Trends and Predictors of underweight among under-five children in Ethiopia, based on Ethiopian Demographic and Health Survey 2005 -2016. Multivariable Decomposition analysis

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Abstract

Background Underweight is one of the paramount major worldwide health problems, and it touches a large number of population from infancy to old age. This study aimed to analyze the trends and predictors of change in underweight among under-five children in Ethiopia

Method The data for this study were accessed from three Ethiopian Demographic and Health Surveys data set 2005, 2011 and 2016. The trend was examined separately for the periods 2005–2011, 2005-2016, and 2011-2016. Multivariate decomposition analysis of change in underweight was employed to answer the major research question of this study. The technique employed the output from the logistic regression model to parcel out the observed difference in underweight into components, and STATA 14 was utilized for data management and analysis.

Result Among children in Ethiopia the prevalence of underweight declined from 38% in 2005 to 25% in 2016. The decomposition analysis indicated that almost half of the overall change in underweight was due to difference in characteristics. Change in the composition of parental education, wealth index, duration of breastfeeding, respondents' occupation, was the major contributor for the decline of underweight, while the age of child and presence of diarrhea were contributors for the rise of underweight in Ethiopia.

Conclusion underweight shows a remarkable decline over the last decades in Ethiopia. Change in composition of Birth size, duration of breastfeeding, household wealth quantile (richer) and husband/partner primary education are attributable to the decline of underweight.

Introduction

Undernutrition is characterized as an obsessive disorder causing from lack of energy and proteins in different extents, which can be intensified by repeated infections(YADAV et al., 2016). It is one of the paramount major worldwide health problems, and it touches a large number of population from infancy to old age, in all geographies, rich people and poor people, and all sexes (Mshida et al., 2018, Tufa et al., 2018).

Child health is considered an important indicator of socio-economic development. This is the basis that Millennium Development Goal 4 aimed to reduce under-five mortality by two-thirds by 2015. However, no substantial improvement has been perceived regarding underweight in Ethiopia it remains the main cause for mortality and morbidity (Gebremedhin, 2015, Tufa et al., 2018, Plavgo and Kibur, 2013).

Proper nutrition of children, leading to adequate growth and good health, is the essential foundation for the body and brain development of humans. However, there is plentiful evidence that deficits in growth during childhood are accompanying with higher levels of mortality, infectious diseases and harm to psychomotor development, lower school performance, and a reduction in height and productive capacity

in the adulthood (Nayak et al., 2018, Mekonen et al., 2015, Deribew et al., 2010, Jomon Mathew John, 2019).

In the case of women, the reduction in growth during childhood is associated with low body mass index (BMI) and a higher risk of having children with low birth weight, showing the inter-generational effect of malnourishment (Olofin et al., 2013, Ghosh and Varerkar, 2019). The problems are very high in developing countries due to multidimensional factors including birth order of the child, early childbirth, low educational level of fathers, consanguineous marriage, low body mass index (BMI) of mothers, low intake iron during pregnancy and low clean water consumption (Tariq et al., 2018, Gamecha et al., 2017, Ghosh and Varerkar, 2019, CHAO, 2017, Mazumdar, 2012, Akombi et al., 2017b). Childhood illnesses such as diarrhea and acute respiratory infections, which are associated with poor hygiene and access to sanitation, are common causes of underweight in developing countries including Ethiopia (Adhikari et al., 2017, Tosheno et al., 2017, Gamecha et al., 2017, Hosseinzadeh Attar et al., 2019, Novignon et al., 2015). Socio-cultural practice such as low consumption of supplementary child feeding, low intake of dietary, late weaning and poverty are major causal factors of underweight among under-five year children(Bhandari and Chhetri, 2013, Adhikari et al., 2017, Fentaw et al., 2013, Mittal et al., 2007, Jomon Mathew John, 2019). Also, underweight is significantly associated with the parental BMI related to lack of adequate diet and related feeding practice that is essential to ensure the health, growth, and development of children to their full potential(Organization, 2018, Mittal et al., 2007, Akombi et al., 2017a). Furthermore, household wealth, food insecurity, mass media exposure, size of child at birth, lack of health facility, place of delivery, an increment of child age, and many mother deliveries lead to growth retardation and underweight (Akombi et al., 2017a, Sulaiman et al., 2018, Paul et al., 2018, CHAO, 2017, Abdollah ALMASIAN KIA 2019).

Identifying the contributing factors to change the weight of children helps to improve the health of children to reduce the impairment of their adult life. A decomposition analysis study conducted in India, Vietnam, Egypt, and Ghana shows a significant reduction in the prevalence of underweight and stunting over time (YADAV et al., 2016, Mazumdar, 2012, Novignon et al., 2015, Kien et al., 2016, Plavgo and Kibur, 2013, Srivastava, 2019). As Ethiopian Demographic and health survey (EDHS) and a meta-analysis study conducted in sub-Saharan Africa indicated a consistent decline of underweight over time i.e. 41% from 2000 to 24% from 2016(Akombi et al., 2017b, Agency, 2016). The weight of children may be scaled up due to the current change in population composition, including urbanization, education of the community related to dietary diversity as well as improving health infrastructures of the country. The main aims of this paper were to quantify the contributing factors that explain underweight among children aged less than five years, which may be useful for informing policy and indicate specific programming to resolve the underweight problem and further reduction for the prevalence of underweight children in Ethiopia.

Methods And Materials

Study design and sampling

This study was based on a secondary analysis of cross-sectional population data from Ethiopia Demographic Health Surveys (EDHS) 20005, 2011 and 2016 to investigate trends and the factors associated with underweight among under-five children in Ethiopia.

So far, in Ethiopia, four consecutive surveys were conducted in the cross-sectional years of 2000, 2005, 2011 and 2016 respectively. Similar to other demographic and health surveys, the principal objective Ethiopian Demographic and Health Survey (EDHS) was to offer current and consistent data on fertility and family planning behavior, child mortality, adult and maternal mortality, children's nutritional status, use of maternal and child health services, as well as data, were collected on knowledge and attitudes of women and men about sexually transmitted diseases and HIV/AIDS and evaluated potential exposure to the risk of HIV infection by exploring high-risk behaviors and condom use.

The sampling frame used for the 2016 EDHS was the Ethiopia Population and Housing Census (EPHC), which was conducted in 2007 by the Ethiopia Central Statistical Agency. The census frame is a complete list of 84,915 *enumeration areas* (EAs) created for the 2007 PHC. An EA is a geographic area covering on average 181 households. The sampling frame contains information about the EA location, type of residence (urban or rural), an estimated number of residential households. Except for EAs in six zones of the Somali region, each EA has accompanying cartographic materials. These materials delineate geographic locations, boundaries, main access, and landmarks in or outside the EA that help identify the EA. In Somali, a cartographic frame was used in three zones where sketch maps delineating the EA geographic boundaries were available for each EA; in the remaining six zones, satellite image maps were used to provide a map for each EA.

Variables and measurement

The outcome variable for this study was underweight measured based on WHO guidelines, under-five children with Weight-for-age a z-score of less than two.

Weight-for-age is a composite index of height-for-age and weight-for-height that accounts for both acute and chronic undernutrition. Children whose weight-for-age Z-score is below minus two standard deviations (-2 SD) from the median of the reference population are classified as underweight. Children whose weight-for-age Z-score is below minus three standard deviations (-3 SD) from the median are considered severely underweight.

The explanatory variables of interest in this study were as follows: child’s age (months), child’s sex, living area (urban/rural), mother’s education level, and household socioeconomic status, place of delivery, antenatal care service during pregnancy, Birth order, duration of breastfeeding, size of child at birth, BMI of women's, occupational status, vaccination status, and religion all of which are important determinants for child underweight.

Statistical Analysis

This study employed a trend analysis of underweight among under five years and decomposition of changes in underweight. The trend in underweight was analyzed using descriptive analyses, stratified by region, urban-rural residence, and selected sociodemographic characteristics. The trend was examined separately for the periods 2005–2011, 2005-2016, and 2011-2016.

Multivariate decomposition analysis of change in underweight was employed to answer the major research question of this study. The purpose of the decomposition analysis was to identify the sources of changes in underweight in the last decade. Both changes in population composition and population behavior related to underweight are important. This method is used for several purposes in demography, economics, and other fields. The present analysis focused on how underweight response to changes in children's characteristics to the adult age and how these factors form differences across surveys conducted at different times. The technique employs the output from the logistic regression model to parcel out the observed difference in underweight into components. The difference can be attributed to compositional changes between surveys (i.e. the difference in characteristics) and changes in effects of selected explanatory variables (i.e. the difference in the coefficients due to change in population behavior). Since the observed difference in underweight use between different surveys additively decomposed into a characteristics (or endowments) component and a coefficient (or effects of characteristics) component. STATA 14 was utilized for data management and analysis and STATA command with mvdcmp package was employed throughout the process of analysis. All calculations presented in this manuscript were weighted for the sampling probabilities and non-response using the weighted factor included in the EDHS data. From the process of testing statistical significance or associations 95% confidence interval calculations), complex sampling procedures were considered. The process was done by using SVY STATA command top control clustering effects of complex sampling (stratification and multistage sampling technique)

For linear relations, the dependent variable is a function of a linear combination of predictors and regression coefficients, where

$Y = F(X\beta)$ where Y denotes the N x 1 dependent variable, X is an N x K matrix of independent variables, and β is a K x 1 vector of coefficients, where A and B represent EDHS 2016 and 2005 respectively.

The mean difference in Y between groups A and B can be decomposed as:

[Please see the supplementary files section to access the equations.]

For our logistic regression, the logit or log-odds of modern contraceptive use is taken as:

[See supplementary files.]

The *E* component refers to the part of the differential owing to differences in endowments or characteristics. The *C* component refers to that part of the differential attributable to differences in

coefficients of effects(Daniel A. Powers, 2011).

The equation can be presented as:

Logit (A) - Logit (B) = [β0A - β0B] + ΣXijB * [βijA- βijB] + ΣβijB * [XijA - XijB]

- X_{ijB} is the proportion of the j^{th} category of the i^{th} determinant in the DHS 2005,
- X_{ijA} is the proportion of the j^{th} category of the i^{th} determinant in DHS 2016,
- β_{ijB} is the coefficient of the j^{th} category of the i^{th} determinant in DHS 2005,
- β_{ijA} is the coefficient of the j^{th} category of the i^{th} determinant in DHS 2016,
- β_{0B} is the intercept in the regression equation fitted to DHS 2005, and
- β_{0A} is the intercept in the regression equation fitted to DHS 2016.

Result

Characteristics of the study population

Table 1: indicates the percentage of underweight among children below five years of age in Ethiopia by some selected background characteristics. The higher percentage of women were found in the age group of 25- 34 years old over three consecutive EDHS survey. Over the last three consecutive EDHS surveys, there has been a decline in the percentage of stunted children (from 47.41% to 38.48%) and the percentage of underweight children declined from 39.19% to 23.58% in Ethiopia.

Across the three EDHS surveys, the percentage of Orthodox Christians decline, from 42.49% to 34.78% between 2005 and 2016, while the percentage of Muslims increased from 34.26% to 40.83%. Regarding the educational status of women, in the first two surveys about three-quarters (79% in 2005 and 68.87% in 2011) were not educated, while in EDHS 2016, 65.52% were not educated. The percentage of primary education among women rose from 16.78% in 2005 to 27.68% in 2011, while there is no change from 2011 to 2016 concerning the primary education of women.

Regarding the wealth quintile of households, there was no reduction in the house in the last decades in Ethiopia, the poorest and the poorer categories show a slight increment in the proportion of households, while the percentage of richer and richest categories shows a slight reduction. The result also indicates that the percentage of women in the "not working category" decreased by 24.36% from 2005 to 2011, while the percentage increases from 2011 to 2016 by 10.02%. In this study, we found that the percentage of institutional delivery rises from 5.26% to 26.67% from 2005 to 2016. Further, the prevalence of diarrhea decreased by 7% from 2005 to 2016 (table 1).

Trends of underweight

This section presents the underweight status of children indicates a decline from 38% in 2005 to 24% in 2016. The largest percentage of decline was perceived from 2005 up 2011 i.e. 11% points decline. Regarding certain background characteristics it shows a variation over it, it is evident that all regions have experienced a decline in underweight from 2005 to 2016. However, Amhara regional state indicates better experience on decline of underweight among under-five children i.e. five percentage points although next to Amhara regional state, southern nations, nationalities, and people's region of Ethiopia (SNNPR) and Oromia regional state experiences similar decline of underweight from 2005 to 2016 four percentage point and three-point seven percentage respectively (table 2). Concerning religion a study found that there is an overall decline in underweight between 2005 and 2016, however, among Orthodox Christians, there is a larger decline in underweight than others in Ethiopia, although Protestant shows the second better decline in underweight over the last decades.

Weight of children below age five in rural areas has improved in the last decade; there has been a thirteen percentage point decline in underweight and a ten-percentage point decline among children whose birth size was average and above, but the decrease is still smaller in urban areas. As the birth order increase the prevalence of underweight also increases. Children whose parents no educational attainment are more likely to be suffering from underweight, although there has been a better decline in underweight among women's delivered in the Home than Health institution. Also, there has been a decline in the prevalence of underweight children below five years of age over the last decade in every wealth quintile group, even though from poorest and poorer wealth quintiles are more suffer from underweight (Table 2).

Decomposition Analysis

The decomposition analysis revealed that about 49% of the overall percentage change underweight was due to differences in characteristics or endowments (compositional factors). Regarding the overall decrease in underweight between 2005 and 2016 attributable to the changes in characteristics, the most important explanatory variables that provide significant contribution were duration of breastfeeding, birth size, age of a child, husband/partner education, and presence of diarrhea between 2005 and 2016.

The result indicated that the husband/partner primary education decreases, the contribution of change in characteristics accounts for 5% point rise in underweight. It implies that education is the need to be a prior agenda to reduce the risk of underweight and other related morbidity and mortality among children.

Household wealth quantile of household accounts both the compositional increment and decrement of underweight in the last decades. Besides the duration of breastfeeding reveals a 7% decline of underweight in the last ten years among under-five children, while a number of a child whose birth size (average above) decreases, it leads to contribute 6% point rise in underweight over the last decades among under-five children.

Another contributor for compositional change of underweight was the presence of diarrhea and age increment of a child in months which accounts for 3% and 24% point increment of underweight over the last decades' table 4 and table 2 respectively. Although the overall decline of underweight due to coefficients/effects were 51%, the contribution of explanatory variables varies substantially from variable to variable and according to categories of within variables (Table 4).

Regarding the overall decline in underweight between 2005 and 2016 attributable to the changes in coefficients were duration of breastfeeding (still breastfed), women's occupation and household wealth quantile accounting for 78%, 22%, and 18% respectively. Further, the interaction effects are significant which means that other unknown explanatory variables lead to the decline of underweight (Table 4).

Discussion

Levels and trends in malnourishment among children in any community are determined by a huge number of aspects related to infant and young child care and nutrition, adequacy and effectiveness of health interventions, promotion of newborn care and the continuum of child care services, public nutrition to safeguard a healthy, hygienic, caring, and nutritionally secure setting; and strengthening of counseling to reach the critical age groups, including pregnant and lactating mothers(Mshida et al., 2018).

Despite there are many nutritional challenges in Ethiopia, it experiences extraordinary progress in reducing the prevalence of underweight in the last decades. This study aimed to determine trends and major compositional factors contributing to the change in underweight among under-five children in Ethiopia in the last decades.

In the past ten years, we perceive a better decline in underweight among under-five children in Ethiopia, due to the great efforts government to aware the public related to the care of their child, feeding practice, environmental sanitation and enhancements of education(Kennedy et al., 2015, Lamstein et al., 2016).

Ethiopia is one of the sub-Saharan countries which try to do on the advancement of child and maternal wellbeing with demanding efforts on multicenter Nutritional programs of government and non-governmental organization (NGO) linking with agriculture and nutrition to reduce high level maternal and Infant mortality (Kennedy et al., 2015, Kennedy et al., 2016, Hodge et al., 2015).

From the descriptive result, we perceive that having higher birth order and child age increases, the prevalence of underweight rises in line with a study(YADAV et al., 2016).

The finding of this study indicates that rural residents(Table 2) indicate a better decline of underweight than urban over the last decades in line with a study conducted in India(Srivastava, 2019). This might be government commitment to the awareness of the community related to child health, feeding practice, child care and establishment of health infrastructure.

The result of decomposition analysis suggests that difference in characteristics (endowments) accounts for the decline of underweight were 49% lower than studies conducted in Nepal and Malawi(Mussa, 2014,

Cunningham et al., 2017). This implies that a significant change in underweight arises due to the compositional change of the population with important variables.

Household wealth quantile (middle) contributed to the compositional rise of underweight, while richer contributes to the compositional decline of underweight in line with studies conducted in Vietnam and India (Kien et al., 2016, Srivastava, 2019, Mussa, 2014). This is known to be poor households often difficult to access food, and inadequate resource for care and unable to utilize the creation of sustainable health settings for their children (Akombi et al., 2017b, Prakash and Jain, 2016).

Also, age of child increased, the risk of deteriorating underweight were increased in line with studies (Abdollah ALMASIAN KIA 2019, CHAO, 2017, Kien et al., 2016, Srivastava, 2019). A child who had diarrhea recently increases underweight status by 3% point Table 4 in line with a study(CHAO, 2017), implies that childhood diarrhea suppresses the immunities, removes fluids from their body leads to weight loss and exposure to certain disease morbidity and mortality.

Further size of child at birth, average above leads to the decline of underweight by 6% point Table 4 in line with

A child who born from normal BMI of mothers have 12% point decline of underweight (Table 2) than others in line with a study (Mittal et al., 2007), implies that a child can get adequate fetal nutrients and energy from their mothers in their gestational period helping for increasing his body and immunity building.

Husband/partner education contributes 8% point (Table 4) decline in underweight among under-five children in line with a study (Mukabutera et al., 2016), implies that parents' education leads better influence on the health of child, greater decision power on the improvements of child health in the household and better financial resource to care and feed children.

Even though the number of population who still breastfed decreases from time to time, it contributes to the reduction of underweight by 9% (Table 4) and (Table 2) which implies that breast milk contributes to safeguarding suitable nutritional status, appropriate growth and develop disease prevention immunity in child body(Khan and Islam, 2017, Field, 2005). Also, breast milk substantively reduces the risk of morbidity and mortality from infectious disease by eliminating the chance of contamination formula milk or other fluids and foods(Lamberti et al., 2011, Field, 2005).

The strength of this study was the analysis based on the national representative sample to ensure adequate generalizability of the study findings. The data employed were collected using a consistent standardized questioner, which provides an important source of information on underweight and nutritional status as well. The analysis technique used to facilitate the proportion of change in underweight over time into components attributable to changing socioeconomic and demographic characteristics of the population and change in underweight and the calculations were based on weight

for the sampling probabilities and nonresponse. Further analytical techniques such as decomposition analysis were applied to recognize the source of change in underweight.

This study tries to highlight important findings to support nutritional programs in Ethiopia, but it is not without limitations, which may affect our conclusion.

Limitations of the study

The possible limitation of the study might be due to the data is collected cross-sectional, this could make the data prone to recall and social desirability bias.

Conclusion

Underweight among under-five children show a remarkable decline over the last decades in Ethiopia. Almost half of the overall change in underweight among under-five children over the decade was due to the difference in characteristics between 2005 and 2016. Change in composition of Birth size, duration of breastfeeding (still breastfed), household wealth quantile (richer) and husband/partner primary education are attributable to the decline of underweight.

Almost half of the decline in underweight was due to the change in the behavior of the population. Mainly the decline was due to change in the duration of still breastfeeding, change in occupation status of women and change in household wealth quantiles over time.

Strengthening nutritional interventions, including infant feeding education, ensure the quality of health service, encourage multicenter nutritional interventions and reduce the prevalence of diarrhea to ensure the decline of underweight in Ethiopia. It is mandatory to continue to educate the population, as education is one of the major contributors to the decline of underweight in Ethiopia. Besides, the government and any concerned body could better focus on the enhancement of household economic status. Further research is needed for successful program implementation and to identify the root cause dynamic for behavior and situations targeted for the change.

Abbreviations

AIDS: acquired immunodeficiency syndrome; ANC: antenatal care; BMI: Body mass index's: central statistical agency; DBF: duration of breastfeeding; EAs: enumeration areas; EDHS: Ethiopia Demographic and Health Survey; EPHC: Ethiopian Population and Housing Census; HIV: human immunodeficiency virus; MOH: Ministry of Health; NGO: non-governmental organizations: southern nations, nationalities, and people's region; WHO: World Health Organization

Declarations

Consent for publication:

Not applicable

Availability of data and material

The data sets used and/or analyzed during the current study are available in the Ethiopian statistical agency and ministry of health

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Ethical approval and consent to participate data

The authors have submitted the proposed title and the aim of the paper to the online EDHS website to download and use the data for this study. The EDHS programs authorized data access, and data were used in the current study. The data is available at https://dhsprogram.com/Data/terms-of-use.cfm

Conflict of interest

The author(s) declared no conflict of interest concerning the research, authorship and/or publication of this manuscript.

Authors' contribution statement

DA conceptualizes and designed the study title and drafted out the statistical models for this manuscript as well as critically reviewed and revised the design of the manuscript. TY carried out the statistical analysis, primarily manuscript writing and drafting. Both authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work

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Tables

Table 1. Percentage distribution of socio-demographic characteristics among respondents, 2005, 2011 and 2016 EDHS

Characteristics		2005 N = 8,123	2011 N = 9, 496	2016 N = 8, 755
Stunting status	Stanted	47.41	43.77	38.48
	Not stanted	52.59	56.23	61.52
Underweight status	Under weight	39.19	28.93	23.58
	Normal	60.81	71.07	76.43
Age of respondents	15-24	25.10	6.21	22.28
	25-34	49.09	52.10	53.26
	35+	25.82	23.66	24.46
Region	Tigray	6.15	6.72	6.63
	Afar	0.82	1.05	1.03
	Amhara	24.09	20.73	19.51
	Oromia	40.15	44.24	43.59
	Somali	3.56	2.65	4.30
	Benishangul-Gumuz	0.80	1.06	1.06
	SNNPR	22.37	21.02	20.83
	Gambela	0.26	0.32	0.24
	Harari	0.18	0.21	0.20
	Addis-Abeba	1.26	1.69	2.24
	Dire-Dawa	0.35	0.31	0.39
Religion	Orthodox	42.49	37.66	34.78
	Protestant	20.65	24.81	22.02
	Muslim	34.26	36.04	40.83
	Catholic	1.16	0.96	0.97
	Traditional	1.45	1.04	1.41
Partners Educational status	None	57.50	49.54	47.89
	Primary	31.35	42.67	40.20
	Secondary& above	11.12	7.79	11.89
Respondents Educational status	None	79.00	68.87	65.52
	Primary	16.78	27.68	27.57
	Secondary+	4.22	3.45	6.91
Wealth index	Poorest	21.23	22.62	23.25
	Poorer	21.06	22.57	23.13
	Middle	22.60	20.69	21.00
	Richer	20.10	19.64	18.37
	Richest	15.01	14.50	14.25
Residence	Rural	92.89	87.94	89.05
	Urban	7.11	12.06	10.95
Sex of child	Female	49.00	47.74	48.01
	Male	51.00	52.26	51.99
Ever had Vaccination	Yes	61.28	76.14	65.63
	No	38.72	23.86	34.37
Place of delivery	Home	94.74	90.36	73.33
	H institution	5.26	9.64	26.67
Duration of breastfeeding	Ever breastfed Not know	50.11	52.38	51.30
	Never breastfed	4.27	3.64	5.25

	Still breastfed	45.61	43.95	43.45
Size of a child at Birth	Average & above	72.30	71.12	74.00
	Below average	27.70	28.88	26.00
Had diarrhea Recently	Yes	18.57	13.73	11.67
	No	81.43	86.27	88.33
Received Vitamin A	Yes	45.93	52.38	35.76
	No	45.93	47.62	64.24
Birth order	1	17.21	18.65	18.70
	2	15.37	17.16	16.51
	3	14.41	14.17	13.95
	4	12.85	12.53	12.32
	5	10.56	10.53	11.21
	6+	29.62	26.96	27.30
Last birth a cesarean section	Yes	0.96	1.18	1.83
	No	99.04	98.82	98.17
Anemic level of respondents	Anemic	29.47	18.54	30.16
	Non-anemic	70.53	81.46	69.83
No of antenatal visits for Pregnancy	0	70.53	57.28	35.98
	1	4.98	4.27	4.40
	2	4.87	6.74	8.27
	3	6.76	12.61	19.30
	4	12.56	19.11	32.06
Body mass index of respondents (BMI)	<18.51	19.70	21.83	19.83
	18.52-24.99	76.91	73.66	74.29
	25.00 – 29.99	3.39	4.51	5.87
Husband/partner occupational status	Working	99.33	98.03	89.28
	Not working	0.67	1.97	10.72
Women occupational status	Working	29.18	53.54	43.52
	Not working	70.82	46.46	56.48

Table 2: Trends in underweight among under-five children from 2005, 2011 and 2016 EDHS.

Characteristics	2005 N= 8,123	2011 N= 9,496	2016 N= 8,755	Percentage point difference in underweight		
				Phase I 2011-2005	Phase II 2016-2011	Phase III 2016-2005
Age of women						
15 -24	8.37	6.66	5.14	-1.71	-1.52	-3.23
25- 34	19.33	15.53	12.30	-3.80	-3.23	-7.03
35+	11.49	6.74	6.12	-4.75	-0.64	-5.37
Region						
Tigray	3.03	2.40	1.62	-0.63	-0.78	-1.41
Afar	0.33	0.42	0.34	0.09	-0.08	0.01
Amhara	11.38	7.02	5.60	-4.36	-1.42	-5.78
Oromia	13.63	11.61	9.90	-2.02	-1.71	-3.73
Somali	1.70	0.84	1.18	-0.86	0.34	-0.52
Benishangul-Gumuz	0.43	0.32	0.36	-0.11	0.04	-0.07
SNNPR	8.28	6.02	4.28	-2.26	-1.74	-4.00
Gambela	0.071	0.064	0.04	-0.007	-0.024	-0.03
Harari	0.061	0.044	0.04	-0.017	-0.004	-0.02
Addis-Abeba	0.17	0.11	0.12	-0.06	0.01	-0.05
Dirie-Dawa	1.00	0.09	0.11	-0.91	0.02	-0.89
Religion						
Orthodox	17.54	11.07	8.38	-6.47	-2.69	-9.16
Protestant	8.20	6.04	4.70	-2.16	-1.34	-3.50
Muslim	12.44	11.19	9.90	-1.25	-1.29	-2.54
Catholic	0.52	0.33	0.22	-0.19	-0.11	-0.30
Traditional	0.48	0.30	0.38	-0.18	0.08	-0.10
Husband/partner educational status						
None	24.02	16.32	13.24	-7.70	-3.08	-10.78
Primary	12.30	11.58	8.38	-0.72	-3.20	-3.62
Secondary+	2.92	1.08	1.83	-1.84	-1.09	-1.09
Women educational status						
None	32.59	21.53	17.62	-11.06	-3.91	-14.97
Primary	5.93	7.07	5.11	1.14	-1.96	-0.82
Secondary+	0.66	0.34	0.85	-0.32	0.51	0.19
Household Wealth quantile						
Poorest	9.52	8.08	7.11	-1.44	-0.97	-2.41
Poorer	9.11	7.52	6.33	-1.59	-1.19	-2.78
Middle	8.46	6.25	4.82	-2.21	-1.43	-3.64
Richer	7.56	5.04	3.11	-2.52	-1.93	-4.45
Richest	4.53	2.05	2.21	-2.48	0.16	-2.32
Residence						
Rural	34.70	27.13	21.95	-7.57	-5.18	-12.75
Urban	1.79	1.81	1.62	0.02	-0.19	-0.17
Sex of child						
Female	19.15	12.93	10.67	-6.22	-2.26	-8.48
Male	20.04	16.01	12.90	-4.03	-3.11	-7.14
Vaccination status						

Vaccinated	24.57	23.92	16.37	-0.65	-6.45	-8.20
Not vaccinated	14.41	5.74	6.56	-8.67	0.82	-7.85
Place of Delivery						
Home	38.23	27.64	18.88	-10.59	-8.76	-19.35
H institution	0.96	1.29	4.69	0.33	3.40	3.73
Duration of Breast Feeding						
Ever BF NK	19.58	15.37	12.58	-4.21	-2.79	-7.00
Never breastfed	0.56	0.37	1.06	-0.19	0.69	0.50
Still breastfed	19.05	13.19	9.93	-5.86	-3.26	-9.12
Size of a child at birth						
Average+	25.56	17.85	15.55	-7.71	-2.30	-10.01
Below average	13.63	11.08	8.02	-2.55	-3.06	-5.61
Had diarrhea						
Yes	8.79	4.89	3.43	-3.90	-1.46	-5.36
No	30.39	24.05	20.15	-6.34	-3.90	-10.24
Receive Vitamin A						
Yes	20.22	15.43	7.11	-4.79	-8.32	-13.11
No	18.96	13.51	13.96	-5.45	0.45	-5.00
Birth order						
1	5.28	5.23	3.82	-0.05	-1.41	-1.46
2	5.21	4.44	3.71	-0.77	-0.73	-1.50
3	5.56	4.41	3.11	-1.15	-1.30	-2.45
4	5.73	3.96	3.17	-1.77	-0.79	-2.56
5	4.23	3.16	2.86	-1.07	-0.30	-2.56
6+	13.17	7.74	6.91	-5.43	-0.83	-6.26
Last birth Caesarian delivery						
Yes	0.08	0.19	0.28	0.11	0.09	0.03
No	39.11	28.75	23.30	-10.36	-5.45	-15.81
Anemic level women						
Anemic	10.95	5.62	7.56	-5.33	1.94	-3.36
Non-anemic	28.23	23.31	16.02	-4.92	-7.29	-12.21
Number of ANC visit						
0	28.07	18.78	8.83	-9.29	-9.95	-19.24
1	1.19	1.28	1.25	0.09	-0.03	0.06
2	2.31	1.65	1.69	-0.66	0.04	-0.62
3	2.72	2.74	4.26	0.02	1.52	1.54
4+	3.65	3.61	5.80	-0.04	2.19	2.15
BMI of women						
<18.51	9.79	8.61	5.81	-1.18	-2.80	-3.98
18.52-24.99	28.6	19.77	17.07	-8.83	-2.70	-11.53
25.00 – 29.99	0.79	0.55	0.69	-0.24	0.14	0.14
Husband/partner occupational status						
Working	38.91	28.79	21.81	-10.12	-6.98	-17.10
Not working	0.17	0.19	1.79	0.02	1.60	1.62
Women occupational status						
Working	12.96	15.50	10.14	2.54	-5.36	-2.82
Not working	26.08	13.44	13.53	-12.64	0.09	-12.55

Table 3: Decomposition Results, High outcome group: Year==1 --- Low outcome group: Year==0

Weight	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]		Pct.
E	-.066812	.018298	-3.65	0.000	-.10268	-.030949	49.407
C	-.068416	.026949	-2.54	0.011	-.12124	-.015596	50.593
R	-.13523	.019028	-7.11	0.000	-.17252	-.097933	

E = difference due to characteristics, C = Difference due to coefficients, R= interaction effect

Table 4: Decomposition of change in underweight among under five children in Ethiopia, 2005 to 2016.

Characteristics		Difference due to characteristics (E)		Difference due to coefficients (C)	
		Coefficient	Percent	Coefficient	Percent
Religion					
Orthodox		-0.005411	4.0013	0.096129	--71.086
Protestant		-0.000567	0.41962	0.0061505	-4.5482
Muslim		0.0018214	-1.3469	0.04693	-34.704
Catholic		0.0072023	-5.326	0.064639	-47.800
Traditional		0		0	
Husband/partner education					
None		0		0	
Primary		-0.0071065**	5.2552	-0.017688	13.08
Secondary+		5.7985e-06	-0.004288	-0.0073215	5.4141
Women education					
None		0		0	
Primary		-0.0037465	2.7705	0.0031405	-2.3224
Secondary+		0.00005682	-0.042017	0.005139	-3.8002
Household Wealth quantile					
Poorest		0		0	
Poorer		-0.00078912	0.58355	-0.0012841	0.94959
Middle		-0.0020619**	1.5248	-0.0078745	5.8231
Richer		0.00181**	-1.3385	-0.025571**	18.909
Richest		-0.00013995	0.10349	0.010037	-7.4226
Residence					
Urban		0			
Rural		0.0048936	-3.6188	0.080052	-59.198
Sex of child					
Female		-0.000013212	0.00977	0.0027523	-2.0353
Male		0		0	
Vaccination status					
Vaccinated		0.0021136	-1.563	0.032825	-24.274
Not vaccinated		0		0	
Place of Delivery					
Home		0		0	
H institution		0.0047285	-3.4967	0.0050736	-3.7518
Duration of Breast Feeding					
Ever BF NK		0		0	
Never breastfed		0.00073015**	-0.53994	0.0025929	-1.9174
Still breastfed		0.0085641**	-6.333	-0.10489**	77.565
Size of a child at Birth					
Average+		-0.0058641**	4.3364	-0.010196	7.5401
Below average		0		0	
Had diarrhea					
Yes		-0.0038854**	2.8732	0.0089951	-6.6518
No		0		0	

Birth Order					
1		0		0	
2		-0.00005458	0.040361	-0.0044615	3.2993
3		-0.00018578	0.13738	-0.0082935	6.1329
4		-0.00038909	0.28773	0.0031684	-2.343
5		0.0011154	-0.82482	0.0057435	-4.2472
6		-0.000097529	0.072122	0.0025552	-1.8895
Anemic level					
Anemic		0		0	
Non-anemic		0.0002389	-.17666	0.001845	-1.3643
Number of ANC visit					
0		0		0	
1		0.00036642	-0.27096	0.005937	-4.3903
2		-0.00070516	0.52146	-0.0040238	2.9756
3		0.00094316	-0.69746	-0.00021473	0.15879
4+		-0.0028434	2.1027	-0.0023055	1.7049
Childs age in Month		-0.031992**	23.658	-0.03431	25.372
husband occupation status					
Not working		0		0	
Working		0.0012066	-0.89228	-0.07054	52.163
Women occupation status					
Not working		0		0	
Working		-.0027145	2.0073	-0.028699**	21.222
Constant					-0.12445 92.028

** Significant at 0.05

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