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Exploring the most dominant drivers of inequalities in child survival in Ethiopia: Dominance analysis

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Abstract

Inequalities in child survival are a global public health concern. Over the past decade, Ethiopia has made remarkable progress in improving child survival. Despite this promising development, inequalities in child survival among the various population groups remained a pressing public health concern. The purpose of this paper is to examine the dominant drivers of inequality in child survival indicators (undernutrition, anemia, and under-five mortality) in Ethiopia. Dominance analysis was used based on a pooled total sample of 48,422 under-five children drawn from five rounds of Ethiopia Demographic and Health Surveys conducted from year 2000 to 2019. Childhood undernutrition, childhood anemia, and under-five mortality were the three outcome variables, and the five dimensions of inequality were considered as key predictor variables. The dominance analysis revealed that maternal education, place of residence, and household wealth index were the three most dominant drivers of inequalities in childhood undernutrition, accounting for 83.48% of the predicted variances. The regional category was found to be the first-ranked key driver of inequalities in childhood anemia, accounting for 50.56% of the predicted variance. The dominance analysis also indicated that maternal education, child sex, and place of residence were the three most dominant drivers of inequality in under-five mortality, accounting for 89.3% of the predicted variance. This study provides empirical evidence that maternal education (individual level), household asset based wealth index (household level), and place of residence (community level) were the most dominant drivers of inequality in child survival. This suggests interventions in reducing inequalities in child survival need to start at the community level, notwithstanding the importance of household and individual level influences.

Keywords: Dominant drivers; Dominance analysis; Inequalities; Child survival; Under-five mortality; Ethiopia

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1. Introduction

1.1. Background

Inequalities in child survival are a global public health concern (Brault *et al.*, 2020; Cha & Jin, 2020). Although reducing inequalities in child survival are given due attention

in sustainable development goals (SDGs) (Yourkavitch *et al.*, 2018), the inequality is widespread at global, regional and national levels (Sharrow *et al.*, 2022). According to the World Health Organization (WHO), children in Africa region are 10 times more likely to die before their fifth birth day compared to children in European Region (WHO, 2022). Two regions, sub-Saharan Africa and Central and Southern Asia, accounted for more than 80% of the 5.2 million under-five deaths, where sub-Saharan Africa remained the region with the highest under-five mortality (U5M) rate (a 1-in-13 rate) in the world in 2019 (WHO, 2020).

In Ethiopia, U5M rate varies across the administrative regions, ranging from 74 deaths/1000 live children in Afar to 29 deaths/1000 live children in Addis Ababa (Ethiopian Public Health Institute & ICF, 2021). Geographic inequality in U5M was higher in Benishagul-Gumuz, followed by Amhara, Afar, Gambela, and South Nation Nationality and People's Region (Liyew *et al.*, 2021). Inequality of anemia among under-five children also exists across regions in the country (Anteneh & Geertruyden, 2021; Endris *et al.*, 2021). Inequalities in childhood undernutrition by administrative region (Yayo Negasi, 2021) and maternal education status (Bras & Mandemakers, 2022) were also documented in the country. Thus, inequality in child survival remains a challenge in the country to achieve SDG targets, specifically among more disadvantageous population groups and emerging regions (Dheresa *et al.*, 2022).

Despite the marked improvement in the prevalence of U5M in Ethiopia, substantial inequalities in child health outcomes among the different socioeconomic subgroups persist and progress is uneven. On the top of this, answering the question "what are the most dominant drivers of inequalities in child survival in Ethiopia?" is essential to identify the key inequalities drivers that can be minimized and/or prevented. In this paper, the child survival indicators refer to childhood undernutrition and childhood anemia (Nkosi-Gondwe *et al.*, 2021) and U5M (Mosley & Chen, 2003).

To date, numerous studies (Agbadi *et al.*, 2021; Alao *et al.*, 2021; Balaj *et al.*, 2021; Ekholuenetale *et al.*, 2020; Endris *et al.*, 2021; Forde & Tripathi, 2018; Hasan *et al.*, 2021; Wang *et al.*, 2021; Yayo Negasi, 2021; Zegeye *et al.*, 2021) have examined the determinants of inequality in child survival. However, these studies have used regression modeling approaches that limit to identify the relative importance of the determinants for predicting inequalities in child survival. In addition, these studies have focused only on one or two child survival indicators; accordingly, identifying the dominant drivers of inequalities in child survival indicators (i.e., childhood undernutrition, anemia, and U5M) remains limited. Therefore, this paper seeks to redress the literature gap on the most dominant drivers of inequalities in child survival indicators in Ethiopia. The objective of this paper was to explore the dominant drivers of inequality in child survival indicators (undernutrition, anemia, and U5M) in Ethiopia by applying the dominance analysis technique developed to estimate relative importance of all predictors in a regression model in relation to an outcome variable (Azen & Traxel, 2009).

1.2. Conceptual framework

This study is mainly focused on five internationally conceptualized dimensions of inequality (WHO and International Center for Equity in Health, 2015). The five inequality dimensions (household wealth index, maternal educational status, place of residence, regional distribution, and child sex) are used as predictors of inequality in child survival to construct conceptual framework for this study. In addition, the five inequality dimensions are commonly used to exploring and comparing health inequalities in developing countries (Hosseinpoor *et al.*, 2016). Furthermore, these inequality drivers are most frequently reported predictors of child survival in Ethiopia (Bras & Mandemakers, 2022; Rebouças *et al.*, 2022). It is essential to understand that since before birth, children whose parents live in a situation of socioeconomic and geographic vulnerability may have worse health outcomes than who live in better situations (Pearce *et al.*, 2019). The ways in which living conditions affect child survival are complex and more driven by socioeconomic inequalities (Rebouças *et al.*, 2022). To identify the dominant drivers of inequality in child survival, it is essential to understand the conditions under which children are born and live, and consider socioeconomic and geographic stratifications among population groups. In this regard, the five drivers of inequality regrouped into socioeconomic (household wealth index, maternal educational status, and place of residence) and geographic (administrative regional distribution) stratifications (Houweling & Kunst, 2010), and the biological determinant (i.e., child sex) (Rebouças *et al.*, 2022). Furthermore, to consider the hierarchical nature of inequality drivers, the five drivers of inequality are grouped into community (administrative regions and place of residence), household (household wealth index), and individual (maternal education and sex of child) levels.

1.3. Background of Ethiopia

Ethiopia is one of the Sub-Saharan Africa countries with highest burden of U5M, ranking third in Africa, and tenth in the world (Dheresa *et al.*, 2022). Ethiopia is a landlocked country, sharing frontiers with Eritrea to the north and

northeast, Djibouti to the east, Somalia to the east and southeast, Kenya to the south, and South Sudan and Sudan to the west (FAO, 2016). The country is ethnically and culturally diverse and the second most populous country in Africa, and among the least urbanized countries in the world, with 82% of the population living in rural areas (USAID, 2021). Administratively, Ethiopia has 11 regional states (including newly established regions: Sidama and South West) and two city administrations (Addis Ababa and Dire Dawa). These regional states possibly vary in their levels of economic development, sociocultural, educational, and health service provision and settings (Bareke *et al.*, 2022).

Based on the development perspective, the old nine regional states and the two-city administrations are categorized into three as emerging (Afar, Somali, Benishangul-Gumuz, and Gambela), established (Tigray, Amhara, Oromia, Southern Nation Nationalities and People [SNNP], and Harari), and central (Addis Ababa and Dire Dawa city administrations) (Bareke *et al.*, 2022; Tesema & Braeken, 2018). The emerging regions are drought-affected areas, pastoralists, and marginalized in terms of basic infrastructure development (Bareke *et al.*, 2022).

Ethiopia is a low-income county having a gross domestic product per capital of US$ 855.80 in 2019 (Tangcharoensathien *et al.*, 2022), making it one of the poorest countries in the world (World Bank, 2020). About 69% of Ethiopia's population is multidimensionally poor in 2019 (UNDP, 2021). The multidimensional child poverty incidence and intensity varies across regions and place of residence in the country, where the multidimensional child poverty incidence ranges from 23% (lowest) in Addis Ababa to 98% (highest) in Somali region (Central Statistical Agency [CSA] & UNICEF, 2020). Likewise, the monetary child poverty incidence and depth varies across regions and areas with the highest incidence in Afar (39%) and Amhara regions (37%) and the lowest in Harari city administration (14%) and considerably higher in rural areas (31%) compared to large city areas (23%) (CSA & UNICEF, 2020).

Regarding child survival policies, the Government of Ethiopia (GoE) has realized pro-poor policies and strategies for child survival (Rono *et al.*, 2022). Since 2003, the country has implemented the Health Extension Program to improve child survival through primary healthcare (MOH, 2020). In addition, the country endorsed the first comprehensive National Child Survival Strategy (2005 – 2015), and the second strategic document the National Strategy for Newborn and Child Survival (2016 – 2020) in 2005 and 2015, respectively (FMOH-FDRE, 2016). GoE has demonstrated a strong policy commitment to nutrition through development of a National Nutrition Strategy in 2008, followed by implementation of National Nutrition Program I (2008 – 2015) and National Nutrition Program II (2016 – 2020) (Kennedy *et al.*, 2020). Ethiopia also joined the Scaling Up Nutrition movement in 2012 and endorsed the Seqota Declaration in 2015 with its high-level commitment to end childhood undernutrition by 2030 (FDRE, 2016). Furthermore, GoE has developed Food and Nutrition Policy to attain optimal nutritional status at all stages of life (FDRE, 2018).

2. Data and methods

2.1. Study design and data source

Retrospective cross-sectional study design is used for the present study, using the five rounds of Ethiopia Demographic and Health Surveys (EDHS) conducted in 2000, 2005, 2011, and 2016, including the 2019 mini EDHS. The datasets were downloaded from DHS website (http://dhsprogram.com) based on secured online permission. The study used children's files that contain information about socioeconomic, demographic, and geographic characteristics for under-five children, their parents, households, as well as their communities. However, anemia indicator was not collected in the 2000 EDHS and 2019 mini EDHS in the country. A pooled sample of 35,688, 19,699, and 48,422 under-five children were used for childhood undernutrition, childhood anemia, and U5M analysis, respectively. The outcome and explanatory variables were extracted from pooled data.

2.2. Study variables

2.2.1. Outcome variables

Childhood undernutrition, childhood anemia, and U5M were the three outcome variables of the study. Childhood undernutrition status categorized as undernourished and coded as 1 if child had any form of anthropometric failure, and as nourished with assigned value of 0 if the child had no failure. Childhood anemia was recoded into dummy variable where a child is considered to be anemic and assigned value of 1 if the child had severe, moderate, or mild anemia level, and 0 if child is not anemic. Under-five mortality was coded as 1 if the child died between 0 and 59 months and 0 if the child was alive at least until age of 59 months (CSA and ICF, 2016).

2.2.2. Predictor variables

The selection of predictor variables in the model was guided by the internationally conceptualized dimensions of inequality (WHO & International Center for Equity in Health, 2015)

and the review of literature and model building procedures. The review of most recent literatures (Bras & Mandemakers, 2022; Rebouças *et al.*, 2022) on the subject indicated that these variables are most frequently reported predictors of child survival in Ethiopia. The five internationally accepted dimensions of child survival inequalities were used as predictor variables in this paper to approximately measure inequality drivers (or as proxy measures of inequality drivers). Henceforth, the predictor variables are referred to as inequality drivers. Table 1 presents the coding for the predictor variables. Household asset-based wealth index was categorized into five quintiles and regrouped as poor (the first two quintiles: poorest and poorer) and non-poor (the last three quintiles: middle, richer and richest). Education was used to reflect the level of education attained by a child's mother, and grouped into two subgroups: no education and primary and above. Each of the place of residence (rural or urban) and child sex (female or male) was classified into two subgroups. The old nine regional states and the two city administrations were regrouped into three as emerging (Afar, Somali, Benishangul-Gumuz, and Gambela), established (Amhara, Oromia, SNNP, Tigray and Harari), and central (Addis Ababa and Dire Dawa city administrations) (Bareke *et al.*, 2022) (Table 1).

2.3. Statistical analysis

To reduce bias, about 3.2% of children with missing height/length, weight, and unknown responses were excluded from the analysis of undernutrition. For childhood anemia analysis, data from children aged 6 – 59 months were used. Descriptive statistics were used to describe the background characteristics of the study participants and the key variables. A correlation-based assessment was used to detect multicollinearity, and an absolute correlation coefficient of less than 0.6 was observed among predictors indicating the absence of multicollinearity (Senaviratna & Cooray, 2019). Logistic regression was used to identify significant drivers of inequality in child survival. Bivariate logistic regression analysis was used to establish the strength of the relationship between inequality drivers and outcome variables. Chi-square tests were computed to verify the significant association.

Table 1. Coding of proxy measures for the inequality drivers

Inequality drivers	Description
Sex of child	1=Female; 2=Male
Maternal education	1=No education; 2=Primary+
Household wealth index	1=Poor; 2=Non-poor
Place of residence	1=Rural; 2=Urban
Regional category	1=Emerging; 2=Established; 3=Central

Furthermore, to determine the relative importance of each predictor to the outcome, we used the dominance analysis (Azen & Traxel, 2009) by employing a user-developed STATA command "domin" (Luchman, 2021). Dominance analysis is a technique developed to estimate relative importance of all predictors in a logistic regression model in relation to an outcome variable (Tonidandel & LeBreton, 2010). It relies on estimating the regression values of all possible combinations of predictors and measures relative importance by doing comparisons of all predictors in the model as they relate to an outcome variable (Tighe and Schatschneider, 2014). The method also allows us in identifying the relative dominance of the predictors (Azen & Traxel, 2009; Lee & Dahinten, 2021). We also conducted sensitivity analysis to predict the outcome of a decision given a certain range of variables (Appendix B). All analyses were weighted and conducted using STATA version 15.

3. Results

3.1. Background characteristics of the study participants

Table 2 presents the background characteristics of the study participants by inequality dimensions. More than half (52.64%) of children were born to mothers residing in established regions, and majority (82.88%) of children were born in rural areas. More than half (51.21%) of children were born in households grouped as poor wealth index. Table 2 also shows that most (70.63%) of the children were born to uneducated mothers, and a little more than half (51.25%) of the children were male. About 51% and 55.06% of children were undernourished and anemic, respectively, and more than 8% of children were reported to have died (Table 2).

3.2. Bivariate logistic regression results

Table 3 presents results from the bivariate logistic regression analysis (with adjusted odds ratio) of the association between the outcome variables and inequality drivers. Table 3 shows that all socioeconomic (place of residence, household wealth index and maternal education), geographic (region), and biological (sex of child) inequality drivers were significantly associated with childhood undernutrition (at $p < 0.001$) and U5M (at $p < 0.05$). Likewise, the region, place of residence, household wealth index and maternal education status had statistically significant association with childhood anemia. The bivariate logistic regression analysis finding revealed that regional category, place of residence, household wealth index maternal education, and child sex are potential and significant drivers of inequality in childhood

Table 2. Background characteristics of study participants, Ethiopia, 2000 – 2019

Inequality drivers	N	%
Community level drivers		
Regional category		
Established	25,489	52.64
Emerging	18,321	37.84
Central	4612	9.52
Place of residence		
Rural	40,131	82.88
Urban	8291	17.12
Household level driver		
Household wealth index		
Poor	24,503	51.21
Non-poor	23,347	48.79
Individual level drivers		
Maternal education		
No education	34,200	70.63
Primary+	14,222	29.37
Sex of child		
Male	24,814	51.25
Female	23,608	48.75
Outcome variables		
Undernutrition (N=35,688)		
Nourished	17,602	49.32
Undernourished	18,086	50.68
Anemia* (N=19,699)		
Anemic	10,847	55.06
Not anemic	8852	44.94
Under-five mortality (N=48,422)		
No	44,485	91.87
Yes	3937	8.13

Note: *Anemia data were not collected in 2000 and 2019 EDHSs.
Source: Ethiopia Demographic and Health Surveys: 2000, 2005, 2011, 2016, and 2019.

undernutrition, childhood anemia, and U5M to explore through multivariable analysis (Table 3).

3.3. Dominance analysis results

Table 4 depicts dominance analysis of the drivers of inequality in child survival indicators. The dominance analysis revealed that maternal education, place of residence, and household wealth index were the three most dominant drivers of inequalities in childhood undernutrition, accounting for 83.48% of the predicted variance. Child sex was the lowest-ranked inequality driver in the dominance analysis, accounting for 1.61% of the predicted variance. In dominance analysis, the geographic predictor (region) was found to be the first-ranked dominant driver of inequalities in childhood anemia, accounting for more than half (50.56%) of the predicted variance. Dominance analysis also revealed that maternal education, child sex, and place of residence were the three top dominant drivers of inequality in U5M, accounting for 89.3% of the predicted variance (Table 4).

Moreover, we checked the ranking of the inequality drivers for a group of eight predictors by including three additional variables (sex of household head, maternal religion, and employment status) and found similar ranking results (Appendix A). Furthermore, we also conducted the sensitivity analysis to explore the predictors effect for undernutrition, anemia, and U5M using the five (region, place of residence, wealth index, maternal education, and child sex) and eight (region, place of residence, wealth index, maternal education and child sex, sex of household head, maternal religion, and employment status) inequality predictors. However, the predictive power of the model was relatively better with the eight predictors compared to the model with the five predictors (Appendix B).

4. Discussion

This study examined associations between the five inequality dimensions and three child survival indicators in Ethiopia based on pooled data from the five consecutive national surveys. The study identified the relative importance of the key drivers of inequality in line with WHO & International Center for Equity in Health (2015) in predicting inequality in child survival through dominance analysis. Maternal education, place of residence, and household wealth index were found to be the three most dominant drivers of childhood undernutrition inequality. This finding is consistent with the previous studies (Alao *et al.*, 2021; Ekholuenetale *et al.*, 2020; Hasan *et al.*, 2020; Yayo Negasi, 2021). The potential reason might be that maternal education could have an impact on feeding practice and healthcare (Lemessa *et al.*, 2022). Besides, place of residence could have effect on access to child health-care service and improved water that leads to better feeding practice (Nahalomo *et al.*, 2022). In addition, asset-based household socioeconomic status might be strongly linked with food insecurity, which directly affects childhood nutritional status (World Bank, 2020). Moreover, the richest households could have better opportunity to feed nutrition-rich food their children that could affect nutrition status of under-five children (Fenta *et al.*, 2021).Thus, these findings highlight the importance of interventions and policies that enhance socioeconomic

Table 3. Bivariate association between inequality drivers and outcome variables, Ethiopia, 2000 – 2019

Inequality drivers	Adjusted odds ratio	SE	[95% LB, UB]	χ^2
Undernutrition (N=35,688)				
Regional category (Central)				14.33
Established	2.580	649	[1.576, 4.225]***	
Emerging	2.022	493	[1.255, 3.259]***	
Place of residence (urban)				350.61
Rural	1.916	067	[1.790, 2.051]***	
Household wealth index (non-poor)				290.90
Poor	1.491	035	[1.424, 1.560]***	
Maternal education (primary+)				392.42
No education	1.647	042	[1.568, 1.731]***	
Child Sex (male)				24.70
Female	1.114	024	[1.068, 1.163]***	
Anemia (N=19,699)				
Regional category (Established)				4.94
Emerging	1.98	613	[1.079,3.634]**	
Central	1.32	531	[0.602, 2.908]	
Place of residence (urban)				102.09
Rural	1.639	080	[1.489, 1.804]***	
Household wealth index (non-poor)				119.86
Poor	1.424	046	[1.337, 1.517]***	
Maternal education (primary+)				12.26
No education	1.128	039	[1.055, 1.207]***	
Child sex (male)				0.24
Female	1.015	031	[0.956, 1.077]	
Under-five mortality (N=48,422)				
Regional category (Central)				7.92
Established	1.357	175	[1.053, 1.748]**	
Emerging	1.421	180	[1.109, 1.83]***	
Place of residence (urban)				28.59
Rural	1.353	076	[1.211, 1.511]***	
Household wealth index (non-poor)				18.58
Poor	1.169	042	[1.089, 1.255]***	
Maternal education (primary+)				63.68
No education	1.395	058	[1.285, 1.514]***	
Child sex (male)				43.70
Female	1.252	042	[1.171, 1.338]***	

Note: LB: Lower boundary, UB: Upper boundary; ***p<0.01, **p<0.05, *p<0.1.
Source: Ethiopia Demographic and Health Surveys: 2000, 2005, 2011, 2016, and 2019.

and livelihood of uneducated, the poor and the rural population groups to reduce inequalities in childhood undernutrition.

Moreover, our dominance analysis finding shows that administrative region, household wealth index and place of residence were found to be the three most dominant drivers of inequalities in childhood anemia. This finding is supported by other studies finding (Adeyinka *et al.*, 2019; Ekholuenetale *et al.*, 2022; Endris *et al.*, 2021; Jember *et al.*, 2021; Yadav & Nilima, 2021). The reason

Table 4. Dominance analysis of the outcome and inequality indicators in Ethiopia, 2000 – 2019

Inequality drivers	Dominance statistics	Standardized dominance statistics*	Ranking
Undernutrition (N=35,688)			
Region	0.0040	0.1459	4
Place of residence	0.0084	0.3030	2
Household wealth index	0.0057	0.2060	3
Maternal education	0.0090	0.3258	1
Child sex	0.0005	0.0193	5
Anemia (N=19,699)			
Region	0.0116	0.5056	1
Place of residence	0.0024	0.1041	3
Household wealth index	0.0075	0.3267	2
Maternal education	0.0014	0.0610	4
Child sex	0.0001	0.0025	5
Under-five mortality (N=48,422)			
Region	0.0001	0.0132	5
Place of residence	0.0010	0.1994	3
Household wealth index	0.0004	0.0522	4
Maternal education	0.0037	0.4158	1
Child sex	0.0016	0.2778	2

Note: *Standardized dominance statistics do not total to 1 due to rounding. Source: Ethiopia Demographic and Health Surveys: 2000, 2005, 2011, 2016, and 2019.

could be explained by existing disparities in geographical location, socioeconomic status, access to resources, level of education, cultural, and feeding practices as childhood anemia is nutritional disease (Gebreegziabher *et al.*, 2020). In addition, place of residence strongly affects access for basic education, child healthcare, and source of income that could be directly or indirectly related to poverty and risk of anemia (Gebreegziabher *et al.*, 2020). Moreover, household wealth index could be directly linked with nutritional intake and risk of childhood anemia, and the richest households might have better chance to address their children's nutritional and health needs (Amegbor *et al.*, 2022). Therefore, this study underscores the importance of implementation of interventions, especially target to geographic, urban-rural setting, and household status variations for accelerated reduction in childhood anemia.

Furthermore, our finding reveals that maternal education, place of residence, and child sex were the three most dominant drivers of inequalities under-five mortality, which is consistent with findings of other studies (Agbadi *et al.*, 2021; Balaj *et al.*, 2021; Forde & Tripathi, 2018; Zegeye *et al.*, 2021). It is evident that maternal education could have substantial impact on adopting better access to child healthcare, uptake of preventive vaccines, and safe water (Moradhvaj & Samir, 2023). Another reason could be that the existing gap in place of residence might result in disparity in accessing child health-care service, living standards, and child healthcare-seeking behavior (Tessema *et al.*, 2021) that may directly affect child survival in the country. Under-five mortality could be affected by sex differences in genetic and biological makeup (Pongou, 2013). This study finding emphasizes the importance of robust, and influencing policies and interventions for reducing inequalities in child mortality and improving the overall child survival through addressing urban-rural and maternal education gaps at community and individual levels.

4.1. Strengths and limitations of the study

The strengths of the present study were its large sample drawn from five rounds of nationally representative cross-sectional surveys and, use of dominance analysis to identify the key predictors of inequality in child survival indicators. There are some limitations in this study. First, this study shows drivers that are associated with inequalities in childhood undernutrition, anemia, and U5M and magnitude of associations, but no causal interpretation of the results is implied here as the cross-sectional survey data preclude causal inferences. Second, although the study focused on the five internationally accepted drivers of inequality, there might be some of important drivers of inequality that were not included in this paper, such as paternal education, household size, maternal and child health, and some community and macro-socioeconomic development indicators. Third, although dominance analysis is robust when all predictors are continuous variables, it has a limitation in dealing with non-continuous variables. For example, we observed different result, particularly for childhood anemia by changing classifications for region, maternal education and household wealth index and the result is annexed (Appendix C) for clarity.

5. Conclusions

This study provides empirical evidence that region and place of residence (community level), household asset based wealth index (household level), and maternal education (individual level) were the most dominant drivers of inequality in child survival in Ethiopia. This suggests that reducing inequalities in child survival need to start at higher hierarchical structure (regional and community levels), notwithstanding the importance of household and individual level influences. Further, improving the socioeconomic status of the poorest households, prioritizing emerging regions and rural areas

with the highest needs, and improving maternal education levels would most likely reduce child survival inequalities in the country.

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Conflict of interest

The authors declare that they have no competing interest.

Author contributions

Conceptualization: Negussie Shiferaw Tessema
Formal analysis: Negussie Shiferaw Tessema
Investigation: Negussie Shiferaw Tessema
Methodology: Negussie Shiferaw Tessema
Writing – original draft: Negussie Shiferaw Tesema
Writing – review & editing: Nigatu Regessa Geda

Ethics approval and consent to participate

For the original conduct of the five rounds of Ethiopia Demographic and Health Surveys (DHSs), ethical approval was obtained from the Ethical Committee of the ICF. The enumerators obtained informed consent and authorization to anonymously use the data from all survey participants. In our study, we obtained permission to use the data from the DHS program. No further ethical approval was required, as our study solely involved secondary data analysis of publicly available data that does not contain any identifiable information that links to the actual survey participants. Authors also confirm that all methods were carried out in accordance with relevant guidelines and regulations.

Consent for publication

Not applicable.

Availability of data

The dataset can be accessed at https://dhsprogram.com/data/available-datasets.cfm

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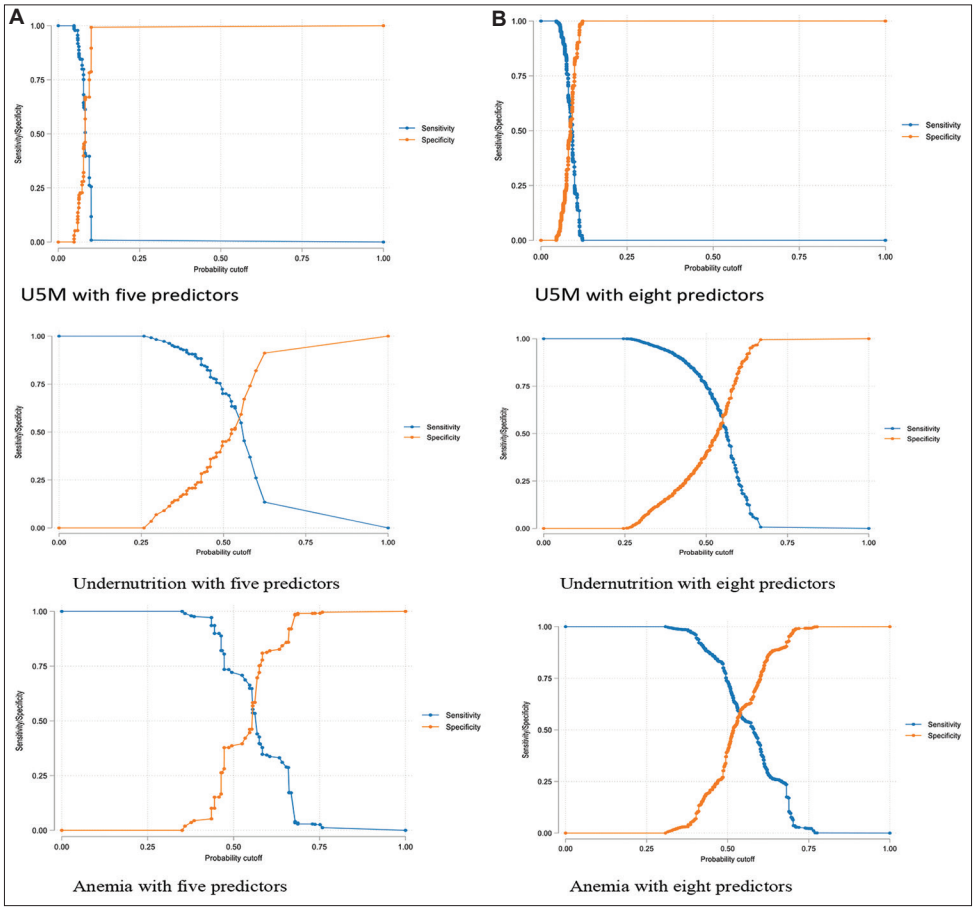
Appendixes

Appendix A: Dominance analysis results of outcome with eight predicators in Ethiopia, 2000 – 2019

Inequality drivers	Dominance statistics	Standardized dominance statistics*	Ranking
Undernutrition (N=35,688)			
Region	0.0029	0.1083	4
Place of residence	0.0080	0.2985	2
Household wealth index	0.0057	0.2119	3
Maternal education	0.0083	0.3100	1
Child Sex	0.0005	0.0172	7
Religion	0.0005	0.0185	6
Sex of Household head	0.0000	0.0018	7
Employment status	0.0009	0.0338	5
Anemia (N=19,699)			
Region	0.0097	0.3329	1
Place of residence	0.0070	0. 2384	3
Household wealth index	0.0071	0.2452	2
Maternal education	0.0013	0.0452	6
Child sex	0.0001	0.0019	8
Religion	0.0017	0.0599	5
Sex of household head	0.0002	0.0007	7
Employment status	0.0021	0. 0709	4
Under-five mortality (N=48,422)			
Region	0.0001	0.0141	6
Place of residence	0.0013	0.1863	3
Household wealth index	0.0005	0.0792	5
Maternal education	0.0025	0.3627	1
Child sex	0.0016	0.2411	2
Religion	0.0000	0.0011	8
Sex of household head	0.0001	0.0127	7
Employment status	0.0007	0.1027	4

Note: *Standardized dominance statistics do not total to 1 due to rounding. Source: Ethiopia Demographic and Health Surveys: 2000, 2005, 2011, 2016, and 2019.



Appendix B. (A and B) Sensitivity analysis results

Appendix C: Dominance analysis based on changed classification of predictors in Ethiopia, 2000 – 2019

Inequality drivers	Dominance statistics	Standardized dominance statistics*	Ranking
Undernutrition (N=35,688)			
Region	0.0063	0.1942	4
Place of residence	0.0068	0.2100	2
Household wealth index	0.0065	0.2022	3
Maternal education	0.0122	0.3776	1
Child sex	0.0005	0.0161	5
Anemia (N=19,699)			
Region	0.0003	0.0256	4
Place of residence	0.0010	0.0779	3
Household wealth index	0.0096	0.7757	1
Maternal education	0.0014	0.1160	2
Child Sex	0.0001	0.0047	5
Under-five mortality (N=48,422)			
Region	0.0001	0.0051	5
Place of residence	0.0010	0.0051	3
Household wealth index	0.0004	0.0581	4
Maternal education	0.0037	0.5225	1
Child Sex	0.0016	0.4093	2

Note: *Standardized dominance statistics do not total to 1 due to rounding.