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# Immunization Incompletion among 12 - 23 Months Old Children and Associated Factors in Wayu-Tuka District, Western Ethiopia: A Community Based Study

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## Abstract

**Background:** Immunization is one of the most successful public health interventions to prevent child morbidity and mortality due to vaccine preventable infectious diseases. This study was aimed at assessing immunization incompletion status and associated factors among children aged 12 - 23 months in Wayu Tuka District, Western Ethiopia.

**Method:** A community based cross-sectional study was conducted among 436 mothers or caretakers with children aged 12-23 months old from June to September 2017. Cluster sampling technique was applied to select the study population. Data were collected using pretested structured questionnaire through house to house visits. The data were then entered in to EPI info version-7 statistical software and exported to SPSS version 20 for analysis. Bivariate and multivariable logistic regression analysis were used to assess the association between the selected independent variables and immunization incompletion status of the children.

**Results:** About 26% of the children didn't complete the recommended immunization. About 95% of the mothers or care takers knew that immunization prevents diseases such as pneumonia, diarrhea, and measles. This study revealed that a child was more likely to have incomplete immunization if he/she was delivered at home [AOR (95%CI) = 2.27 (1.37, 3.74)], the mother or care giver is illiterate [AOR (95%CI) = 2.29 (1.38, 3.78)], satisfaction from vaccination services is poor [AOR (95%CI) = 1.87 (1.13, 3.08)], there is fear of vaccines/side effects [AOR (95%CI) = 1.75 (1.06, 2.90)], No any ANC for this pregnancy [AOR (95%CI) = 2.13 (1.04, 4.36)], and no functional radio in the family [AOR (95%CI) = 2.36 (1.42, 3.93)].

**Conclusion:** There is a high proportion of immunization incompletion among children aged 12 - 23 months in the study area. Home delivery, maternal/care giver illiteracy, poor satisfaction from vaccination services, fear of vaccines/side effects, and no functional radio were significant predictors of immunization incompletion. Increasing awareness about the importance of vaccination, antenatal care follow-up, institutional delivery and improving the quality of service delivery at health facilities are recommended.

***Keywords:*** *Children Aged 12 - 23 Months; Community Based; Immunization Incompletion; Western Ethiopia*

## Abbreviations

AFP: Acute Flaccid Paralysis; ANC: Ante Natal Care; BCG: Bacillus Calmette: Guerin; Penta: Diphtheria, Pertussis, Tetanus, Hepatitis B and Haemophilus influenzas B; DHS: Demographic and Health Survey; EPI: Expanded Program on Immunization; FMOH: Federal Ministry of Health; GVAP: Global Vaccine Action Plan; HEW: Health Extension Worker; HiB: Haemophilus Influenza Type b; HSDP: Health Sector Development Plan; HSTP: Health Sector Transformation Plan; MCV: Measles Containing Vaccine; SOS: Sustainable Outreach Service; OPV: Oral Polio Vaccine; PNC: Post-natal Care; UNICEF: United Nation International Children's Fund; WHO: World Health Organization

## Background

Immunization is one of the most important public health interventions to reduce child morbidity and mortality through controlling and even eradicating communicable diseases for which case countries are aiming to achieve pentavalent-3 vaccination coverage of at least 90% nationally and at least 80% in every district by 2020 and World Health Organization (WHO) is leading efforts to support regions and countries as they adapt the Global Vaccine Action Plan (GVAP) for implementation [1-3].

In developing countries vaccine preventable diseases constitute a major cause of morbidity and mortality in children less than five years. Approximately 29% of deaths in children under five are because of vaccine preventable diseases [4]. This was mainly because of low coverage of immunization which was again due to distant vaccination centers, unaware of return for next dose, unavailability of vaccines, unaware of need for immunization and others as identified by studies [5].

In 2016, about 19.5 million infants globally didn't recieve routine vaccines, incluing Pentavalent-3 vaccine. About 60% of these infants live in 10 countries: Angola, Brazil, the Democratic Republic of the Congo, Ethiopia, India, Indonesia, Iraq, Nigeria, Pakistan and South Africa [1]. Globally, about 1 in 10 infants do not have any access to any type of vaccination [2].

Utilization of immunization services is measured using dropout rate and for which case penta1-3 dropout rate is the best indicator according to the WHO RED strategy. In routine EPI Programs, dropout rate > 10% usually indicate quality problem of the program and need to be addressed [2]. To achieve maximal protection against vaccine- preventable diseases, a child should receive all vaccines within recommended intervals [6]. In Ethiopia it has also been recognized that vaccine preventable diseases are responsible for 16% of under-five mortality.

The national vaccination coverage cluster survey conducted in Ethiopia by 2012 revealed the existence of pockets of inaccessibility and poor utilization of service in most regions as it varies significantly among regions. From this survey, only 50% of children 12 - 23 months of age fully complete their vaccination and dropout rate for pent1-3 were 25.6% [7].

The base line surveys conducted in 2015 in east Wollega zone by JSI/L10K indicate that 69% of children were fully vaccinated with penta1-3 dropout rate of 15% [8].

Similarly, EDHS 2016 shows that 73% of children had received first dose of Penta vaccine, 53% had received third dose of Penta which indicate high dropout rates (27.4%) and fully vaccination coverage was 39% [9].

## Methods

### Study design, aim and area

A community based cross sectional study was applied to mothers/caretakers who have children 12-23 months old over June to September 2017 in Wayu-Tuka district, western Ethiopia. Two stages cluster sampling technique was used to select the study population. The objective of this study was to determine the level of incompletion of routine immunization among 12 - 23 months old children and its associated factors in the study area. Wayu-Tuka district is located at 310 km distance from the capital, Addis Ababa. There are 12 kebeles (the lowest administrative units, each with a size of about 1000 households) in the district. According to the 2016/17 administrative report of the district, the total population of the district was estimated to be 82,133, with 41,887 (51%) males, and 40,245 (49%) females. There were about 2,645 infants (3.22%); 1,823 12 - 23 months old children (2.22%). There are 3 health centers and 10 health posts owned by the government and 2 Clinics owned by private organizations.

### Study population and sampling

Mothers/caretakers with 12 - 23 months old children in the randomly selected 05 (five) kebeles were included in the study.

Sample size was calculated using single population proportion formula and Epi-Info version-7 statistical software based on the following assumptions: with 4% margin of error, non response rate of 10%, a confidence level of 95%, and using the proportion of children 12-23 months old with incomplete immunization from base line survey conducted in east Wollega zone was 31% [8] and using finite population correction formula with the total eligible children in the district of 1,823 (less than 10,000). Accordingly, the total sample size was 442. Cluster sampling technique where all eligible children included was applied on five (01 urban and 04 rural) kebeles. Wayu-Tuka district has 01 urban and 09 rural kebeles. Four (04) kebeles out of the 09 rural kebeles were selected by lottery method. The urban kebele was purposely included to have urban data.

### Data collection procedures

A house to house interview using structured and pretested standard interviewer administered questioner was done.The questionnaire was adopted from the Ethiopian Demographic Health survey (EDHS) and other previous studies done on EPI in other areas, and then developed according to the local context. The questionnaire used in this study was first developed in English and later on translated into the local language (Afan Oromo) to be used for data collection and then translated back into English to check for consistency. Households with eligible children in the selected kebeles were visited by trained data collectors and interviewed. Data collection was undertaken from June- September 2017 and supervisors checked data for completeness at the end of each day. Mothers or caretakers were asked to show immunization cards. Vaccines received and dates of immunization were copied from immunization cards. For those whom the immunization card was not available, the mothers/caretakers were asked on the immunization status of child. For Penta, Polio, PCV, and Rota vaccines, the mother was asked to report the number of doses that the child has received and was rechecked from the EPI registration book from the respective health facilities. In order to reduce recall bias for mother's/caretakers history, reminders such as body site of vaccine administration were asked.

### Data processing and analysis

The data was entered using EPI Info version 7 statistical software and was exported to SPSS version 20 for analysis. The predictors of incomplete immunization were assessed using the bivariate and multivariable logistic regression analysis techniques to measure the level of association between the selected independent variables and immunization incompletion. Summary statistics such as, percentages and crosstabs were used for Univariate analysis to describe the descriptive data. Bivariate analysis was done to test the association between each independent variable and the outcome variable.

All explanatory variables associated with the outcome variable at P-value < 0.25 in the bivariate analysis were included into multivariable logistic regression to determine factors that are independent predictors of immunization incompletion. P-value of less than 0.05 was considered as a cut- off point for statistical significance at 95% CI.

## Result

A total of 436 mothers/caregivers with children aged 12 - 23 months old were interviewed for the survey with response rate of 98.6%. The majority of respondents 303 (69.5%) were between the age of 20-34, 113 (25.9%) 35 years and above and the remaining 20 (4.6%) were less than the age of 20 years with mean age of 28.6 years.

The immediate care givers of the children were mothers 373 (85.6%) and other family member's/care givers 63 (14.4%). Regarding marital status 384 (88.1%) of care givers were currently married. 28 (6.4%) were separated, 14 (3.2%) were single and 10 (2.3%) were divorced. Regarding religion 283(64.9%) were protestant, 118 (27.1%) were orthodox, 20 (4.6%) were Catholics and 15 (3.4%) were Muslims.

The majority 381 (87.4%) belong to the Oromo ethnic group. Among the interviewed care givers 197 (45.2%) have primary education, 55 (12.6%) have secondary education, 30 (6.9%) have higher education level and the rest 154 (35.3%) were with no education (Table 1).

| Variables | Frequency | Percentage (%) |
|---|---|---|
| **Relationship with the child** | | |
| Mother | 373 | 85.6 |
| Other care taker | 63 | 14.4 |
| **Marital Status** | | |
| Single | 14 | 3.2 |
| Married | 384 | 88.1 |
| Separated | 28 | 6.4 |
| Divorced | 10 | 2.3 |
| **Maternal education** | | |
| Illiterate (can't read & write) | 154 | 35.3 |
| Primary (1-8) | 197 | 45.2 |
| Secondary (9-12) | 55 | 12.6 |
| Higher (college and above) | 30 | 6.9 |
| **Maternal occupation** | | |
| Housewife | 234 | 53.7 |
| Farmer | 118 | 27.1 |
| Government employ | 8 | 1.8 |
| Merchant | 62 | 14.2 |
| Other jobs | 14 | 3.2 |
| **Family size** | | |
| 2 - 4 | 168 | 38.5 |
| ≥ 5 | 268 | 61.5 |
| **Ethnic group** | | |
| Oromo | 381 | 87.4 |
| Amhara | 43 | 9.9 |
| Tigre | 12 | 2.7 |

***Table 1:*** *Socio demographic characteristics of women and care givers with children 12 - 23 months old in Wayu Tuka district, Western Ethiopia, 2017 (N = 436).*

### Family size and characteristics of child

The mean age of children included in the study were 17.8 months and from the total of 436 children aged 12-23 months 210 (48.2) were males and 226 (51.8) females. Majority of families had greater than 5 members 268 (61.5%) with birth order of most child were fifth and above 112 (25.7%). Majority of child 271 (62.2%) delivered at health facilities.

Major source of information includes health personnel 221 (50.7%) and Radio 55 (12.6%) as well as from friends/peers. From the total, 93.7% of respondents were knowledgeable on child immunization. As indicated in table 2.

| Variables | Frequency | Percent |
|---|---|---|
| **Immunization prevents communicable diseases** | | |
| Yes | 416 | 95.4 |
| No | 20 | 4.6 |
| **Number of sessions needed to complete routine vaccines** | | |
| Three | 62 | 14.2 |
| Four | 307 | 70.4 |
| Five | 67 | 15.4 |
| **Knows when child should complete routine vaccination** | | |
| Yes | 396 | 90.8 |
| No | 40 | 9.2 |
| **Knows when child should receive measles vaccine** | | |
| Yes | 326 | 74.8 |
| No | 110 | 25.2 |
| **Right age to complete routine vaccines (N= 396)** | | |
| Before 12 months | 336 | 84.8 |
| After 12 months | 60 | 15.2 |
| **Knows about immunization** | | |
| Yes | 399 | 91.5 |
| No | 37 | 8.5 |
| **Necessary to return if child defaulted** | | |
| Yes | 378 | 86.7 |
| No | 58 | 13.3 |
| **Immunization has harmful effect** | | |
| Yes | 38 | 8.7 |
| No | 398 | 91.3 |
| **Immunization is beneficial** | | |
| Yes | 419 | 96.1 |
| No | 17 | 3.9 |
| **Voluntary to advice others about vaccination** | | |
| Yes | 332 | 76.1 |
| No | 104 | 23.9 |

***Table 2:*** *Respondents perceived benefits and needs on immunization and vaccine preventable diseases (VPDs) in Wayu Tuka district, Western Ethiopia, 2017 (N = 436).*

### Attitude of mothers/caregivers towards immunization

Majority 399 (91.5%) responded as it is important for them to know about immunization and 378 (86.7%) of them said it is necessary to continue immunization in case if child defaults. 419 (96.1%) of respondents knew that immunization is beneficial for child and 332 (76.1%) of mothers/caregivers advice other mothers to get their children immunized. Most of the respondents 398 (91.3%) responded

that immunization has no harmful/adverse effect for child. From the total respondents, 88.3% of them had positive attitude on immunization according to the summarized attitude questions. As shown in table 3.

| Variables | Frequency | Percent |
|---|---|---|
| **ANC visit for this pregnancy** | | |
| Yes | 383 | 87.8 |
| No | 53 | 12.2 |
| **Frequency of the ANC visit (N = 383)** | | |
| Once | 160 | 41.7 |
| Twice | 118 | 30.8 |
| Third | 55 | 14.4 |
| Fourth | 50 | 13.1 |
| **Ever received TT vaccination** | | |
| Yes | 392 | 89.9 |
| No | 44 | 10.1 |
| **Number of TT vaccines received (N= 392)** | | |
| Once | 81 | 20.7 |
| Twice | 217 | 55.4 |
| Third | 63 | 16.1 |
| Fourth | 22 | 5.6 |
| Fifth | 9 | 2.2 |
| **Place of delivery** | | |
| Health institution | 271 | 62.2 |
| Home | 165 | 37.8 |
| **Place of treatment if child sick** | | |
| Health post | 68 | 15.6 |
| Health center/hospital | 276 | 63.3 |
| Private/NGO clinic | 92 | 21.1 |

***Table 3:*** *Maternal Health Care Utilization in Wayu Tuka district, East Wollega Zone, Oromia Region, Ethiopia, August/2017 (N = 436).*

### Maternal health care utilization

Majority 383 (87.8%) of mothers/caregivers had ANC visit during their pregnancy. Among this 160 (41.7%) of them have attended antenatal care at least once, 118 (30.8%) of them twice and 105 (27.5%) of them three and above. From the total respondents 392 (89.9%) have received TT vaccine from which most 217(55.4%) received twice as shown in table 4.

| Variables | Frequency | Percent |
|---|---|---|
| **Child Ever Vaccinated** | | |
| Yes | 431 | 98.9 |
| No | 5 | 1.1 |
| **Have immunization card (n = 431)** | | |
| Yes | 417 | 96.8 |
| No | 14 | 3.2 |
| **Received all vaccines (n = 431)** | | |
| Yes | 318 | 73.8 |
| No | 113 | 26.2 |
| **Number of vaccines left (n = 113)** | | |
| Only one | 57 | 50.4 |
| Two | 29 | 25.7 |
| 3-5 | 12 | 10.6 |
| > 5 | 15 | 13.3 |

***Table 4:*** *Immunization status of children aged between 12-23 months old in Wayu Tuka district, Western Ethiopia, 2017 (N = 436).*

### Immunization status

From the total of 436 mothers/caretakers interviewed majority of them 431 (98.9%) were vaccinated at least once and 5 (1.1%) have never attended immunization. Among this 417 (96.8%) had vaccination card during the survey. Fully vaccination coverage was 73.8% and regarding the number of vaccines left for defaulters most of them 57 (50.4%) were left with only one vaccine as well as 29 (25.7%) with two vaccines and 27 (23.9%) were left with three and above vaccines to be fully vaccinated. As shown in table 5.

### Immunization coverage by card plus mother recall

According to the vaccination card and mothers recall about 431 (98.9%) of children received at least a single dose of vaccine. Out of the recommended vaccines in general, pentavalent is the most consumed one. Particularly, Pent-1 was taken by the majority (92.3%) followed by OPV-1 (89.7%), Rot-1 (89.3%), PCV-1 (88%), OPV-2 (87.2%), PCV-2 (86%) and BCG (85.3%). Measles was the least taken vaccine (77.4%) and full vaccination (73.8%). About 81.4% of children took pent3 with 11.8% of pentavalent dropout rate and 16.1% of pentavalent to Measles dropout rate. The coverage of immunization from the initial dose of vaccine to the last doses is indicated on figure 1 below.

### Reasons associated with immunization incompletion

From mother's/care takers not immunized or not completed immunization for their children 14 (12.7%) responded as due to unavailability of vaccine, 12 (10.9%) due to unaware of return for next dose, 11 (10%) due to postpone until another time, 5 (4.5%) place of immunization too far, 13 (11.8%) due to family problem including illness, 8 (7.3%) due to absence of vaccinator, 10 (9.1%) due to fear of side effects and 33.7% were due to other reasons.

| Variables | Immunization Status | | Odd Ratio (95%CI) | |
|---|---|---|---|---|
| | Complete | Incomplete | Crude OR | Adjusted OR |
| **Place of delivery** | | | | |
| Health institution | 215 (67.6%) | 53 (46.9%) | 1 | 1 |
| Home | 103 (32.4%) | 60 (53.1%) | 2.36 (1.53, 3.66) | 2.27 (1.37, 3.74) |
| **Residence** | | | | |
| Urban | 28 (8.8%) | 11 (9.7%) | 1 | 1 |
| Rural | 290 (91.2%) | 102 (90.3%) | 0.90 (0.43, 1.86) | 0.81 (0.35, 1.86) |
| **Relationship with child** | | | | |
| Mother | 273 (85.8%) | 97 (85.8%) | 1 | 1 |
| Other care taker | 45 (14.2%) | 16 (14.2%) | 1.00 (0.54, 1.85) | 1.27 (0.62, 2.60) |
| **Marital status** | | | | |
| Married | 1.27 (0.62, 2.60) | 95 (84.1%) | 1 | 1 |
| Others | 33 (10.4%) | 18 (15.9%) | 1.64 (0.88, 3.04) | 1.89 (0.94, 3.78) |
| **Maternal/care giver education** | | | | |
| Primary and above | 227 (71.4%) | 53 (46.9%) | 1 | 1 |
| Illiterate | 91 (28.6%) | 60 (53.1) | 2.82 (1.82, 4.40) | 2.29 (1.38, 3.78) |
| **Satisfaction from vaccination services** | | | | |
| Good | 237 (74.5%) | 63 (55.8%) | 1 | 1 |
| Poor | 81 (25.5%) | 50 (44.2%) | 2.32 (1.48, 3.64) | 1.87 (1.13, 3.08) |
| **Distance from nearest health facility** | | | | |
| < 5 KMs | 262 (82.4%) | 87 (77%) | 1 | 1 |
| ≥ 5 KMs | 56 (17.6%) | 26 (23%) | 1.40 (0.83, 2.36) | 1.48 (0.83, 2.66) |
| **Fear of vaccine/side effects** | | | | |
| No | 229 (72%) | 65 (57.5%) | 1 | 1 |
| Yes | 89 (28%) | 48 (42.5%) | 1.90 (1.22, 2.97) | 1.75 (1.06, 2.90) |
| **Family size** | | | | |
| 2 - 4 | 129 (40.6%) | 36 (31.9%) | 1 | 1 |
| ≥ 5 | 189 (59.4%) | 77 (68.1%) | 1.46 (0.93, 2.30) | 1.04 (0.61, 1.76) |

***Table 5**: Bivariate and multivariable analysis model for factors associated with incompletion of immunization among children 12-23 months old in Wayu Tuka district, Western Ethiopia, 2017.*

## Factors associated with immunization incompletion status of children

In multivariable analysis: place of delivery, maternal/care taker education, having functional radio, satisfaction from immunization service, fear of vaccine side effects and having ANC follow-up for this pregnancy were found to be significantly associated with the outcome variable with p value of 0.05 and below. Children born at home were 2.09 times more likely to incomplete their immunization compared to those born at health institution [AOR, 2.09 (95%CI = 1.29, 3.39)]. Additionally, the immunization incompletion status was 2.77 times higher among mothers who did not have functional radio compared to those who had functional radio [AOR, 2.77 (95% CI = 1.65, 4.65)].

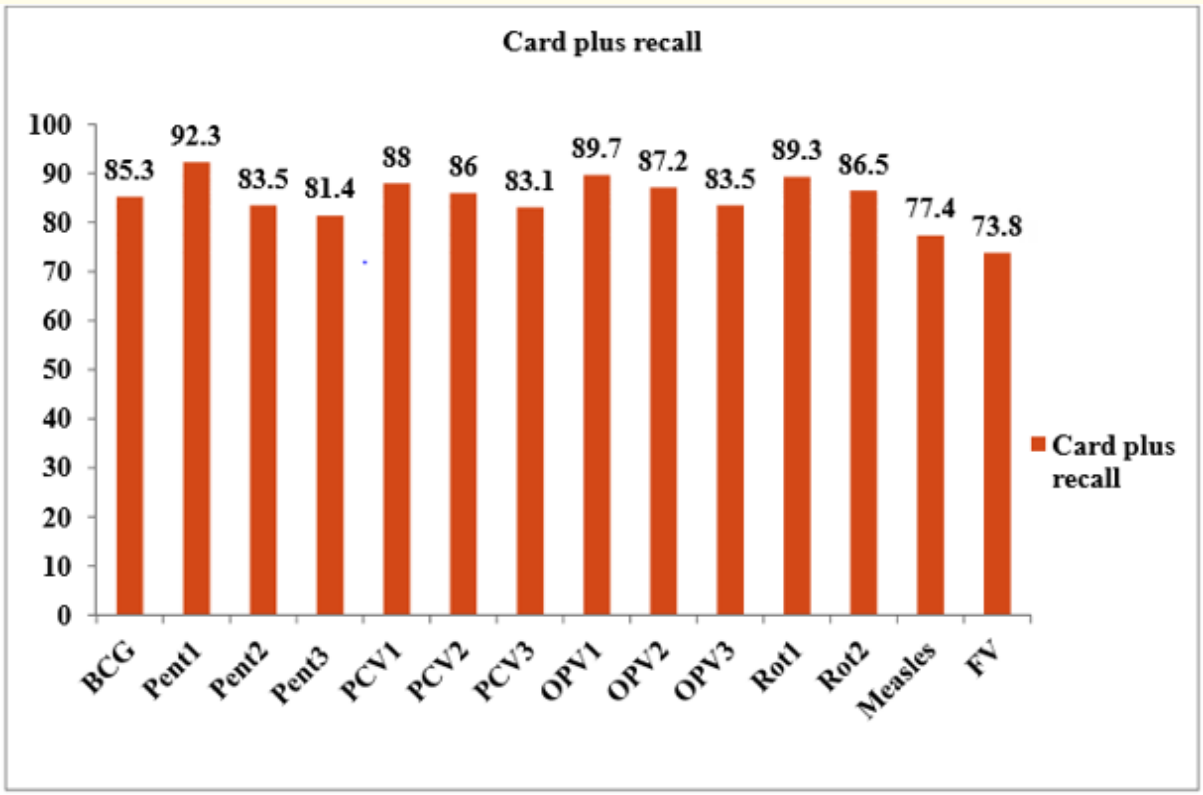


***Figure 1****: Immunization coverage among children aged 12-23 months by card plus history in Wayu Tuka district, western Ethiopia, August/2017.*

*FV: Fully Vaccinated.*

Those who traveled 30 - 60 to reach the nearby health facilities were 3.41 times more likely to incomplete immunization compared to those who traveled < 15 minutes to reach the nearby health facilities [AOR, 3.41 (95%CI = 1.56, 7.42)] as shown in table 6.

| Variables | Immunization Status | | Odd Ratio (95%CI) | |
|---|---|---|---|---|
| | Complete | Incomplete | Crude OR | Adjusted OR |
| **Attended ANC for this pregnancy** | | | | |
| Yes | 286 (89.9%) | 94 (83.2%) | | |
| No | 32 (10.1%) | 19 (16.8%) | 1.81 (0.98, 3.34) | 2.13 (1.04, 4.36) |
| **Own functional radio** | | | | |
| Yes | 243 (76.4%) | 57 (50.4%) | 1 | 1 |
| No | 75 (23.6%) | 56 (49.6%) | 3.18 (2.03, 5.00) | 2.36 (1.42, 3.93) |
| **Family problem at vaccination date** | | | | |
| No | 227 (71.4%) | 65 (57.5%) | 1 | 1 |
| Yes | 91 (28.6%) | 48 (42.5%) | 1.84 (1.18, 2.88) | 1.17 (0.70, 1.98) |

***Table 6:*** *A logistic regression model for factors associated with incompletion of immunization among children 12 - 23 months old in Wayu Tuka district, Western Ethiopia, 2017.*

Regarding vaccination service satisfaction, those who rated immunization service poor were 1.87 times more likely to incomplete their vaccination as compared to those who rated the immunization service as good [AOR, 1.87 (95%CI = 1.13, 3.08)].

## Discussion

Full immunization status of children was confirmed using immunization card of children and mothers recall method. From the total respondents, 417 (96.8%) of them were able to show the immunization card and this may be due to good advice on handling of immunization cards which is higher than the study done in east Wollega zone, Oromia regional state of Ethiopia [8].

This study found that the immunization incompletion status in the study area using both immunization card and mother/care givers recall method was 26.2%. The finding was lower than the EDHS 2016 report and the base line survey done in east Wollega zone of western Ethiopia which were 61% and 31%, respectively [8,9].

The coverage of immunization in this study was higher than that of EDHS 2016 but there were significant proportion of defaulters with pent-1 coverage of 92.3%, pent-3 coverage of 81.4% and that of measles 77.4%.

Despite the defaulters, this study indicated that the coverage of vaccine doses that should be given at the same time was similar with slight difference and this may be explained as due to shortage of some vaccines.

The penta-1 coverage is seen as an indicator of access, while pent1-3 dropout rate as utilization of immunization services. From this study, pent-1 coverage and pent1-3 dropout rate was 92.3% and 12%, respectively by immunization card and maternal history which shows that there was good access (pent1 > 90% cut of point) but poor utilization (pent1-3 DOR > 10% cut of point) according to the reaching every child/community strategy of WHO coverage of PCV, OPV and ROTA which is given at the same time with pentavalent was the same with slight difference. The measles coverage was 77.4% which was lower than other vaccines and similar finding with other similar studies [8,10]. However, this finding is higher compared to other studies such as EDHS 2016 and study done in Ambo district [9,10]. This indicates as there is good improvement on vaccination coverage from time to time.

Dropout rate for pent1-measles from this study was 16%. Other studies including EDHS 2016 report have shown similar findings with high dropout rate for pent1-measles. From this finding the high dropout rate for measles may be indicated that the long time interval of appointment at the nine month for measles has made mothers to forget the immunization appointment date. Particularly, because of this longer interval a number of children may not return for measles vaccine and this makes the coverage rate for this antigen to be lower than other vaccines.

Knowledge and attitude of mothers/caretakers were assessed about the number of sessions needed for fully vaccination and 70.4%% of them responded the correct answer. From the total respondents 96.1% of them correctly answered that immunization is beneficial for child. It can be stated the coverage improvement is due good knowledge of mothers/caretakers. This finding is consistence with the study done in Nigeria and Ambo district, Oromia regional state in which majority of respondents knew about vaccine and vaccine preventable diseases [10,11].

Mothers/care takers mentioned different reasons for not completing immunization for child. These reasons were unavailability of vaccine, postpone until another time, inconvenient time of immunization, absence of vaccinator, family problem including illness at the appointment date, unaware of return for next dose and others.

This may be the reason why there is high dropout rate on immunization. Findings from other studies of Mozambique and Sinana district, South-east Ethiopia have reported similar reasons with this finding [12,13].

The study also assessed factors associated with immunization status of children in which case immunization completion status was categorized into incomplete and complete immunization. Bivariate and multivariable analysis were computed using logistic regression to identify factors associated with immunization incompletion of the respondents.

From the variables included in the final model home delivery, maternal or care giver's illiteracy, poor satisfaction from vaccination services, fear of vaccines/side effects, no ANC follow-up for this pregnancy, and no functional radio in the family were found to have significant association with immunization incompletion status of the study subjects.

Regarding place of delivery, home delivered children were 2.27 times more likely to have incomplete immunization as compared to children delivered at health facility [AOR (95%CI) = 2.27 (1.37, 3.74)]. This finding could be explained by increased awareness and health seeking behavior of those mothers/care takers at health facility which contributed for their children's immunization service utilization. This is consistent with studies conducted in Ethiopia and other developing countries in Africa [12,14-16].

Children whose mothers/care takers were illiterate (can't read and write) were 2.29 times more likely to incomplete their immunization than those who attended primary and above levels of education [AOR (95%CI) = 2.29 (1.38, 3.78)]. This finding is consistent with many studies conducted in Ethiopia and other developing countries as maternal education is a key in improving maternal and or child health care services utilization through better access to knowledge and information [14,16-18].

Regarding immunization services satisfaction, those respondents who rated immunization service as poor were 1.87 times more likely to incomplete immunization as compared to those who rated it as good [AOR (95%CI) = 1.87 (1.13, 3.08)]. This may be due to the poor handling of clients by health care providers affecting demand [19].

Mothers/care takers who fear side effects of vaccines were 1.75 times more likely to incomplete immunization as compared to their counterparts [AOR (95%CI) = 1.75 (1.06, 2.90)]. This is due to the wrong perception about vaccine side effects which is similar with other previous studies [13,15,20-22].

The odds of not completing immunization was 2.13 fold higher among children whose mothers didn't attend any ANC services during the pregnancies of these children than children whose mothers attended any ANC for the pregnancies [AOR (95%CI) = 2.13 (1.04, 4.36)].

Health educations during the antenatal care follow-up could have positive influence on the woman's decision making about her child health care, including immunization completion [10,13,15-17,22].

Mothers/caretakers who did not have functional radio at home were 2.36 times more likely to have incomplete immunization for their child [AOR (95%CI) = 2.36 (1.42, 3.93)]. This may be explained by a relatively good access to media, and hence exposure to information regarding immunization through radio and getting awareness about benefits of getting children immunized [20].

## Limitations of the Study

- The cross sectional study design made it impossible to reach at causal relationship between the different independent and out come variables.
- Information bias, no standard cut off point for knowledge and attitude.
- Recall bias where mother may forget immunization status of their children.

## Conclusion

There is high immunization incompletion among children aged 12 - 23 months in the district as compared to national and global acceptable targets which should be < 10% at national level according to WHO reaching every district strategy. The main sources of information on immunization for majority of respondents were health personnel followed by radio and friends/peers. Place of delivery, having functional radio, time it takes to reach nearby health facility and rate of satisfaction from immunization service were found to be factors associated with immunization incompletion status of children. The most common reasons for defaulting were obstacles followed by lack of information and lack of motivation.

## Recommendations

District health office and all health facilities in the district should work to increase current immunization coverage to reach the intended target. Health facilities should apply systematic defaulter tracing mechanisms and involving communities in defaulters tracing. Outreach sites should be established in each village of the Kebele for reaching every child in the community including hard to reach areas. Strengthening the linkage at each level as well as health extension workers and health development armies should regularly aware the mothers about the advantage of completing immunization for children, when children should start immunization, the number of sessions needed and when child will be fully immunized. Strengthening regular supervision and monitoring on immunization and other related activities to improve both access and utilization.

## Declarations

### Ethics Approval and Consent to Participate

Ethical clearance was obtained from Research Ethics Review Committee of Wollega University, Ethiopia and the research was done in conformity with the ethical guidelines approved by the Institutional Review Board (IRB) of Wollega University. Supporting letter was written by Wollega University to zonal, district health offices and concerned bodies to get official permission. Respondents were informed about the objective and purpose of the study. Participation in the study was completely voluntary and refusal to respond to some of the questions or interruption from the study was possible at any time the respondent need. Written consent was attached to each questionnaire and was read out by the interviewer at the time of data collection.

### Consent for Publication

Not applicable.

### Availability of Data and Materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Competing Interests

The authors declare that they have no competing interests.

## Funding

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## Authors Contribution

MG and WD conceived the project idea, conceptualized the design and data collection, and participated in the data analysis. MK participated in the data collection, analyzed the data and prepared the first draft of the manuscript. All authors read and approved the final manuscript.

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