest (for which the inequality is evaluated) are different. Hence, the HCI is a bivariate measure of inequality, measuring health inequality in one variable related to the ranking of another. As the HCI is a bivariate measure, a redistribution of the variable of interest need not affect the ranking based on the other variable (Koolman and van Doorslaer, 2003).

If income is used as the relevant ranking variable, then we begin with the poorest individual in the society and progress through the income distribution up to the very richest individual against the cumulative proportion of the health/healthcare variable (e.g., stunting, under-five mortality rate) being measured. Therefore, following a report by Ontario Agency for Health Protection and Promotion (2013), one of the major advantages of using concentration curves is that they provide an effective visual display of inequality in a population while incorporating intermediate socioeconomic groups, as well as the distribution of a population between the groups. It also noted that another advantage of using concentration curves is its ability to measure dominance between two concentration curves (i.e., determine which curve represents a greater degree of inequality), thus providing a means of comparing inequalities between different populations.

4.2 Concentration Index

A concentration index is a summary measure of the degree of inequality in a health outcome. It is defined with reference to the concentration curve. A concentration index is defined as twice the area between the concentration curve, *L(p)*, and the line of equality (45-degree line). A concentration index that is computed from the concentration curve assumes values between -1 and +1. Its value is negative when it is above the line of equality, indicating disproportionate concentration of a health variable among the poor; and positive when the curve is below the line of equality. In the absence of inequities the concentration curve coincides with the line of equality, and the value of the concentration index is zero (Wagstaff & van Doorslaer, 1998). Thus, since the health variable of interest in our case is child health (with a focus on child mortality), a negative value of the concentration index means child mortality is higher among the poor. In other words, inequalities in ill-health favour the better-off (popularly known as pro-rich).[2] A concentration index can be used where concentration curves cross, or where a numerical measure of health inequality is required. Figure 2 provides an overview of a concentration curve.

Thus, following Kakwani et al. (1997) health inequality can be measured by the *CI* denoted by C, defined as twice the area between *L(p)* and the line of equality. This is given by equation 1 as follows:

$$C = 1 - 2\int_0^1 L(p)dp \quad (1)$$

[2] More specifically, following van Doorslaer and Gerdtham (2002), if we have a continuous cardinal measure of health *yi*, the concentration curve *L*(*s*) plots the cumulative proportion of the population (ranked by income, beginning with the lowest incomes) against the cumulative proportion of health. If *L*(*s*) coincides with the diagonal, everyone enjoys the same health. If by contrast *L*(*s*) lies *below* the diagonal, inequalities in health exist and favour the richer members of society. The further *L*(*s*) lies from the diagonal, the greater the degree of inequality.

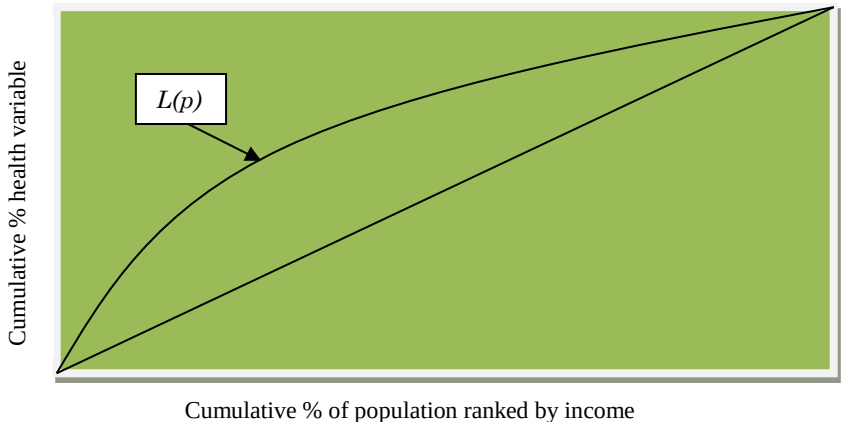


Figure 2: ***An Overview of Concentration Curve***

C takes the value of zero when $L(p)$ coincides with the line of equality; and is negative (positive) when $L(p)$ lies above (below) the line of equality. Inequalities in health can be frequently investigated using survey data such as demographic and health survey datasets. The concentration index (C) can be computed using the following equation:

$$C = (p1L2 - p2L1) + (p2L3 - p3L2) + ... + (pT - 1LT - pTLT - 1) \qquad (2.2)$$

where p is the cumulative percent of the sample ranked by economic status, $L(p)$ is the corresponding concentration curve ordinate, and T is the number of socioeconomic groups.

To test for the statistical significance of the concentration index, standard errors can be computed using the Distributive Analysis Stata Package (DASP). The package can easily be used to estimate the most popular statistics such as indices and curves mostly used for the analysis of poverty, inequality, social welfare, and equity.

5. Data and Variables

The analysis in this study is based on data from the 2010 Tanzania Demographic and Health Survey (TDHS). The 2010 TDHS is a nationally representative survey, and is the sixth in a series of national sample surveys conducted in Tanzania to measure levels, patterns and trends in demographic and health indicators. As the key indicator of child health, this study employs information on child mortality and the use of health care services (immunization, breast feeding and children under-five who slept under mosquito bed net among various categories of child health).

In principle, there are two key variables underlying the concentration curve: the health variable, the distribution of which is the subject of interest; and a variable capturing living standard, against which the distribution is to be assessed. In this

analysis of child health inequalities, the sample comprises births of children drawn from the demographic and health survey data, while the living standard measure used is the assets (wealth) index,[3] and health variable is child mortality. Finally, other measures of health services utilization are also provided, defined and measured as presented in Table 2.

Table 2: Variables Used in Measuring Inequality in Child Mortality

Variable	Definition
Neonatal mortality	the probability of dying within the first month of life
Infant mortality	the probability of dying before the first birthday
Child mortality	the probability of dying between the first and fifth birthday
Under-five mortality	the probability of dying between birth and fifth birthday
Utilization of health care services	
BCG	Bacillus Calmette-Guerin vaccination against tuberculosis
DPT	three doses each of the diphtheria, pertussis and tetanus
POLIO	Children who received vaccination by the age of 12 months
MEASLES	Children who received vaccination by the age of 12 months
Breast feeding	Children who received breastfeeding for at least six months
Sleptnet	Children under-five who slept under treated mosquito net during the previous night

The data used is at individual level (i.e., raw household survey data), in which case values of both the health variable and the living standards variables are available for each observation.

6. Findings and Discussion

This section presents descriptive analysis of inequality trends in child health using concentration curves for various categories of child health in urban and rural areas with their interpretations. It also provides empirical estimates of the concentration indices (CI) to augment findings from the concentration curves with estimated standard errors so as to ascertain their statistical significance.

6.1 Inequalities in Child Health

Indicators of the status of children health employed in this study include: neonatal, infant, child and under-five mortality rates as Table 2 indicates. These indicators were also further assessed by looking at differences between rural and urban inequalities. As can be seen from Fig. 3, both concentration curves for infant, child and under-five mortality lies above the line of equality; and the Lorenz curves indicate that child deaths are concentrated among the poor than the rich based on ranking by wealth index as a welfare measure. However, the Lorenz curves for child

[3]The wealth index is constructed from Tanzania Demographic and Health Survey (DHS). The construction of the index is based on household asset ownership involving steps such as determination of indicator variables, dichotomization, calculation of indicator weights and the index value, and calculation of distribution cut points.

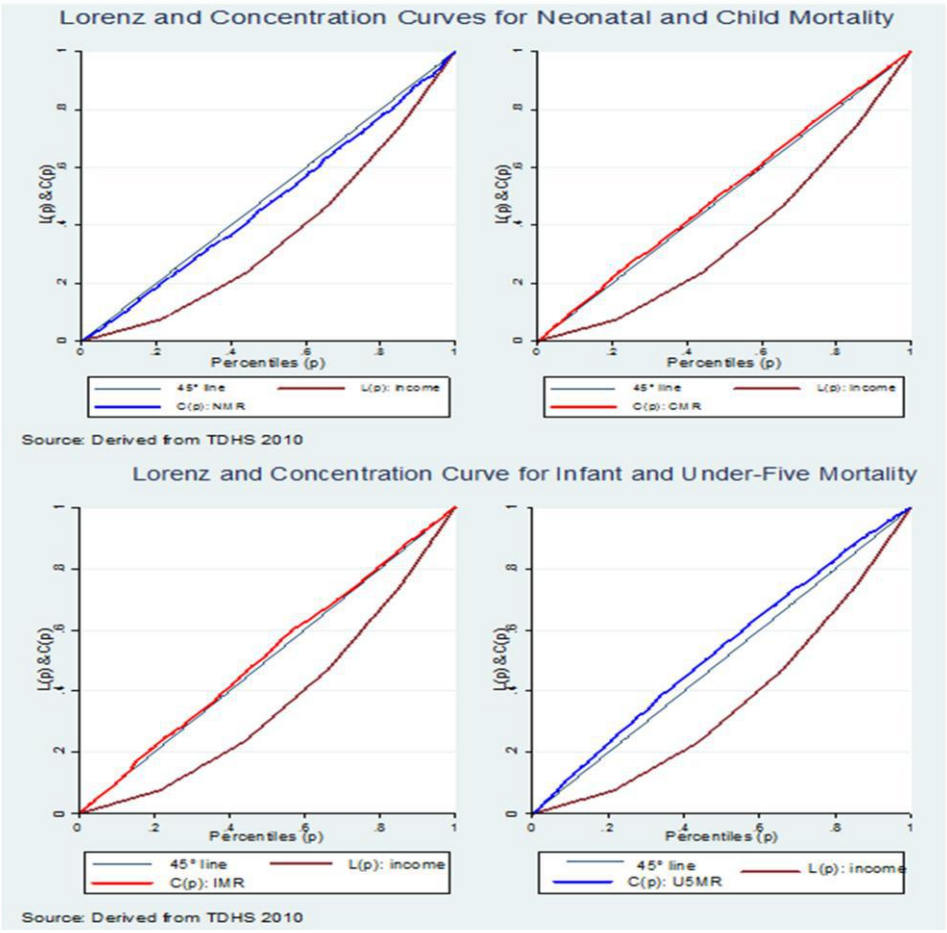


Figure 4: ***Lorenz and Concentrations Curves of Child Health in Tanzania***

and infant mortality seems to be very close to the line of inequality, indicating that inequalities in child health at this level of health outcomes among households seems to be equal for both poor and rich households. In other words, the gap between the poor and rich is not big. But the concentration curve lies far away from the line of inequality for under-five mortality. This indicates that at this level of health outcome the burden of under-five mortality is more pro-poor in the sense that inequality is disproportionately higher among children from the poor than the non-poor households. These results mimic the same findings by Zere et al. (2007).

Intuitively, it appears that childhood survival prospects are worse for children born into poor families than those born into better-off families. According to Wagstaff (2000), the prospects improve more or less steadily with upward movement through the income distribution. The only exception is with the concentration curve for

neonatal mortality. The panel for child mortality shows that the concentration curve of neonatal mortality lies below the line of equality, but very close to it, indicating that inequalities in child health at this indicator is pro-rich, and the gap between the poor and rich households is very small. Nonetheless, the distance at which each concentration curve lies above the line of equality differs across different categories of child health as well. The further the curve is above the line of equality, the more concentrated the health variable is amongst the poor. Similarly, the opposite applies when the curve lies below the line of equality. However, a visual inspection of the concentration shows that substantial inequalities in child health outcomes exists between the rich and the poor households especially among infant and under-five mortality indicators as observed by Wang (2013).

We now turn into an alternative approach for assessing and measuring inequality by computing a concentration index measure of health inequality. This is because the concentration curve gives only the ranking which in any rate is not very informative (Wagstaff, 2000). Intuitively, the concentration curves can tell us which health outcome or variable experiences more inequality than the other, but they do not indicate by how much more, or whether the degree of inequality is statistically significant. As noted earlier on, concentration indices take the values between -1 and 1; with the negative values favoring the poorest quintiles of the households, and the positive values favoring the rich ones.

Table 3 present the results of concentration indices for neonatal, infant, child and under-five mortality respectively. Following the size of the estimated indices in all categories of child health, inequality is more pronounced in neonatal mortality, followed by infant and under-five mortality, with very little inequality in child mortality with children born into the poorest quintiles of the households bearing the burden of inequality. More importantly, the estimated standard errors show that the degree of inequality in all categories appears to be statistically significant, with the exception of child health mortality. Both categories take negative values, indicating that their concentration curves lie above the line of equality. This entails that while poor households bear more the burden of inequality, they also experience more inequality in neonatal mortality, infant and under-five mortality. Given the fact that majority of the poor lives in rural areas where the incidence of poverty is high, it means that poverty is predominantly a rural phenomenon where more than 80 percent of Tanzania's poor live (Aikaeli, 2010). Following the 2010 HDR, which focused on the decomposition of multidimensional poverty index (MPI) by region, it clearly indicates

Table 3: Concentration Indices of Various Categories of Child Health

	Variable	Estimate	STE	LB	UB
1:	Neonatal Mortality	-0.117978	0.054017	-0.224357	-0.011599
2:	Infant Mortality	-0.081485	0.040873	-0.161977	-0.000992
3:	Child Mortality	-0.023050	0.066734	-0.154472	0.108373
4:	Under-five Mortality	-0.065960	0.035674	-0.136214	0.004294

Source: Own Computation from DHS (2010)

that there is a serious deprivation in many basic needs. Child mortality alone accounts for 43 percent of MPI in rural areas. This also means that addressing child mortality could enable Tanzania gain most in reducing multidimensional poverty.

Table 4 provides further insights when we look at concentration indices of various categories of child health by type of place or area of residence. The results show that for neonatal mortality inequality in child health is more pronounced in rural areas though the difference is not big. The same applies for infant mortality and under-five mortality with the exception of child mortality where the degree of inequality is more pronounced in urban areas when compared to rural areas. The estimated standard errors for all categories of child health for urban and rural areas show that the degree of inequality is statistically significant for all categories in rural areas while for urban areas they are not. Henceforth, these findings support the earlier views about scaling up effort to reduce child mortality especially in rural areas.

Table 4: Concentration Indices of Child Health by Area of Residence

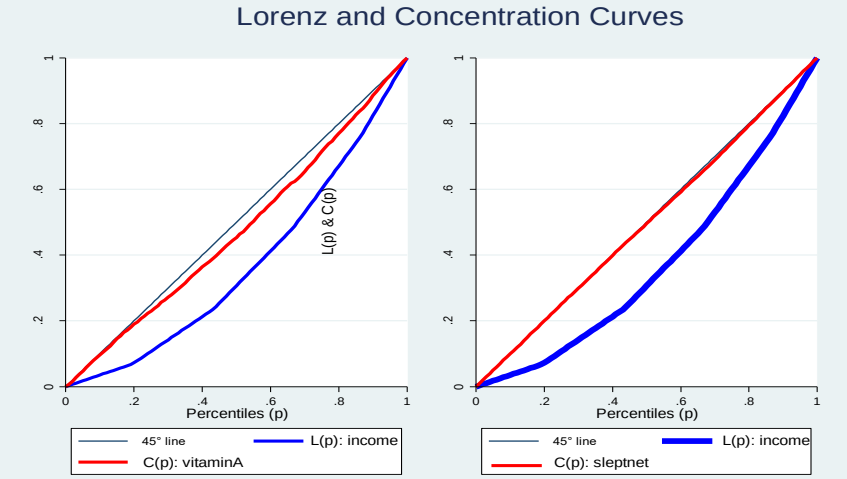
Group	Neonatal Mortality		Infant Mortality		Child Mortality		Under_5 Mortality	
	Estimate	*STE*	*Estimate*	*STE*	*Estimate*	*STE*	*Estimate*	*STE*
1: urban	-0.118710	0.093622	-0.030031	0.072343	-0.058791	0.177908	-0.037760	0.084538
2: rural	-0.141326	0.052925	-0.086384	0.043515	0.009315	0.072434	-0.061048	0.039420
Population	-0.117978	0.054017	-0.081485	0.040873	-0.023050	0.066734	-0.065960	0.035674

Source: Own Computation from DHS (2010)

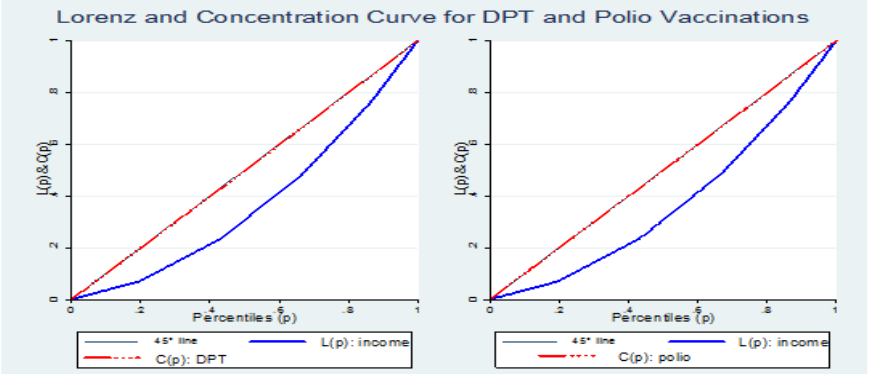
6.2 Inequality in Child Health per Different Health Use

Other than neonatal, infant, child and under-five mortalities, the study assessed similar inequalities for a set of other child health indicators, which included the number of children under-five years of age who slept under a bed net, duration of breastfeeding a child in months, as well as immunization services (with focus on measles, polio, BCG and DPT vaccinations). Figure 5 presents the children health outcome indicators by their socioeconomic predictors. The figures show that the concentration curves for children who received vitamin A supplements lies below the line of equality. This implies that children from rich section of the population received more vitamin A supplements compared to those from poor households. The same trend of inequality seems to be exhibited by the measles concentration curve.

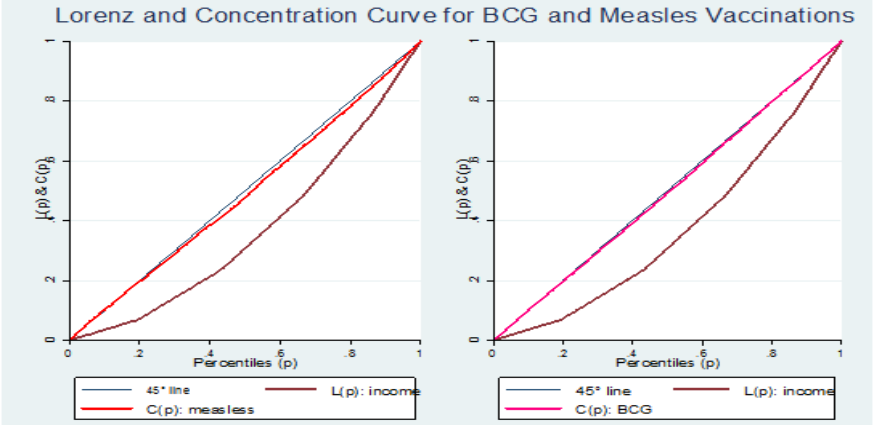
However, the concentration curves for polio, DPT and BCG vaccinations, and children breastfeeding almost coincides with the line of equality; indicating that there is no inequality in accessing this vaccination service between the poor and rich segments of the society. This result is essentially supported by having very small concentration index for most of the variables. For instance, the index for polio is around 0.017018 (and therefore small inequality) as shown in Table 5. As measured by their summary measure, most of the concentration curves—with the exception of the infant and under-five mortality—lie between the line of equality and the Lorenz curve, thereby exhibiting a similar pattern of inequality. Intuitively, this means that access to these services is apparently in favour of the rich (pro-rich) rather than the poor as households are ranked by income quintiles along the concentration curve.



Source: Derived from TDHS 2010



Source: Derived from TDHS 2010



Source: Derived from TDHS 2010

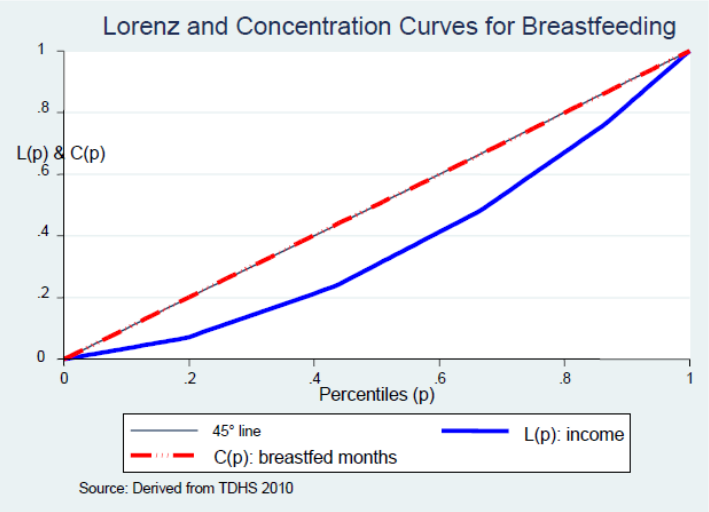


Figure 5: ***Lorenz and Concentration Curves of Other Variables of Child Health***

Table 5 presents the results of the concentration index for the use of other health service utilization.[4] The results show that all categories of immunization lie below the line of equality by taking positive values. The coefficient estimates of their respective standard errors show that they are both statistically significant. The same applies for vitamin A supplement, which also lies below the line of equality,

Table 5: Concentration Indices for Health Service Utilization

Variable	Estimate	STE	LB	UB
Sleeping under bed net	-0.080789	0.027676	-0.135293	-0.026285
vitamin A supplement	0.006145	0.002401	0.001416	0.010874
Measles vaccination	0.089545	0.017561	0.054961	0.124129
Polio vaccination	0.017018	0.003231	0.010654	0.023382
BCG vaccination	0.040044	0.007937	0.024413	0.055676
DPT vaccination	0.053730	0.007122	0.039705	0.067755
breastfeeding	-0.031394	0.006457	-0.044110	-0.018679

and its concentration index coefficient is also statistically significant. These results also imply that the use of these services is more pronounced among the rich segments of the population compared to the poor ones. Since the results for the degree of inequality on child showed that inequality is more concentrated in rural area compared to urban areas where the rich segments of the population live, then there is an urgent policy need to address the use of these services in favour of the poor, if the country is to reduce child mortality significantly.

[4]As note earlier, concentration indices provides more robust statistics as opposed to concentration curves that provides just a comparative ranking. When CI takes positive value it indicates that the use of such health service favours the most advantaged and negative value the least disadvantaged households.

The estimated concentration index for children under-five who slept under bed nets, with the associated standard errors, seems to be statistically significant and lies above the line of equality. This implies that the use of bed nets is concentrated more among the poor segments of the population than the rich ones. This may be partly because of the government's initiative to provide free treated mosquito bed nets in an effort to combat malaria disease, which is among leading killers of children; and the fact that a majority of the households that participated in the survey is drawn from rural areas. Another aspect that takes the same trend is breastfeeding of children, which also seems to be concentrated more among the poor, with its standard errors showing that it also statistically significant. This could again be attributed to the fact that rural women may have more time to breastfeed when compared to their urban counterparts.

7. Conclusions

This paper has applied both concentration curves and concentration indices to measure inequalities in child health. The focus was on child mortality and utilization of other essential child health services among households ranked by living standard measures such as wealth index, which is used as a proxy indicator for real per capita income or consumption. The results offer a number of conclusions. To begin with, the concentration curves and indices show that inequalities in most of the categories of child health are more concentrated among the poor. For the most part, the findings are also statistically significant. More importantly, the extent to which this is true differed between rural and urban areas. Estimates for the degree of inequality showed the existence of inequality in all categories of child health, with urban estimates being not statistically significant according to the estimated standard errors. However, all categories appeared to be statistically significant for the rural estimates of inequality in child health.

According to Wagstaff (2002), inequalities in health—and most probably in-service utilization—largely reflect inequalities at the individual and household levels, in such areas as education, income or location. Thus, this indicates that policies aimed at combating child health inequalities should aim to reduce both inequalities in areas such as the quality and availability of health services, as well as accessibility of health services especially in rural areas.

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