Child Health Outcome Inequalities in Nepal

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Abstract

This study aimed to quantify child health outcome inequalities in neonatal death and explore major contributors to the inequalities for the periods 1991-1995, 1996-2000, 2001-2005, 2006-2010 and 2011-2015 in Nepal using data from Nepal Demographic and Health Surveys conducted in 1996, 2001, 2006, 2011 and 2016 respectively. Concentration index was used to measure the inequalities and decomposition of the index was performed to explore major sources of the inequalities. Results showed that there were substantial neonatal death inequalities between the poor and better-off which concentrated more on disadvantaged groups for all survey periods in spite of highly prioritized newborn policies. The neonatal death inequality was slightly narrowed in the second survey but worsened continuously for the last three surveys. Decomposition analysis evidenced that mother education was the largest contributor to the inequality though there was an increasing trend of women literacy rate. Other major contributors were higher birth orders, hill zone, rural residence and small sized child. This information regarding the relative importance of various determinants of inequitable child health outcome could be helpful in making effective health policy in Nepal.

Keywords: Neonatal Death, Socioeconomic Groups, Health Outcome Inequality, Concentration Index, Decomposition of the Health Outcome Inequality
JEL Classification code: C20, C21, O10, O15

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1. Introduction

Health equity becomes a central dimension for the overall equity and justice in the societies which causes the enhancement of capabilities and participation of individuals towards social and economic development. Further, good health as an instrument for enabling people's participation in society increases the positive potential for enhancement of economic progress (Muskin, 1962; Becker, 1964; Grossman, 1972; Wagstaff, 1986; Bloom & Canning, 2000). In spite of the importance of health for economic prosperity, its distribution between countries and across the country for various socioeconomic and demographic strata is persisted and widened considerably (Moser et al., 2005; Bryce et al., 2006). Thus, health inequalities are becoming more prominent in the policy agenda. Average achievement is no longer considered a sufficient indicator of a country's performance on health; rather, the distribution of health in the population is also equally important (Pande&Yzbeck, 2003; Arokiasamy& Pradhan, 2011). The large inequalities that exist in the health sector between the poor and better-off continue to be a cause for concern in both the industrialized and the developing world (van Doorslaer et al., 1997;Gwatkin, 2000; Wagstaff, 2000). Growing health inequalities have the most adverse impact on vulnerable and impoverished societies which consequences at reducing their contribution for socioeconomic development. Thus, addressing the social and economic determinants of health outcome inequality will be more effective and realistic to improve towards the health equity and its distribution in the societies (van Doorslaer et al., 1997; Deaton, 2003;Wagstaff et al., 2003; Dhanaraj, 2015). It takes into account the socioeconomic distributions of determi-nants of health which are relevant to understand why unfair and avoidable inequalities exist and what actions may be taken to improve equities and its distri-butions for policy purposes (Kakwani et al., 1997; Gwatkin, 2000; Hosseinpoor et al., 2006;Rarani et al., 2017).

There have been many contemporary efforts (Wagstaff et al., 1991; Wagstaff& van Doorslaer, 1994; Kakwani et al., 1997; Regidor, 2004a & 2004b) for measuring of health inequalities and has benefited from contributions from a number of disciplinary perspectives. Wagstaff et al. (1991) have reviewed six measures of health inequality which were the range, the Gini coefficient, pseudo-Gini coefficient, the index of dissimilarity, the slope index of inequality and the concentration index. They recommended concentration index (CI) obtained from the concentration curve (CC) a better inequality measure as it considered all three minimal requirements: reflected the socioeconomic dimension of inequalities in health; considered entire population; and sensitive to the distribution of each individual in the population. Due to the lack of first feature, Gini coefficient could not be a good health outcome inequality measure despite its popularity. Regidor (2004a, 2004b) clearly illustrated the limitation of the coefficient showing the same Gini coefficient obtained for different socioeconomic situations.

Wagstaff et al. (2003) have presented the method for decomposing the causes of health sector inequality. When decomposing the inequality, the first deterministic component equaled to a weighted sum of the CIs of the determinants and the weight was simply the elasticity of the health inequality with respect to the determinant while the second residual component was unexplained part of systematic variation across socio-economic groups in the decomposition. O'Donnell et al. (2008) and Yiengprugsawan et al. (2010) have conditioned two criteria for the decomposition of CI which were binary outcome variable as most of the health outcome variables were binary in nature; and, outcome variable as a linear combination of exogenous determinants to hold the decomposition of CI. The paper claimed that generalized linear model as an appropriate model as it specified the binomial distribution family and identity link function to hold for decomposition.

Nepal has emphasized and committed through national health policies (NHP-1991 &NHP-2014) to improve the health status of infants and young children considered as one of the most vulnerable groups of the society in the country (MoHP, 2015). Nepal's government endorsed "Health Sector Strategy: An Agenda for Reform" to address the health sector problem and to align and respond the global agendas such as Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs). Guided by both the National Health Policy 1991 and the Second Long Term Health Plan 1997–2017 (SLTHP), the strategy put in place the first Nepal Health Sector Program (NHSP–I) for the period 2004–2009 and the second Nepal Health Sector Program (NHSP–II) for the period 2010–2015 as an extension, both provided basic framework for implementation of health programs (MoHP, 2015).

Nepal has successfully implemented both the programs NHSP–I and NHSP–II. During the period, Nepal has made notable progress on improving overall health outcomes of the citizen. There have been marked reductions in maternal mortality, neonatal mortality and infant mortality along with a remarkable increase in life expectancy at birth (MoHP, 2015; NPC, 2016; MoHP, New ERA and ICF, 2017). Despite this progress, the country faces many health challenges including inequity and it is still unanswered if this progress is properly distributed to all groups of the population. Policy makers should know is there any significant gap in the distribution of health of disadvantaged and marginalized child and women population as prioritized by the constitution of Nepal, what are the extents of health inequalities across various socio-economic groups, which factors contribute the inequalities and to what extent different factors contribute to the inequalities for reducing systematically the health sector inequalities. Hence, this research tries to answer these questions and accordingly has focused its objectives. From the background of such varied contexts and corresponding policy demands with recently developed measurement methods, the broad objective of this research is to assess the child health disparity in Nepal and to identify the sustainable policies to overcome the disparity. More specifically, our research objecttives are: to estimatechild health outcome inequality in Nepal and to decompose the inequality into the important determinants.

Most of the researches carried out about child health outcomes in Nepal only explored determinants and gave information on how and which determinants were more crucial. Similarly, studies conducted in child health outcome inequalities have focused on explaining average health outcomes of advantaged and disadvantaged strata, for example health outcome of the richest and the poorest quintiles. Towards reducing the inequality of child health outcome this may not be sufficient as the distribution of these determinants also matter. This research along with the estimation of child health outcome inequality performs decomposition analysis of the inequality giving information on marginal effects and distribution of the determinants which help to identify the contribution of each determinant. In this regard, this research would better inform the role of determinants than previous researches. Besides, to explore ecological heterogeneity in child health outcome in Nepal, we have introduced ecological variable which is a new feature in health outcome inequality analysis from past literatures. In our knowledge, there is no such study recently that examines the decomposition of child health outcome inequality in Nepal. We hope this study would be unique and fulfills the gap in this area in the country. Its findings could track policy outcomes over time and also provide a means of evaluating the need for policy change for proper utilization of scarce resources in the child health sector.

The next four sections comprise the major body of the research. The second section presents methods for measuring child health outcome inequality and decomposition of the inequality. The third section comprises data sources, outcome variable, explanatory variables and ranking variables. The fourth section presents results showing all the calculations for the inequality and decomposition of the inequality. The last section contains the conclusion drawn from the results section with the interpretation and limitations of this study.

2. The Model

We follow the Wagstaff et al. (2003) for child health demand function which assumes a linear additive regression model with health variable h as a dependent variable and a set of k exogenous regressors (X_k). This model is a reduced form of a child health demand function derived from a utility maximizing framework (Grossman, 1972; Rosenzweig& Schultz, 1982; Jacobson, 2000). The child health outcome model in the form of linear regression equation is:

$$h_i = \alpha + \sum_{i=1}^{n} \beta_k X_{ki} + \varepsilon_i \qquad (1)$$

Where β_k denotes the coefficients and ε is an error term. Here, interpersonal variations in h are thus assumed to derive from systematic variations in the determinants of h, i.e. X_k.

To measure inequalities in health outcomes, this study applies a concentration index (CI) proposed by Kakwani et al. (1997). The CI is defined and estimated on the basis of a Concentration Curve (CC). The CC is the graphical plot of the cumulative proportion of a health outcome variable in the vertical axis against the cumulative proportion of population ranked from the most disadvantaged to the most advantaged socioeconomic group in the horizontal axis. Two variables are included in a CC, a health outcome variable, and a socioeconomic variable against which the distribution of the health variable is to be examined. This study takes survival of newborn child as a health outcome variable and household wealth index as a socio-economic variable. When all the people have the same level of health outcome irrespective of various socioeconomic levels, CC would be 45-degree straight line called a line of equality. In contrast, when higher values of health outcomes are concentrated among the disadvantaged group, CC would lie above the line of equality; and, CC would lie below the line in case health outcomes more concentrated among the advantaged group. Further, CC passes away from the line of equality if more unequal is the distribution of health outcome variable than the less unequal distribution of the variable.

CI is defined as twice the difference of area below the line of equality and CC (Wagstaff et al., 1991; Kakwani et al., 1997). CI quantifies CC by showing the relationship between health and socioeconomic status. Its sign indicates the direction of the relationship if the distribution of the health variable is concentrated at disadvantaged or advantaged groups. Its magnitude shows the degree of variability in the distribution of the health outcome variable across various socioeconomic levels. Thus, CI is zero when CC coincides with the line of equality and takes a negative or a positive value when it is above or below the line of equality respectively. Further, it takes a value between –1 if the health of all population is concentrated at the individual who is the most disadvantaged and +1 when the health of all population is concentrated at the most advantaged individual.

Following Kakwani et al. (1997), child health outcome inequality denoted by CI here is given by the equation:

$$CI = \frac{2}{n\mu} \sum_{i=1}^{n} h_i R_i - 1 \qquad (2)$$

Where h_i is the child health outcome of the i^{th} individual, μ is the mean or proportion of the health outcome variable h_i, R_i is the fractional rank of the i^{th}

individual in the socioeconomic distribution from the most disadvantaged (the poorest) to the most advantaged (the richest) and n is the number of individuals.

Wagstaff et al. (2003) derived the decomposition equation by substituting equation (1) into equation (2) which can be stated as:

$$CI = \sum \frac{\beta_k \bar{X}_k}{\mu} CI_k + \frac{GC_\varepsilon}{\mu} \quad (3)$$

Where $\bar{X}_k$ and CI_k are respectively the mean and the concentration index for the determinant X_k and GC_ε is the concentration index for error term ε. The index CI_k is defined and estimated exactly like the concentration index in equation (2). The term GC_ε is called generalized concentration index of error term ε (van Doorslaer&Koolman, 2004; O'Donnell et al., 2008) and is given as:

$$GC_\varepsilon = \frac{2}{n} \sum_{i=1}^{n} \varepsilon_i R_i \quad (4)$$

The product $\frac{\beta_k \bar{X}_k}{\mu} CI_k$ is the contribution of determinant k in the actual concentration index. A positive contribution implies that the determinant operates towards advantaged socioeconomic distribution and negative contribution implies that the determinant operates towards disadvantaged socioeconomic distribution. Overall inequality in health outcome has two components: a deterministic or explained component, $\sum \frac{\beta_k \bar{X}_k}{\mu} CI_k$, and an unexplained component or residual component, $\frac{GC_\varepsilon}{\mu}$, one which cannot be explained by systematic variation. The contribution of X_k explanatory variable to explained child health outcome inequality CI is derived by multiplying the elasticity component $\frac{\beta_k \bar{X}_k}{\mu}$, which is the elasticity of health outcome h with respect to $X_k$measured at the mean, by the corresponding concentration index CI_k. Thus, if the estimated coefficient β_k is not statistically significant, then the contribution of the X_k to the explained health outcome inequality will not be statistically significant too. In overall, the concentration index of health outcomes can be expressed as the sum of contributions of various factors together with an unexplained residual component.

Decomposition of concentration index works only for linear regression model. For non-linear regression model, an appropriate statistical technique to convert the non-linear model into linear model is needed. Hosseinpoor et al. (2006) and O'Donnel et al. (2008) have recommended using of marginal effects evaluated at means for each determinant of the non-linear health outcome regression model to calculate the contributions of the each k explanatory variables. This approach of using marginal effects evaluated at means to calculate the non-linear estimations thus approximately restores the underlying assumptions of the decomposition method. Hence, this study follows the method proposed by O'Donnel et al. (2008) and applies the logistic regression of h on all the X's, obtains the marginal coefficients and uses in equation (3) to calculate elasticity of h with respect to each X.

3. Data and Variables

Data Source

Data for this research are obtained from all five waves of the Nepal Demographic and Health Surveys (NDHS) conducted in 1996, 2001, 2006, 2011 and 2016. NDHS are national level comprehensive surveys conducted as part of the worldwide DHS project in Nepal and are carried out under the aegis of Ministry of Health and Population of Nepal. All the districts of Nepal have divided into urban municipalities and rural municipalities which have further divided into wards. Sampling frame which contains information about the ward location, type of residence (rural or urban), households and population were obtained from preceding censuses. The NDHS samples were stratified and selected in two stages in rural areas and in three stages in urban areas. In rural areas, wards were selected as primary sampling units (PSUs), and households were selected from the sample PSU's. In urban areas, wards were selected as the PSU's, one enumeration area (EA) was selected from each PSU, and then households were selected from the sampled EAs.This study obtains the information from household's and woman's questionnaires. NDHS interviewed 8082, 8602, 8707, 10826 and 11040 households with 8429, 8726, 10793, 12674 and 12862 all women of age 15–49 in the households in 1996, 2001, 2006, 2011 and 2016 respectively.

Outcome variable

The outcome variable in this research is neonatal death which reveals the survival status of newborn child. Neonatal death has been defined by the World Health Organization (WHO) as death among live births during the first 28 completed days of life (WHO, 2006). This study uses data from Nepal Demographic and Health Surveys which have considered neonatal death as death during first month of life for all live births (MoHP, New Era & ICF, 2017). Our study follows the demographic and health survey to define the duration for the neonatal death. Further, neonatal death is considered as a binary variable and assigned 1 for death and 0 for survival in the first monthduration.

Explanatory variables

The explanatory variables for neonataldeath in this study are based on the literature reviews (Mosley & Chen, 1984; Schultz, 1984; Jacobson, 2000; Wagstaff et al., 2003) and available variables in the survey data. These predictors are categorized into four groups: child characteristics, maternal characteristics, household characteristics, and community characteristics.Our study considers child sex, birth type, birth order, and birth size as child characteristics; mother's age at delivery and mother's education as maternal characteristics; wealth quintiles as household characteristic; and types of residence and ecological zone as community characteristics. Many researches consi-dered safe water and sanitation as an important predictor for child health. We have not included these variables as explanatory variables because these variables are used to construct a wealth asset index and wealth quintiles.

Ranking variable

This study uses a wealth asset index for ranking socioeconomic status of households which is readily available in NDHS. It is constructed by principal components analysis (PCA) method using information on ownership of assets/housing characteristics. Dwelling's construction materials including floor, roof, and exterior walls; source of drinking water; type of sanitation facility; type of cooking fuel; and whether household owns assets like fan, radio, television, sewing machine, refrigerator, clock, bicycle, motorcycle, car, etc. are the key variables for wealth asset index construction.

4. Results

The standard concentration indices estimated for neonatal deaths in Nepal are presented in Table 1 giving the inequality of neonatal deaths based on wealth status. Since all the indices are of negative signs, all neonatal deaths were more concentrated in poorer parts of societies in all five periods. The estimated result shows that the concentration index for neonatal deaths has improved in 1996–2000 by 0.0087 or moved 0.0087 unit closer to equality line than 1990–1995. However, the index has worsened by 0.0233, 0.0050 and 0.0893 in the periods 2001–2005, 2006–2010 and 2011–2015 respectively. There was a continuous worsening of the distribution of neonatal death from the thirdsurvey and it extremely scaled in the latest survey.

Table 1. Neonatal deaths inequality and its change (measured in CI)

Survey year	Observed period	CI	ΔCI
1996	1990–1995	-0.0342	-
2001	1996–2000	-0.0255	-0.0082
2006	2001–2005	-0.0488	0.0233
2011	2006–2010	-0.0538	0.0050
2016	2011–2015	-0.1431	0.0893

Tables in the appendices (A1–A5) present the results obtained from decomposition of CI of neonatal deaths in Nepal for the periods 1991–1995, 1996–2000, 2001–2005, 2006–2010 and 2011–2015 which show how the various socioeconomic variables contribute to the neonatal deaths inequalities during these periods. Determinants associated with neonatal death are shown in the first column where male child, single birth, birth order one, average size child, no education, mother's age 15–24 at delivery, poorest quintile, urban residence and mountain zone are taken as references. The second, third, fourth and fifth columns in these tables show mean value, marginal coefficients, elasticity of the health outcome and concentration indices of the determinants. The last two columns show absolute and percentage contributions of determinants to the concentration indices of neonatal death.

Regression coefficients which are shown in the third column of the tables were marginal effects obtained from the linear approximation of the logistic model. Results show that female child and higher birth orders were less likely; and, multiple births, small and large sized child were more likely than their references to the neonatal deaths and statistically significant in more of the survey periods. Similarly, mother's higher education, rural residence and hill zone were less likely than their references to the newborn deaths. Mother higher education at the third and the fourth surveys; rural at latest survey; and hill zone at the second, the third and the fifth surveys were statistically significant. Other determinants related to mother's age at delivery, wealth quintiles and terai zone were not or rarely statistically significant. Further, birth order more than two, small sized child, primary education in later surveys, rural residence and hill zone were more concentrated at poorer population; and, birth order two, large child, primary education in earlier surveys and higher education were more concentrated at richer population.

Last columns of the tables in the appendices revealed that mother's higher education, higher birth orders, hill zone, rural residence and small sized child were the major contributors to the neonatal death inequality in the later three surveys. We considered recent information more crucial. For example, multiplications of elasticities -0.1654 and -0.1460 of mother's higher education obtained from marginal coefficients -0.0250 and -0.1460 to its CIs 0.5357 and 0.4427 yielded absolute contribution -0.0732 and -0.0603 which were nearly 150 percent and 112 percent of the neonatal death inequalities -0.0488 and -0.0538 respectively for the survey periods 2001–2005 and 2006–2010. Here, mother's higher education which were more concentrated at richer population reduced the newborn deaths incidences and caused huge differences of the deaths with the poorer population. Both elasticity and CI of mother's higher education were relatively higher than other determinants caused its higher contribution to the inequality.

Birth order two which were concentrated at richer strata reduced the death incidents and increased the neonatal deaths inequality concentrated at poorer strata further. On the other hand, birth order more than two lowered the deaths which were concentrated at poorer strata decreased the deaths inequality that concentrated in poorer strata. Birth order more than two contributed more to decrease the neonatal death inequality than to increase it by birth order two. These two phenomena traded off and yielded 16 percent, 69 percent and 15 percent contribution of higher birth orders to reduce the neonatal deaths inqualities in periods 2001–2005, 2006–2010 and 2011–2015 respectively. Proportion of birth order two were in increasing trends (0.2626, 0.2710 and 0.2922) whereas for more than two were in decreasing trend (0.4351, 0.3891 and (0.3139) for last three surveys.

Similarly, the hill zone contributed in reducing 18 percent in 2001–2005 and 16 percent in 2011–2015; rural residence in increasing 20 percent in 2011–2015; and small sized child in increasing 14 percent, 15 percent and 6 percent in periods 2001–2005, 2006–2010 and 2011–2015 respectively of the inequality. Although, multiple births were statistically significant in all later three surveys, due to the small elasticities(0.0330, 0.0256 and 0.0123) and small CIs (-0.0258, -0.0634, 0.0773), its contribution to the inequalities were very small (2%, 3%, -1%). Proportions of multiple births were also in decreasing trend (0.0160, 0.0131 and 0.0123).

5. Conclusion

In this study, we tried to estimate neonatal death inequality as a child health outcome and explore major contributors to the inequality using data from five waves of Nepal Demographic and Health Survey (NDHS) conducted in 1996, 2001, 2006, 2011 and 2016. We used a concentration index to measure the inequality in neonatal deaths taking the household's wealth index as a ranking variable and decomposed the index to see how determinants contribute to the inequality applying the methods proposed by Kakwani et al. (1997) and Wagstaff et al. (2003). We have chosen concentration index to gauge health outcome inequality as it considers all three minimal requirements i.e. it includes each individual in the entire population, sensitive to the distribution of the each individual across different socioeconomic strata and ensures the socioeconomic dimension for inequalities in health. We applied the logistic regression since the outcome variable is binary in nature and marginal effects evaluated at means are taken as the linear approximation as the outcome variable must be a linear combination of the independent variables for the decomposition of the concentration index to hold.

Finally, measurement and decomposition analysis of neonatal deaths inequality in Nepal yielded the following main findings: *First*, there were substantial neonatal death inequalities between the poor and better-off in Nepal and the deaths incidences were more concentrated in poorer population for all five survey periods. *Second*, concentration indices for the neonatal deaths evidenced that the inequality has increased from the third survey period and become the worst in the latest survey period. *Third*, decomposition analysis found that mother's education, higher birth order, hill zone, rural residence and small sized child were the major contributors for the child health outcome inequalities in recent three surveys. Of these, hill zone and higher birth orders were contributing for reducing the neonatal deaths inequality.

The decomposition of the child health outcomes inequality has yielded useful information regarding the relative importance of various determinants of inequitable health outcomes which could be helpful for the health policy maker. We observed the largest contribution of higher education in neonatal death inequality in our study. Higher education was concentrated in richer strata and there were persistent gap between rich and poor. If we educate poor people it reduces the education inequality. At the same time higher education reduces the neonatal death compared to no education. Here, the combined effect of reduction in inequality and negative elasticity of education to the neonatal deaths ultimately reduces the neonatal death inequality. Thus, this paper suggests for effective education program targeted at poor population in Nepal. In addition, rural residence and small sized child were more concentrated at poorer parts in the population and contributing significantly to increase the inequalities, thus recommendablepolicy might be, focus healthcare access to newbornsto those areas.

Obviously, this study is not free from limitations. Some of the limitations are: *firstly*, this study considers demand side determinants. Supply side determinants like access to and utilization of healthcare services are not included which are vital to people's health. However, the healthcare system is itself socioeconomic determinants of health. *Secondly*, wealth index is used to measure household's well-being which is not an absolute measure. It was thus limited in its ability to measure multiple dimensions of household economic well-being. *Lastly, but not least*, this study has limited predictive or explanatory power of the model. In the neonatal death decomposition, the model yielded large residuals (under-explained or over-explained inequality). Lack of a rich set of explanatory variables due to limited data, it was not possible to identify the sources of inequality in a more depth manner.

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Table A1. Decomposition of inequality in neonatal death (1991 – 1995)

	Mean	**β**		**η**	**CI_k**	**AbsContri to CI**	**%Contri to CI**
Child level							
Male							
Female	0.4855	-0.0155	***	-0.1809	-0.0064	0.0012	-3
Single birth							
Multiple birth	0.0149	0.0792	***	0.0283	0.0126	0.0004	-1
Birth order 1							
Birth order 2	0.2158	-0.0172	**	-0.0892	0.0706	-0.0063	18
Birth order 2+	0.5546	-0.0202	***	-0.2690	-0.0885	0.0238	-70
Average child							
Small child	0.2542	-0.0054		-0.0330	-0.0721	0.0024	-7
Large child	0.3180	0.0045		0.0341	0.0228	0.0008	-2
Maternal level							
No edu							
Primary edu	0.1167	-0.0024		-0.0067	0.1460	-0.0010	3
Higher edu	0.0902	-0.0067		-0.0146	0.5994	-0.0088	26
Age 15-24							
Age 25-34	0.3803	0.0038		0.0349	-0.0619	-0.0022	6
Age 35-49	0.0964	-0.0005		-0.0011	-0.1549	0.0002	-1
Household level							
Poorest							
Poorer	0.2036	-0.0068		-0.0330	-0.2782	0.0092	-27
Middle	0.2023	0.0068		0.0332	0.1277	0.0042	-12
Richer	0.1941	-0.0121		-0.0566	0.5240	-0.0297	87
Richest	0.1410	-0.0055		-0.0185	0.8590	-0.0159	47
Community level							
Urban							
Rural	0.9365	0.0079		0.1788	-0.0462	-0.0083	24
Mountain							
Hill	0.4257	-0.0106		-0.1085	-0.0631	0.0068	-20
Terai	0.4973	-0.0060		-0.0716	0.0702	-0.0050	15
Total Estimated						-0.0282	82
Residual						-0.0060	18
Total Observed						-0.0342	100

"***" $p < 0.01$, "**" $p < 0.05$, "*" $p < 0.10$
Reference variables are Male, Single birth, Birth order 1, Average child, No education, Age 15 - 24, Poorest, Urban and Mountain.

Table A2. Decomposition of inequality in neonatal death (1996 – 2000)

	Mean	β		η	CI_k	AbsContri to CI	%Contri to CI
Child level							
Male							
Female	0.5055	-0.0106	***	-0.1415	0.0064	-0.0009	4
Single birth							
Multiple birth	0.0123	0.0732	***	0.0238	0.1311	0.0031	-12
Birth order 1							
Birth order 2	0.2261	-0.0156	***	-0.0931	0.0715	-0.0067	26
Birth order 2+	0.5354	-0.0152	**	-0.2157	-0.0830	0.0179	-70
Average child							
Small child	0.2100	0.0159	***	0.0882	-0.1020	-0.0090	35
Large child	0.2273	0.0007	*	0.0042	0.0490	0.0002	-1
Maternal level							
No edu							
Primary edu	0.1390	-0.0004		-0.0015	0.1297	-0.0002	1
Higher edu	0.1191	-0.0100		-0.0314	0.5357	-0.0168	66
Age 15-24							
Age 25-34	0.3761	-0.0065		-0.0650	-0.0382	0.0025	-10
Age 35-49	0.0925	-0.0015		-0.0037	-0.1765	0.0007	-3
Household level							
Poorest							
Poorer	0.2202	0.0095		0.0550	-0.2712	-0.0149	59
Middle	0.1998	0.0078		0.0414	0.1489	0.0062	-24
Richer	0.1882	0.0060		0.0299	0.5370	0.0160	-63
Richest	0.1374	-0.0081		-0.0295	0.8626	-0.0255	100
Community level							
Urban							
Rural	0.9356	0.0019		0.0469	-0.0515	-0.0024	9
Mountain							
Hill	0.4118	-0.0119	**	-0.1296	-0.1079	0.0140	-55
Terai	0.5115	-0.0038		-0.0517	0.1119	-0.0058	-23
Total Estimated						-0.0216	85
Residual						-0.0039	15
Total Observed						-0.0255	100

"***" $p < 0.01$, "**" $p < 0.05$, "*" $p < 0.10$
Reference variables are Male, Single birth, Birth order 1, Average child, No education, Age 15 - 24, Poorest, Urban and Mountain.

Table A3. Decomposition of inequality in neonatal death (2001 – 2005)

	Mean	β		η	CI_k	AbsContri to CI	%Contri to CI
Child level							
Male							
Female	0.4920	0.0013		0.0201	-0.0064	-0.0001	0
Single birth							
Multiple birth	0.0160	0.0670	***	0.0330	-0.0258	-0.0008	2
Birth order 1							
Birth order 2	0.2626	-0.0258	***	-0.2081	0.0973	-0.0203	41
Birth order 2+	0.4351	-0.0132	**	-0.1770	-0.1566	0.0277	-57
Average child							
Small child	0.1918	0.0131	***	0.0773	-0.0854	-0.0066	14
Large child	0.2248	0.0047		0.0328	0.0161	0.0005	-1
Maternal level							
No edu							
Primary edu	0.1820	-0.0094		-0.0528	0.0805	-0.0042	9
Higher edu	0.2151	-0.0250	***	-0.1654	0.4427	-0.0732	150
Age 15-24							
Age 25-34	0.3175	-0.0093		-0.0911	-0.0562	0.0051	-11
Age 35-49	0.0780	-0.0042		-0.0102	-0.3169	0.0032	-7
Household level							
Poorest							
Poorer	0.2127	0.0018		0.0115	-0.2779	-0.0032	7
Middle	0.2042	0.0088		0.0555	0.1390	0.0077	-16
Richer	0.1774	0.0030		0.0161	0.5205	0.0084	-17
Richest	0.1511	0.0029		0.0135	0.8489	0.0114	-23
Community level							
Urban							
Rural	0.8780	-0.0016		-0.0432	-0.0839	0.0036	-7
Mountain							
Hill	0.4077	-0.0136	**	-0.1707	-0.0516	0.0088	-18
Terai	0.5053	-0.0112	**	-0.1734	0.1176	-0.0204	42
Total Estimated						-0.0523	107
Residual						0.0035	-7
Total Observed						-0.0488	100

"***" p < 0.01, "**" p < 0.05, "*" p < 0.10
Reference variables are Male, Single birth, Birth order 1, Average child, No education, Age 15 - 24, Poorest, Urban and Mountain.

Table A4. Decomposition of inequality in neonatal death (2006 – 2010)

	Mean	β		η	CI_k	AbsContri to CI	%Contri to CI
Child level							
Male							
Female	0.4844	0.0016		0.0230	0.0070	0.0002	0
Single birth							
Multiple birth	0.0131	0.0640	***	0.0256	-0.0634	-0.0016	3
Birth order 1							
Birth order 2	0.2710	-0.0056		-0.0467	0.1014	-0.0047	9
Birth order 2+	0.3891	-0.0162	**	-0.1924	-0.2170	0.0417	-78
Average child							
Small child	0.1591	0.0136	**	0.0660	-0.1233	-0.0081	15
Large child	0.1776	0.0044		0.0237	0.0094	0.0002	0
Maternal level							
No edu							
Primary edu	0.2002	-0.0156	**	-0.0957	-0.0788	0.0075	-14
Higher edu	0.3269	-0.0146	*	-0.1460	0.4129	-0.0603	112
Age 15-24							
Age 25-34	0.3368	-0.0026		-0.0270	-0.0292	0.0008	-1
Age 35-49	0.0706	-0.0361	***	-0.0778	-0.3233	0.0251	-47
Household level							
Poorest							
Poorer	0.2193	0.0090		0.0604	-0.2651	-0.0160	30
Middle	0.2102	0.0112		0.0720	0.1644	0.0118	-22
Richer	0.1739	0.0086		0.0458	0.5485	0.0251	-47
Richest	0.1388	-0.0094		-0.0399	0.8612	-0.0344	64
Community level							
Urban							
Rural	0.9066	0.0038		0.1043	-0.0594	-0.0062	12
Mountain							
Hill	0.3952	0.0005		0.0062	-0.1945	-0.0012	2
Terai	0.5255	-0.0057		-0.0912	0.2099	-0.0191	36
Total Estimated						-0.0391	73
Residual						-0.0147	27
Total Observed						-0.0538	100

"***" $p < 0.01$, "**" $p < 0.05$, "*" $p < 0.10$
Reference variables are Male, Single birth, Birth order 1, Average child, No education, Age 15 - 24, Poorest, Urban and Mountain

Table A5. Decomposition of inequality in neonatal death (2011 – 2015)

	Mean	β		η	CI_k	AbsContri to CI	%Contri to CI
Child level							
Male							
Female	0.4768	-0.0053	*	-0.1257	-0.0049	0.0006	0
Single birth							
Multiple birth	0.0123	0.0204	***	0.0123	0.0773	0.0010	-1
Birth order 1							
Birth order 2	0.2922	-0.0044		-0.0626	0.0804	-0.0050	4
Birth order 2+	0.3139	-0.0096	**	-0.1483	-0.1855	0.0275	-19
Average child							
Small child	0.1703	0.0132	***	0.1110	-0.0804	-0.0089	6
Large child	0.1629	0.0128	***	0.1024	-0.0318	-0.0033	2
Maternal level							
No edu							
Primary edu	0.2014	-0.0024		-0.0239	-0.1702	0.0041	-3
Higher edu	0.4561	-0.0066		-0.1480	0.2018	-0.0299	21
Age 15-24							
Age 25-34	0.3444	-0.0034		-0.0580	0.0374	-0.0022	2
Age 35-49	0.0390	-0.0025		-0.0048	-0.2669	0.0013	-1
Household level							
Poorest							
Poorer	0.2119	0.0015		0.0162	-0.3604	-0.0058	4
Middle	0.2216	-0.0101	*	-0.1104	0.0731	-0.0081	6
Richer	0.2048	-0.0032		-0.0320	0.4996	-0.0160	11
Richest	0.1478	-0.0127		-0.0924	0.8522	-0.0788	55
Community level							
Urban							
Rural	0.4604	0.0074	**	0.1679	-0.1742	-0.0292	20
Mountain							
Hill	0.3776	-0.0084	*	-0.1559	-0.1489	0.0232	-16
Terai	0.5511	-0.0024		-0.0660	0.1710	-0.0113	8
Total Estimated						-0.1408	98
Residual						-0.0023	2
Total Observed						-0.1431	100

"***" $p < 0.01$, "**" $p < 0.05$, "*" $p < 0.10$
Reference variables are Male, Single birth, Birth order 1, Average child, No education, Age 15 - 24, Poorest, Urban and Mountain.