

Determinants of full immunization among children aged 12-23 months in Ethiopia. Further analysis of the 2016 Ethiopian Demographic and Health Survey Data.

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Abstract

Background: Immunization program has become the most effective public health measure for the controlling of vaccine-preventable disease among children. Globally, immunization coverage is increasing, however, 19.4 million infants not vaccinated in 2015. Ethiopia is one of the Sub-Saharan African countries with a high number of children unimmunized. Although there are studies about immunization among children, there is a dearth of information about factors associated with full immunization. Therefore, this analysis was performed to identify factors associated with full immunization among children aged 12-23 months in Ethiopia.

Methods : The analysis was done based on the 2016 Ethiopian Demography and Health Survey data. The 2016 Ethiopian Demography and Health Survey was a community based, cross-sectional study conducted from January 18, 2016, to June 27, 2016. The survey used a two-stage stratified random sampling technique. A total of 2004 children aged 12-23 months were included in the analysis. Both descriptive and logistic regression analyses were performed using STATA. A P-value less than or equal to 0.05 at 95% confidence interval was set to test statistical significance.

Result: Fully immunization coverage among children was 38.6%. Born at a health facility, living in Dire Dewa city, source of information from the card, mothers' educational level (primary and secondary plus), and marital status (married and formerly married) were found positively associated with full immunization. On the other hand, smoking history of mothers and living in Afar, Amhara, Somalia, Gambella, and Oromia regions were negatively associated with full immunization.

Conclusion: Fully immunization coverage among children was low. Children who were born at a health facility, source of information from the card, living Dire Dewa city, and whose mothers' literate and married had higher Odds of being fully immunized. On the other hand, children whose mothers' had a history of smoking and living Afar, Somalia, Gambella, Amhara and Oromia regions were had lower Odds of being fully immunized. Therefore strengthening institutional delivery and keeping immunization cards should be strengthened, and more emphasis should be given to children whose mothers' illiterate, never married, smoker and living in Afar, Amhara, Somali, Gambella, and Oromia regions.

Background

Globally, child survival is increasing but still remains a public health problem. According to the United Nations Children's Fund (UNICEF) 2016 report, 6 million children were died globally, before reaching their fifth birthday, of which 50% death was contributed by Sub-Sahara(1). Almost one-third of global and 40% of Sub-Saharan Africa under-five deaths is due to Pneumonia, diarrhea, and malaria(1).

Immunization has become the most effective public health measure for controlling the vaccine-preventable disease. It can avert 2 to 3 million children deaths annually(2, 3). Globally, immunization coverage is increasing. As a result, the annual number of child deaths fell from 10 million in 2000 to 6 million in 2015. However, an estimated 19.4 million infants worldwide missed out on basic vaccines in

2015. About two-thirds of children none-immunized living in Ethiopia, Angola, India, Indonesia, Iraq, Nigeria, Pakistan, Philippines, Ukraine and the Democratic Republic Congo (1, 4).

Barriers for full immunization coverage have been identified as, household Wealth index (5, 6), mother's occupation (6, 7), Educational status of mothers(5, 8), History of antenatal care(ANC) and place of delivery(8). According to Andersen behavioral health model, external environment (region, residence), predisposing characteristics such as demographics (child's sex, family size, marital status, mother's age, birth order), social structure (parent's education and occupations), and health belief (mother's exposed to media and tobacco use history) and enabling resource (ANC, postnatal care (PNC), place of delivery, distance to health facility, decider of mothers) were factors affecting fully immunization of children (9).

In Ethiopia, the vaccine-preventable disease accounts for a large proportion of under-five deaths. About 52% of under-five deaths contributed by pneumonia (28%), diarrhea (20%), and measles (4%)(10). Ethiopia expanded program of immunization (EPI) was launched in 1980 with the goal of achieving 100% vaccination coverage for all under two years of age by the year 1990. However, in 1986 the target age group was changed to infants less than one year of age (11, 12). Currently, the minister of health has planned to achieve at least 90% national coverage and 80% in every district with all vaccines by 2020 (13). The government of Ethiopia has made encouraging promotion, prevention, and health service utilization by introducing health extension workers (HEWs) at the community level in 2005(14). However, surveys in Ethiopia reported that full immunization coverage among children below one year was low (15, 16). But studies to identify determinants of full immunization coverage at national level are limited. Therefore, this analysis was done to identify factors associated with full immunization coverage among children aged 12–23 months in Ethiopia.

Methods

Data source

This analysis was based on the 2016 EDHS data. Ethiopia is administratively structured into nine regional states and two city administrations. EDHS was a cross-sectional community-based survey conducted from January 18, 2016, to June 27, 2016. The survey was implemented by the Central Statistical Agency (CSA) at the request of the Federal Minister of Health (HMOH).

The 2016 EDHS used a two-stage stratified cluster sampling technique to ensure representativeness at the national and regional levels. Initially, each region was stratified into urban and rural areas yielding 21 sampling strata. Each stratum was subdivided into enumeration areas. After stratification, a total of 645 enumeration areas (202 in urban areas and 443 in rural areas) were selected with probability proportional to enumeration area size based on the 2007 Ethiopia population and housing census. A household listing operation was carried out in all the selected enumeration areas from September to December 2015. Then, 28 households from each cluster were selected using a systematic random sampling technique from the household listing.

Mothers were asked to provide information about the immunization status of their children. The data about immunization was obtained in three ways: Written vaccination records (including the infant immunization card and other health cards), mothers' verbal reports and health facility records. Consent was obtained from mothers prior to contacting the facilities and verifying child vaccination records (15). The analysis was restricted to age 12–23 months. Therefore 2004 children aged 12–23 months were included in this analysis.

Measurements

Outcome variable

The outcome variable full immunization obtained by re-coded of each basic vaccine (one dose of BCG, three doses of Penta-valent (DPT-Heb-Hib), three doses of polio (excluding polio zero) and one dose of measles vaccine) in to "0" and "1". Vaccination date on the card, reported by mother, and vaccination marked on card response categories coded as "1" (received vaccine) and don't know, and no response categories coded as "0" (not received the vaccine). Then added all received and not received scores and labeled as immunization status. The immunization status again coded as "1" if the child had received all doses of vaccinations (one dose of BCG, three doses of Penta-valent (DPT-Heb-Hib), three doses of polio (excluding polio zero) and one dose of measles vaccine) and categorized as fully immunized and "0" if the child had missed one or more doses and don't know immunization status and categorized as not fully immunized.

Independent variables

Residence, region, parent's characteristics(age of mother, education status of mother's and father's, occupation of mother's and father's, mother's smoking history and marital status), family size, household has radio and or television, number of living children, wealth index, place of delivery, ANC, PNC, mother's received tetanus toxoid (TT), distance to a nearby health facility, decision-maker about mother's own health cares, number under-five children, sex of children, birth order, source of information about immunization history, and perceived size at birth were independent variables included in the analysis.

Statistical analysis

The analysis was done using STATA software V.14. The data were weighted to adjust for over-sampling or under-sampling and non-response. Descriptive statistics were calculated for all variables. Correlation between independent variables was checked before fitting the final regression model. When two independent variables were found correlated, one was dropped. Multivariable logistic regression analysis was used to identify factors associated with full immunization among children aged 12–23 months. In addition, complex survey analysis techniques were employed when computing Odds ratios since DHS

used a two-stage stratified sampling technique. Odds ratios (AOR) with their 95% CI were calculated to measure the strength of association, and P-value < 0.05 was considered as statistically significant.

Results

Socio-demographic and other characteristics of mothers and children

The analysis included a total of 2004 children aged 12–23 months. The majority of children living in a rural setting (88.4%), female (53.8%), born at home (63.4%), second up to fifth birth order (53.0%), and born to mothers with no educational level (62.7%). More than half (54.3%) of children born to mothers with had no work. About 1% of children born to mothers with had a smoking history, and 29.7% of children born to households have radio and or television. Almost, three-fifth (59.9%) of children's mothers were reported as the distance to a nearby health facility was a big problem. About 90.7% of children were from four regions (Oromia (44.0%), South nation and nationality people of region (SNNPR) (20.9%), Amhara(18.2%), and Tigray(7.6%)) and the rest(9.3%) from tow city administrations (Addis Ababa(2.6%) and Dire Dawa(0.5%)) and five regions (Afar(1%), Somali(3.7%), Benshangul Gumz(1%), Gambella(0.3%) and Harari(0.2%)). Mothers' self-report was the major source (65.9%) for children immunization history and the rest was children cards. About, 44.9% of children their households' wealth index was poor and the rest 22.5% and 32.6% were middle and rich wealth index category respectively. The majority of children, 94.7% their mothers were married. And about, 4.5% and 0.8% were formerly married, and never married respectively (table1).

Table1. Socio-demographic and other characteristics of mothers and children in Ethiopia, EDHS 2016

Variables	Categories	Frequency n (%)
Age of mother's	15-24	499(24.9)
	25-34	1052(52.5)
	35-49	453(22.6)
Family size of a household	1-5	913(45.6)
	>6	1091(54.4)
The religion of the mother's	Orthodox	697(34.8)
	Muslim	786(39.2)
	Other	521(26.0)
Mother's Educational	No education	1257(62.7)
	Primary	577(28.8)
	Secondary	170(8.5)
Decision-maker for mother's own health cares	Mother	326(17.9)
	Mother with husband	1139(62.6)
	Husband	349(19.2)
	others	5(0.3)
Husband's education	No education	899(47.4)
	Primary education	746(39.3)
	Secondary	247(12.9)
	Don't know	7(0.4)
Husband's occupation	No	158(8.4)
	Has	1725(90.9)
	Don't know	14(0.7)
ANC follow up	No	712(37.4)
	1-3	561(29.4)
	>4	632(33.2)
TT vaccination status	Null	838(44.0)
	One	236(12.4)
	Two and above	796(41.8)
	Don't know	35(1.8)
At least one PNC visits	No	1750(91.8)
	Yes	155(8.2)
Birth order	First	372(18.6)
	2-5	1063(53.0)
	>5	569(28.4)
Number of under-five children	0	38(1.9)
	1-3	1932(96.4)
	>4	34(1.7)
Number of living children	1-4	1335(66.6)
	≥5	669(33.4)
The perceived size of children at birth	Small	673(33.6)
	Average	769(38.4)
	Large	538(26.8)
	Don't know	24(1.2)

Fully immunization coverage by regions.

The majority of children living in Addis Ababa (89.2%), Dire Dewa (75.9%) and Tigray (67.3%) region were fully immunized. On the other hand, only 15.2% of children living in the Afar region were fully immunized (figure1).

Figure1. Full immunization coverage by region among children age 12–23 months in Ethiopia, EDHS 2016.

Fully immunization coverage by socio-demographic and other characteristics

Many children whose mothers had work (44.3%), religion orthodox (50.8%), a secondary plus education (70.5%) and who were urban residents (64.6%) were fully immunized. About 48.2% of children whose mothers perceived the distance to a nearby health facility, not a big problem were fully immunized (table2).

Table2. Full immunization coverage among children aged 12-23 months by socio-demographic characteristics of mothers, in Ethiopia, EDHS 2016.

Variables	Category	Fully immunization (%)
Residence	Urban	64.6
	Rural	35.2
Age of mother's	15-24	38.0
	25-34	40.2
	35-49	35.8
Marital status	Never married	21.7
	Married	39.3
	Formerly married	28.8
Mother's occupation	No	33.9
	has	44.3
House hold's wealth index	Poor	29.2
	Middle	37.1
	Rich	52.7
Family size	1-5	45.0
	≥6	33.3
Mother's Religion	Orthodox	50.8
	Muslim	26.5
	Other	40.7
Mother's education	No education	30.9
	Primary	46.1
	Secondary	70.5
A household has a radio and or television	No	35.3
	yes	46.5
Decision maker for mother's own health cares	Mother	41.8
	Mother with husband	40.2
	Husband	33.3
	others	95.1
Husband's education	No education	31.5
	Primary education	41.8
	Secondary	60.7
	Don't know	10.7
Mother's history of tobacco use	no	39.0
	yes	5.0
Distance to a nearby health facility	Big problem	32.3
	Not a big problem	48.2
Husband's occupation	No	23.5
	Has	40.8
	Don't know	29.4

Full immunization coverage by maternal characteristics

The majority of children whose mothers had four and above antenatal follow-ups (59.6%), received two and above tetanus toxoid vaccine (50.8%), and had at least one postnatal follow up (63.4%) were fully immunized. Most numbers of children who were the first birth order (46.8%), and born at a health facility (54.4%) were fully immunized (table3).

Table3. Full immunization coverage among children aged 12-23 months by maternal characteristics, in Ethiopia, 2016 EDHS.

Variables	Categories	Fully immunization %
ANC follow up	No	18.6
	1-3	40.7
	>4	59.6
TT vaccination	Null	26.0
	One	44.4
	Two and above	50.8
	Don't know	34.4
	At least one PNC visit	No
	Yes	63.4
Birth order	First	46.8
	2-5	40.4
	>5	30.0
Number of under-five children	0	57.5
	1-3	38.3
	≥4	35.6
Place of delivery	Home	29.5
	health facilities	54.5
Number of living children	1-4	43.4
	≥5	29.2
Sex of child	Male	36.5
	female	40.5
The perceived size of children at birth	Small	36.8
	Average	43.0
	Large	35.9
	Don't know	11.8
Source of information about vaccine history	Mother self-report	30.3
	card	54.8

Basic and Full immunization coverage

Of the total children aged 12–23 months, only 774(38.6%) were received all basic vaccines (95%CI: 34.6–42.9). The least utilized vaccine was Penta-valent (53.2%) (figure2).

Figure2. Basic and full immunization coverage among children aged 12–23 months in Ethiopia, EDHS 2016.

Factors associated with full immunization among children aged 12–23 months.

On bi-variable analysis, residence, region, distance to a nearby health facility, marital status, birth order, and number of under-five children, source of information for immunization history, place of delivery,

family size, and household has radio and or television, and mothers' education, religion, smoking history, and occupational status were associated with full immunization. On multivariable analysis region, marital status, source of information for immunization status, mothers' education and smoking history were significantly associated with full immunization among children aged 12–23 months. Children whose mothers married were 5.6 times higher to being fully immunized compared to children whose mothers never married (AOR = 5.60, 95%CI: 1.46, 10.91). The Odds of full immunization among children whose mothers' educational status secondary and above level was 2.67 times higher compared to children whose mothers with no educational level (AOR = 2.67, 95%CI: 1.11, 6.41) (table4).

Table4. Factors associated with full immunization among children aged 12-23 months in Ethiopia, EDHS 2016.

Variables	Categories	COR	95%CI	AOR	95%CI
Residence	Urban	1			
	Rural	0.3	0.17, 0.54	1.28	0.56, 2.93
Region	Tigray	1		1	
	Afar	0.09	0.04, 0.20	0.18	0.07, 0.47*
	Amhara	0.42	0.24, 0.75	0.54	0.30, 0.99*
	Oromia	0.16	0.09, 0.27	0.27	0.14, 0.51*
	Somalia	0.14	0.07, 0.27	0.30	0.12, 0.72*
	Benshangul	0.66	0.37, 1.18	1.05	0.52, 2.10
	SNNPR	0.43	0.25, 0.74	0.60	0.32, 1.15
	Gambela	0.34	0.18, 0.67	0.35	0.16, 0.77*
	Harari	0.35	0.19, 0.67	0.42	0.19, 0.90*
	Addis Ababa	4.03	1.95, 8.33	2.29	0.84, 7.06
	Dire Dawa	1.53	0.76, 3.07	2.77	1.09, 7.06*
Distance to a nearby health facility	Big problem	1		1	
	Not big problem	1.95	1.46, 2.61	1.10	0.79, 1.53
Marital status	Never married	1		1	
	Married	2.33	0.79, 6.84	5.60	2.29, 13.67*
	Formerly married	1.46	0.42, 5.08	3.99	1.46, 10.91*
Mother's education	No education	1		1	
	Primary	1.91	1.42, 2.57	1.55	1.06, 2.25*
	Second	5.34	2.73, 10.40	2.67	1.11, 6.41*
Mother's occupation	Had no work	1		1	
	Has work	1.55	1.16, 2.08	1.18	0.85, 1.64
Mother's religion	Orthodox	1		1	
	Muslim	0.35	0.23, 0.53	0.80	0.48, 1.34
	others	0.66	0.43, 1.03	0.95	0.56, 1.64
Family size	1-5	1		1	
	≥6	0.61	0.46, 0.80	0.82	0.58, 1.64
Mother's smoking history	No	1		1	
	yes	0.08	0.02, 0.35	0.07	0.01, 0.39*
Place of birth	Home	1		1	
	Health facility	2.86	2.06, 3.96	1.65	1.13, 2.40*
A household has a radio and or television	no	1		1	
	yes	1.59	1.18, 2.15	1.13	0.76, 1.68
Birth order	First	1			
	1-5	0.77	0.55, 1.08	1.22	0.78, 1.90
	≥6	0.49	0.33, 0.72	1.10	0.65, 1.88
Number of under-five children	1	1		1	
		0.46	0.16, 1.34	0.67	0.22, 2.08
		0.41	0.09, 1.77	1.17	0.21, 6.45
Source of information about vaccine history	Mothers self-report	1		1	
	card	2.79	2.0, 3.89	1.81	1.25, 2.63*

*=statically significant at p-value ≤0.05.

Discussion

According to this analysis, full immunization among children aged 12–23 months was 38.6%, which was low compared to the national plan(13).

This analysis revealed that there was a significant regional difference in full immunization coverage in Ethiopia. Children who were living in Afar, Amhara, Somali, Gambella, and Oromia regions were less likely to complete the basic immunizations compared to children living in the Tigray region. Conversely, children who were living in Dire Dewa city administration were more likely to complete the basic immunizations compared to children living in Tigray region. The finding was in line with previous studies done in Ethiopia (17), Pakistan and Mozambique (5, 9, 18). The reason might be the lifestyle of people and the educational status of mothers. Most people living in Afar, Somali, Gambella, and Oromia regions are nomadic. Secondly the health service and infrastructure coverages are low in those regions.

Children whose mothers attained primary and secondary plus educational levels were more likely to fully immunization compared to children whose mothers with no educational level. The finding was in line with the studies done in Ethiopia (19), Senegal (8), Congo (20), Nigeria (21), Pakistan (5, 9), Philippines (22), Greece (23), and Lome (24). The reason might be literate women have better access to health care information from different sources and more aware of immunization benefits. Secondly, educated mothers have better communication skills and tend to better utilize the available service. Generally, literate mothers having a better knowledge of vaccine-preventable diseases and recognizing the benefits of immunization (5, 25–27).

The other finding in this study was that children born at a health facility had higher Odds of being fully immunized compared to children born at home. This finding was in line with the studies done in Zimbabwe(28) and Democratic Republic Congo(20). The reason might be women utilized institutional delivery service, be more confident in utilizing child immunization services. And also administrative of the BCG vaccine soon after childbirth and counseling at a health facility might have contributed to being knowledgeable on children's vaccination (20).

Marital status of mothers significantly associated with children's full immunization. The Odds of being fully immunized among children whose mothers married and formerly married were higher compared to children those mothers never married. This finding was in line with the study done in Lome (24). The reason might be married mothers might get supporting from their partners. On the other hand child from never-married mothers might be unplanned and in turn reducing childcare.

In this analysis, mothers' smoking history was significantly associated with children's fully immunization. Our study identified that maternal history of smoking was more likely to reduce childhood fully immunization. The reason might be a good relationship among providers and mothers is very important for adherence to vaccination service. However, smoking mothers might experience emotional and behavioral problems than non-smokers and in most instances they are rule-breakers. This might cause to drop the immunization services(29). Secondly, information and knowledge about immunization is an

important concern to use vaccines. However, health and information-seeking behavior among smokers is low (30).

This analysis also revealed that fully immunization was associated with a source of information about vaccination history. The use of vaccination cards as a source of data to assess children's immunization status was positively associated with receiving all the basic vaccination compared to mothers' self-report as a source of data. The finding was in line with other studies(17, 24).

The reason might be the mothers kept the immunization card indicates the attention they give to immunization or the awareness they had about immunization.

Conclusions

Fully immunization coverage among children was low compared to national and global plans. Place of delivery, region, mothers' educational level, source of information about immunization history, and mothers' smoking history, and marital status were significantly associated with children's fully immunization. Therefore, strengthening health facility delivery and keeping immunization cards may improve fully immunization among children. Furthermore, more emphasis should be given to children whose mothers illiterate, never married, and living in Afar, Amhara, Somali, Gambella, and Oromia regions.

Moreover, the concerned bodies should promote interventions targeting the predisposing and reinforcing behavioral factors affecting fully immunization of children.

Abbreviations

ANC-antenatal care

BCG- Bacillus Calmette-Guerin

DPT- diphtheria-tetanus-pertussis

EDHS-Ethiopian Demographic Health Survey

EPI- expanded program on immunization

Heb- Hepatitis Band

Hib- Haemophilus influenza type B

IPV- Inactivated Polio Virus

Pcv10-Pneumococcal

PNC- postnatal care

SNNP- Southern Nations Nationalities and Peoples

TT- tetanus toxoid

UNICEF- United Nations Children's Fund

Declarations

Ethical approval

The 2016 EDHS protocol was reviewed and approved by the Federal Democratic Republic of Ethiopia Ministry of Science and Technology and the Institutional Review Board of ICF international.

Consent for publication

Not applicable

Data Availability

The data for this analysis are available in the repository, (<https://dhsprogram.com/data>) upon permission from The DHS program.

Competing of interest

The author declares that they have no competing interests.

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Author contributions

MBA conceived, designed and performed the analysis: *GWD*, *DN*, and *GAF* were equally involved in the analysis, interpretation, and writing of the results.

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Figures

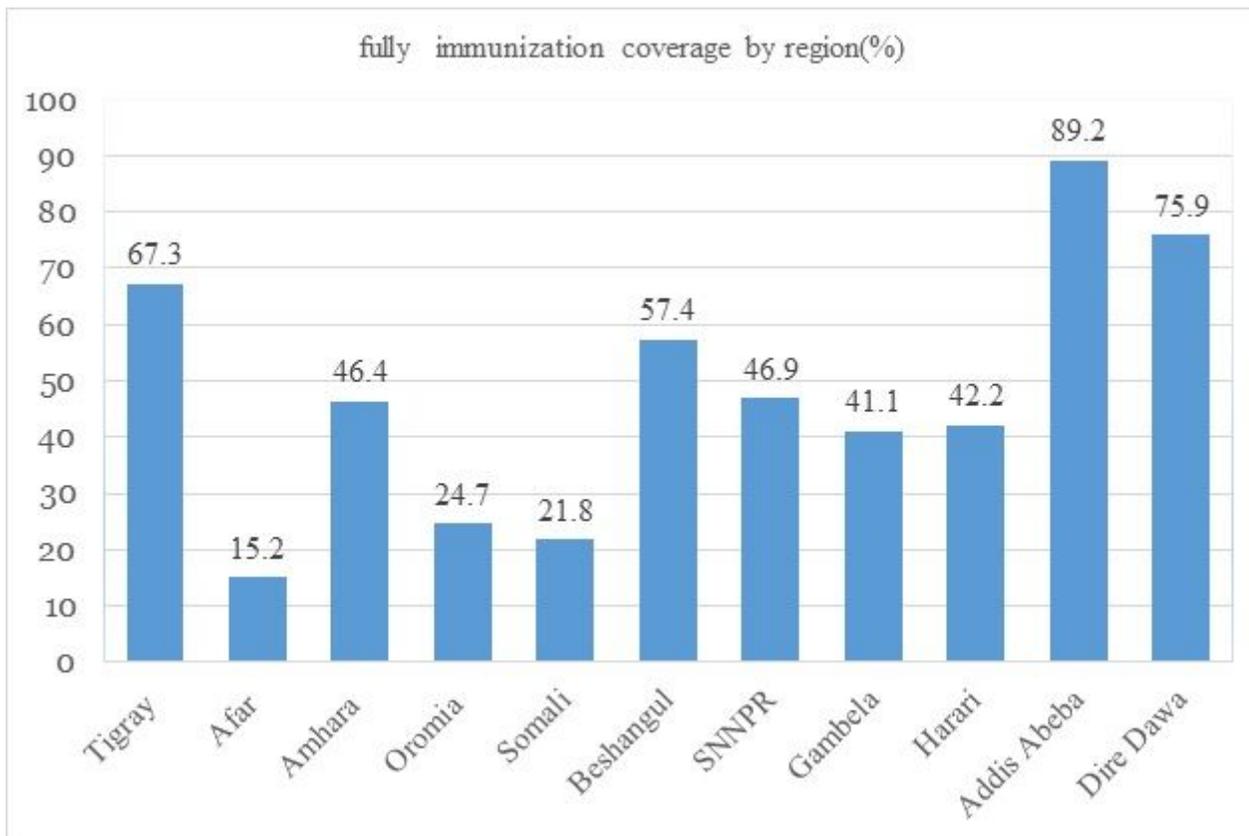


Figure 1

Full immunization coverage by region among children age 12-23 months in Ethiopia, EDHS 2016.

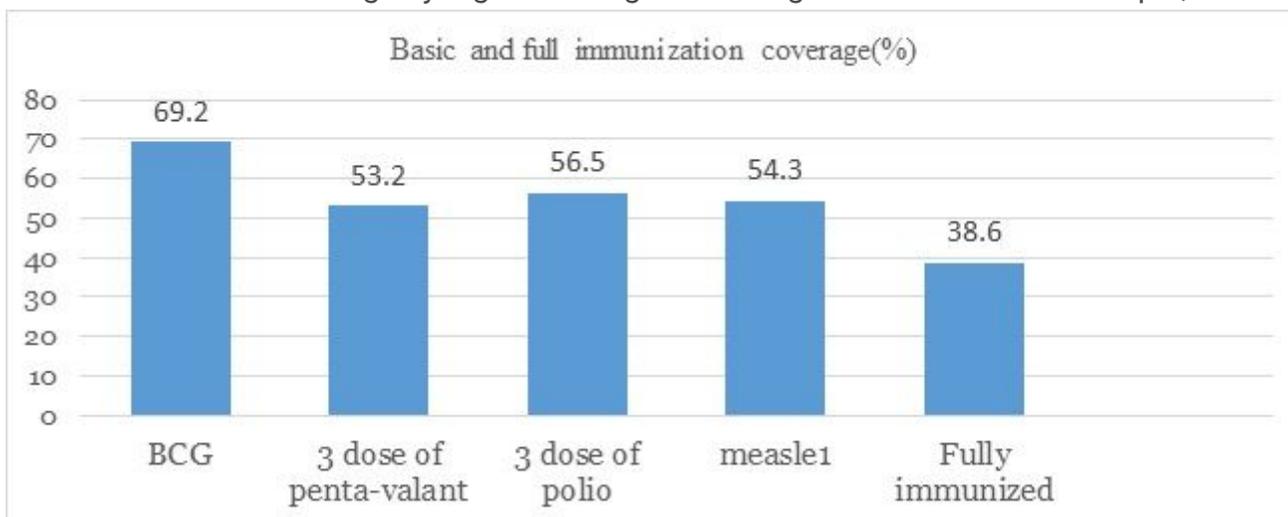


Figure 2

Basic and full immunization coverage among children aged 12-23 months in Ethiopia, EDHS 2016.