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Ageappropriate Vaccination Coverage and Associated factor for Bcg, Pentavalent 1-3 And Measles Vaccine For Children 12-23 Months of Age in Ankesha Guagusa District, North West Ethiopia, Community Based Cross-Sectional Study, 2021

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AGEAPPROPRIATE VACCINATION COVERAGE AND ASSOCIATED FACTOR FOR BCG, PENTAVALENT 1-3 AND MEASLES VACCINE FOR CHILDREN 12-23 MONTHS OF AGE IN ANKESHA GUAGUSA DISTRICT, NORTH WEST ETHIOPIA, COMMUNITY BASED CROSS-SECTIONAL STUDY, 2021

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Acronyms

ACIP	Advisory Committee on Immunization Practices
ANC	Antenatal Care
AOR	Adjusted odds ration
BCG	Bacillus Calmette Guerin
CI	Confidence Interval
COR	Crude odds ration
DPH	Department of Public Health
DPT 3	Diphtheria Pertussis Tetanus 3
EPI	Expanded Program of Immunization
Hib	Hemophilus Influenzas type B
MCV1	Measles Containing Vaccine One
MCV2	Measles Containing Vaccine Two
OPV	Oral Polio Vaccine
PI	Principal Investigator
PNC	Post-natal care
SPSS	Statically Package for Social Science
WHO	World Health Organization

Abstract

Background: Vaccine is crucial for prevention of an estimated 2 to 3 million global deaths each year from vaccine preventable diseases. Vaccine timeliness is important to prevent child death and morbidity. According to the 2016 Ethiopian Demographic and Health survey report 1 out of 15 Ethiopian children die before reaching age five due to vaccine preventable disease. So we assessed age-appropriate vaccinations coverage and associated factor among children 12 to 23 months of age in Ankesha Guagusa district, northwest Ethiopia.

Methods: A community-based cross-sectional study was carried out from September to October, 2021 in Ankesha Guagusa district among 403 mothers/caregivers who had children 12 to 23 months of age by using simple random sampling technique. A face-to-face interviewing and document review with pre-tested questionnaire were used to collect data from each participants. Data were enter into Epi-Info7 software and exported to SPSS-23 for analysis. Bi-variable and multivariable logistic regression analysis were done. Factors with a p- value of < 0.05 in multivariable analysis was considered as independent determinants age appropriateness vaccination coverage.

Results: Age appropriate vaccination coverage among children was 7.7% (95% CI: 5.0 to 10.4) for BCG, 30 %(95% CI: 25.6 to 34.7) for pentavalent 1, 28.3% (95% CI: 24.3 to 33.5) for pentavalent 2, 24.8% (95% CI: 20.4 to 29.3) for pentavalent 3 and 26.8 %(95% CI: 22.1 to 31.0) for measles. Age appropriate vaccination of pentavalent 1-3 and measles vaccination was associatedwithrural residence of pentavalent one (AOR:0.138, 95% CI:0.058-0.332),uneducated mother/caregiver for pentavalent two (AOR: 0.328, 95% CI: 0.137-0.787),increased household family members(>5members) for pentavalent two (AOR:0.55, 95% CI:0.34-0.90), lack of knowledge about vaccine side effect for pentavalent two (AOR:1.69, 95% CI:1.03-2.76), pregnant women not participated in conference pentavalent three (AOR:2.53, 95% CI: 1.29-4.94).

Conclusion and recommendation

In this study area, age-appropriate vaccination coverage proportion of BCG, pentavalent one, pentavalent two, pentavalent three and measles were low. The identified findings will be important to improve age appropriate vaccination coverage by focusing on timeliness. Focusing on repeatedly aware on age appropriate vaccination and encourage mothers/caregivers to recognize the appointment day of each vaccine to increase timeliness vaccination coverage should be recommended.

Keyword: BCG, Pentavalent, Measles,Vaccination, .

1. Introduction

1.1 Background;

Vaccination is the most important, cost effective, simple and safe way to reduce and prevent global child hood morbidity and mortality(1).The death of high number of children due to vaccine preventable disease per year requires high vaccination coverage with age appropriate or timely administration of vaccines to get expected benefits of vaccination(2). Age-inappropriate or untimely high vaccination coverage indicates false consideration of disease protection(3, 4).World Health Organization recommends that each vaccine doses should be administered at defined age, both early and delay is undesired(2).Timeliness vaccination is critical to prevent outbreaks(5, 6).

Vaccine preventable diseases are the main contributing factors and a treat of high children morbidity and mortality in sub-Sahara African countries(1, 7).To reverse vaccine preventable disease morbidity and mortality timely or age appropriate vaccination is crucial in sub-Sahara countries(1).As World Health Organization(WHO) recommendation vaccines must be given within the first years of age based on the vaccination schedule(8).

In Ethiopia vaccination is one of the strategies under the government health policy to improve child health by administering of vaccine to help the immune system to develop protection against infectious pathogens to which infants are susceptible and to reduce individual vulnerability and prevent repeated occurrence of outbreak of the diseases in the community(9).The health policy and strategies of Ethiopia helps to improve child health by giving vaccine to develop immunity and protect from diseases(10). The goals of Health Sector Transformation plan is to increase the coverage of Bacillus Calmette Guerin(BCG), pentavalent and measles vaccine, this is the Second Growth and Transformation Plan of Ethiopia(11). The pentavalent vaccine contains a combination of 5 vaccines in one dose: diphtheria, tetanus toxoid, pertussis, hepatitis B, haemophilus influenza type b vaccine (Hib). Currently, the Ethiopian expanded program of immunization (EPI) gives a comprehensive vaccination schedule. Vaccine dose schedule to be administer for BCG at birth, pentavalent 1 at 6 weeks, pentavalent 2 at 10 weeks, pentavalent 3 at 14 weeks and measles at 9 months of age(12).

Monitoring the age at receipt of each vaccine-dose ("timeliness") helps verify that vaccines are not administered too early, which might reduce vaccine effectiveness, yet as soon as possible after the scheduled age to minimize the time that the child is at risk of infection(13). Timely or age appropriate vaccination is very necessary to get adequate disease protection(14).The timeliness of vaccination of the receipt of the scheduled vaccinations in an age-appropriate way is a serious issue for the prevention of diseases in infants and the achievement is to reduce infant mortality and morbidity(15).

Children receive the scheduled vaccinations as early as possible according to the vaccination schedule, resulting in high age-appropriate vaccination coverage rates(16).In the population, particularly for those diseases in which age is related to severity or higher complication rates(17).Administering vaccine less than WHO recommended minimum age to start vaccine and the minimum interval may lessen the antibody development because of sero-conversion rate(2).In other way lengthening the interval between doses of the vaccine is leads to develop high immunity that is as age increases the immunity development increases(2).However delayed vaccination is a strong risk factor for vaccine preventable disease, particularly pertussis, measles, pneumonia and haemophilusinfluenza type B invasive virus. Mostly infants in rural area often receive delayed vaccinations and in risk to vaccine preventable diseases early in the first year of life(17).Consequently, highly morbidity and mortality occur primarily among infants. About 5.5%, 2.6% and 16.4% of children were received Penta1, Penta3 and measles vaccines earlier than the acceptable time interval, respectively. On the contrary, 53.6%, 30%, 53.0% and 23.6% of children took BCG, Penta1, Penta3 and measles vaccines later than the acceptable time interval, correspondingly. So Timely vaccination is important to get adequate protection of disease(14).

Therefore the WHO recommended vaccination schedule is prepared to protect infants and children early in life, when they are highly vulnerable to vaccine preventable diseases and the risk of acquiring vaccine preventable disease from unvaccinated children is reduced by increasing herd immunity. The aim of this study will be to identify age appropriate vaccination coverage and its associated factors on BCG, pentavalent 1-3 and measles for children 12-23 months of age in Ankesha Guagusa district.

1.2. Statement of the Problem

Globally, 2 to 3 million deaths annually are occurred due to vaccine preventable diseases(2). Even though the up to date vaccination coverage has significant progress, an estimated 1.5 million children are continuing to die every year due to vaccine preventable diseases globally, mainly in developing countries(2, 18).

Global studies showed that few children received all recommended vaccine doses on time, even with high up-to-date coverage(2).The up to date vaccination describes only age specific coverage and doesn't measuredelay in age appropriate vaccination coverage(17).Globally, it is estimated that about 22.6 million children under one year of age were partially protected(19). One out of five(4.52 million) infants worldwide does not receive life-saving doses of diphtheria, tetanus and pertussis vaccine(19). More than 70% of these children live in ten countries including Ethiopia. Studies evidenced that vaccine preventable diseases are still responsible for about 25% of deaths occurring annually among children under five years of age and globally it is estimated that between 2 and 3 million child deaths are occurred (19-21).

In Sub Sahara Africa vaccine preventable disease has major contribution for high child morbidity and mortality, particularly highly infectious diseases(1).Measles is the leading cause of death of young children worldwide, even though it is a vaccine preventable disease(22).In Madagascar between October 2018 and April 2019, 117,075 measles case and 1205 deaths are reported by World Health Organization(22).As researchers observed timely vaccination in Sub-Sahara Africa is a substantial delay receipt(2).. In Africa and other countries many children receive vaccine doses in inappropriate time(1).

In Ethiopia vaccine preventable diseases are continuing to be a major health problem(23).According to the 2016 Ethiopian Demographic and Health survey report 1 out of 15 Ethiopian children die before reaching age five. This ranges from 39 deaths per 1000 live births in Addis Ababa, the region with highest fully vaccination coverage to the Afar region 125 deaths per 1000 live birth with lowest fully vaccination coverage(18, 23).These studies mostly examined delayed vaccinations that is the administered vaccinations are at older ages or above the target age than the recommended time of vaccination which resulted in prolonged risk of exposure to infection(1, 2).Not only delayed vaccination but also vaccines are administered in an untimely way are doses administered earlier than the recommended time(1, 2). . In terms of BCG dose 71.3% was given after 1 month. Infant vaccine doses were

also typically delayed with 63.8% of DTP dose and 68.5% of measles administered more than one month after the recommended date(24).The result of delayed and early vaccination is suboptimal response(1). Especially delayed vaccination is strongly risk factor for vaccine preventable disease(2). The World Health Organization (WHO) classified early and delayed vaccination doses as invalid doses(25).In Ethiopia vaccination is one of the strategies under the government health policy to improve child health by administering of vaccine to help the immune system to develop protection from vaccine preventable diseases(2).However, In Ethiopia studies focus on only fully vaccination coverage not age appropriateness(2).The aim of vaccination is to obtain high coverage with a timely, safe and effective way for all targeted children. The studies in timeliness in Ethiopia is limited and also limited information about age appropriate vaccination(2).Generally for desirable response to a vaccine depends on different factors, from these different factors age of the recipient is one factor. Recommendations for the age at which vaccines are administered are influenced by age-specific risks for disease, age-specific risks for complications, age-specific responses to vaccination, and potential interference with the immune response(26). So, vaccine preventable diseases remain a potential public health problem, recurrence of outbreaks are continued(1). Additionally there is a discrepancy between the child age and the vaccination date during observing the vaccination registration. Therefore identifying of the actual factors that affect age appropriateness vaccination coverage of children is very important to achieve targeted age appropriate vaccination coverage in urban and rural community.

1.3. Significance of the study

The study result from this research will be serve as an important preliminary data to plan appropriate interventions towards to improve age-appropriate vaccination coverage. This study also emphasizes the particular need for continued monitoring of vaccination program performance to detect problems and to identify solutions. Additionally,the study will also showage-appropriate vaccination coverage gaps, problems and other relevant findings for health providers, public health officers, health educators and programmers as well as the community at large.

2. Literature review

2.1 Age appropriate vaccination coverage

In 2021, astudy conducted in China indicates that, vaccination coverage rates of MCV1 (98.9%) and MCV2 (95.8%) among children in Lincang City were high, however, the timely vaccination coverage rates of MCV1 (52.0%) and MCV2 (74.1%) were low, and the timely-complete vaccination coverage rate (41.0%) of MCV were even lower, and the median delay in the administration of MCV1 (33 days) and MCV2 (196 days) is a cause for concern.Additionally, timely vaccination rate for the MCV1 whom immunization card were available were lower than the overall coverage. The measles containing vaccine one (MVC1) 47.5% received at eight month of age. A substantial proportion of children were not vaccinated within the recommended time-frame(27,28)

The study conducted in Bangladesh in 2018, 74%, 70%, and 65% had EPI cards with records of BCG, pentavalent 3, and measles vaccinations, respectively(29). The vaccination coverage who did not have vaccination cards was 98% for BCG, 91% for pentavalent 3, and 86% for measles. Children who vaccinated timely was 24% for BCG, 46% for pentavalent 3, and 53% for measles, whereas 76%, 51%, and 36%of children had delays in receiving the BCG, pentavalent 3, and measles vaccines, respectively. The proportion of children who had received early vaccination was 3% for pentavalent 3 and 12%for measles(29).

In 2020 Mongolian study shows age appropriate vaccination coverage is 91.7%,65.3%,59%,48.2% and 35.9% of vaccination of BCG, pentavalent one, pentavalent two, pentavalent three and measles respectively(30). Early vaccination coverage of pentavalent one, pentavalent two, pentavalent three and measles vaccine were10.9%,7.7%,8.6%,19.4% respectively and delayed vaccination coverage of pentavalent one, pentavalent two, pentavalent and measles were 23.8%, 33.3%, 43.2% and 44.7% respectively(30).

In 2020 study Northwest Ethiopia overall, 13.1% of children aged 12-23 months were received their vaccinations at the recommended time interval. About 18.4 % and 79.4 % of children aged 12-23 months were received their vaccinations earlier and later than the recommended time interval, respectively. About 42.2, 64.3, 41.4 and 42.9 % of children received BCG, Penta1, Penta3 and measles vaccines in the recommended time interval, respectively. Moreover, 5.5, 2.6 and 16.4% of children were received Penta1, Penta3 and measles vaccines earlier than the acceptable time interval, respectively. On the contrary, 53.6,

30, 53.0 and 23.6% of children took BCG, Penta1, Penta3 and measles vaccines later than the acceptable time interval, correspondingly(31)

The study conducted in 2018 in Addis Ababa vaccine coverage was 82.32% of children fully immunized excluding measles, and 89.43% fully immunized including measles(32). Percentages for timely administration were not as high; 55.94% of children in the survey sample received all vaccines on time and 50.41% of children were fully immunized when including measles (56.36% of those who were fully immunized).In Ethiopia vaccination coverage by DPT3 (Diphtheria, Pertussis and Tetanus) has shown increasing trend from 61% in 2010 to 77% in 2016.Fully vaccinated children aged 12–23 months have increased from 14% in 2000 to 39% in 2016(10).Over time, as children progress later into the immunization schedule, a greater proportion of vaccines were received in an untimely way(32).Vaccine coverage and timeliness in Addis Ababa BCG late 8.7%, pentavalent one early 4.35% and late 3.48%, pentavalent two early 2.95% and late 5.22%, pentavalent three early 1.74% and late 9.57% and measles early 2.44% and late 27.64%(32).

The study carry out in 2014 in Micha district vaccination coverage by history, pentavalent one were taken by the majority of children 98.4%, BCG 97.6% and measles 79% coverage were the least taken vaccines. The coverage showed a decrement from the first doses of vaccine to the last doses. From the total children 65% took pentavalent one followed by BCG 64.8% and measles 53.5 % were the least taken vaccine by children(21). Another study in 2018, the study conducted in north showa zone Menzlalo district in age-appropriate vaccinations up to date vaccination coverage for pentavalent1−3 and measles vaccine doses were 99.3%, 97.1%, 92.6% and 82.7% respectively. However, only 39.1%,36.3%,30.3% and 26.4% were vaccinated age-appropriately for pentavalent1−3 and measles vaccine doses respectively(2). The proportion of antigens received earlier than the recommended national schedule was 6.8%, 5.9%, 5.2% and 51.3% for pentavalent1−3 and measles vaccine doses respectively(2).

2.2 Associated factor as age appropriate vaccination coverage

2.2.1 Socio-demographic factors

The study conducted in Senegal national study, Mother's education was associated with timely vaccination. Children of mothers with a primary education level were 22% more likely to receive the Pentavalent 3 vaccine higher at a given age compared to children born to women with no education at that age. Similarly, women with secondary education or higher were 20% more likely to receive Pentavalent 3 vaccine as compared to women without

education level. Therefore, there was an exposure response trend with timely vaccination and education. The more educated the better timeliness vaccination and also maternal education has been associated with better vaccination coverage (1).

A study of 31 low and middle-income countries also found that children in poorer families and families with more than one child were at increased risk for vaccination delay. In a study in Ethiopia, showed that children born to mothers of higher wealth index were 40% more likely to be fully vaccinated compared to children from women of poor wealth index group(1). Regarding maternal occupation,maternal unemployment were significantly positively associated with the failure of timely BCG vaccination (16).

The study conducted in 2018 in Amhara region north showa zone Menzlalo district the odds of having age-inappropriate pentavalent one vaccination among female children were two times higher when compared to male children. Similarly, the odds of having age-inappropriate pentavalent1 vaccination among children who didn't have usual care taker were 2.5 times higher compared to who have usual caretaker(2).The study carryout in Machakel, children whose place of delivery at home was 4.113 times more likely to have incomplete vaccination status than children born at health institution (19).

Muslim and Protestant religions were both found to be significant predictors of untimely vaccination (AOR 3.01, 95% CI: 1.33, 6.82 and AOR 3.14, 95% CI 1.26, 8.03, respectively) compared to Ethiopian Orthodox religion(32). Compared to the children born in families without religion, those belonging to Buddhist families had significantly higher odds of getting age appropriate vaccination for BCG Hep B and OPV0(30).The odds of having child full vaccination among ever married mothers were 0.45 [AOR = 0.45, 95% CI: 0.22 − 0.94] times among children of not married mothers(10).The odds of having child full vaccination among ever married mothers were 0.45 [AOR = 0.45, 95% CI: 0.22 − 0.94] times among children of not married mothers(10).Children from households of smaller size (≤5 members) were 1.45 times more likely not to receive the recommended BCG vaccine schedule (AOR = 1.45, 95% CI = 1.06, 1.97 and p < 0.05) as compared to larger households.Comparatively, children of the younger mothers (<20 and 20-34 were at (3.21 and 3.01 times)higher risk of incomplete vaccination than those older mothers(>34years) (15).Children at ≤ 30 minutes travel time to the nearest vaccination site were less likely to be fully vaccinated when compared to child who had > 30 minutes travel time (AOR: 0.47, 95% CI: 0.33, 0.65)and mothers who live in urban (AOR: 2.1, 95% CI: 1.20, 3.66) were the maternal factors that were associated with children vaccination statuses(20).

2.2.2 Maternal health service factor

Failure to participate in pregnant women's conference increases the odds of age-inappropriate pentavalent one vaccination by 2.7 times compared to mothers who have 3 or more participation in pregnant women's conference. Children from mothers having three or more ANC follow up had a better chance of being vaccinated age-appropriately than children who were born from mothers who had low or no ANC follow up were 2.549 times more likely default to complete vaccination(2, 19).Children who were born from mothers who had no PNC visit were 2.512 times more likely to default to complete vaccination compared to children who were born from mothers who had PNC visit(19).

2.2.3 Obstetric factor

The study carryout in Menzlalo district, the odds of age-inappropriate pentavalent1 vaccination were decreased substantially with decreasing birth order. Unplanned pregnancy was found to increase the odds of age-inappropriate pentavalent one vaccination with two folds(2).Mothers who had more than 3 children were 3.550 times more likely to had their child incomplete vaccination status compared to mothers who had one child(19).

2.2.4. Source of information

As previous study had showed that the presence of telephone (mobile telephone) availability in the household was found to decrease the odds of age-inappropriate pentavalent one vaccination with more than two folds(2). This is indeeded true that the available of the information accessing materials would enable to get more message about children vaccination and utilization

2.3. Conceptual frame work

To asses associated factors of age apropraite vaccination coverage of BCG, pentavalent 1-3 and measles for children 12-23 months of age.This framework will be identify the associated factors of age appropriate vaccination coverage.
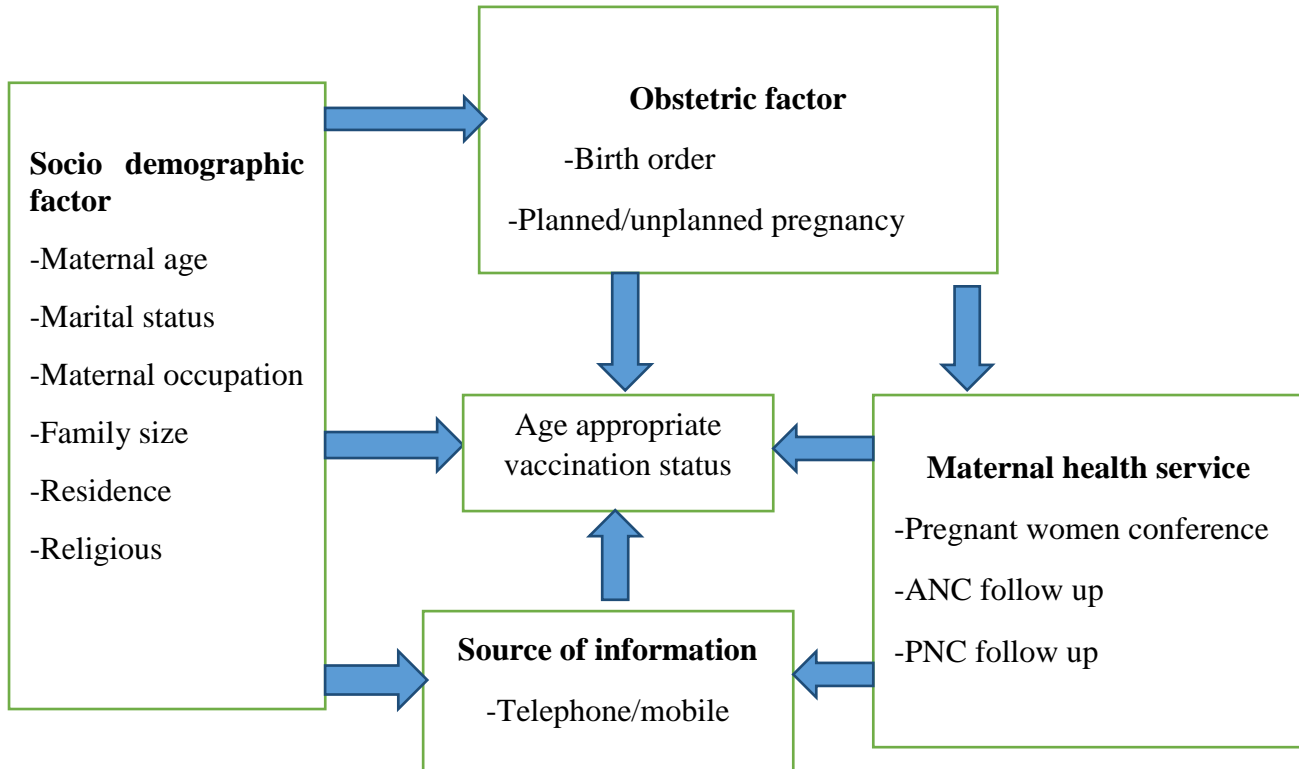
Figure 1:Conceptual framework to determinants of age appropriate child immunization of the children aged between12-23months(33-35)

3. Objectives

3.1 General objective

To assessage appropriate vaccination coverage and its associated factors of BCG, pentavalent 1-3 and measles vaccine for children 12-23 months of age in Ankesha Guagusa district, Awi Zone, Northwest, Ethiopia from September 2021 to October, 2021.

3.2 Specific objectives

- To determine age appropriate vaccination coverage of BCG vaccine in Ankesha Guagusa district
- To determine age appropriate vaccination coverage of pentavalent 1-3 vaccine in Ankesha Guagusa district
- To determine age appropriate vaccination coverage of measles vaccine in Ankesha Guagusa district
- To identify the associated factors that affect timely or age appropriate vaccination coverage of BCG, pentavalent 1-3 and measles vaccine in Ankesha Guagusa district

4. Methods

4.1 **Study area and period**

The study was conducted in the AnkeshaGuagusa district from September 2021 to October 2021. Ankesha Guagusa is one of the districts from the Awi Zone of the Amhara region. The district is located in the north western part of Ethiopia, approximately 449 km north-west of Addis Ababa, from Bahir Dar the capital city of Amhara region 140km southwest, 19 km from Zonal town Injibara and AgewGimjabet is a town of the Ankesha Guagusa district. Ankesha Guagusa district is bounded; on the south by Ayehu Guagusa, on the west by Guangua, on the north by BanjaShekudad and on the east by Guagusa Shekudad. The total population of the district are 110066. Of which 55,253 are females. From the total population residing in the district, the targeted childbearing age groups are 25,954. In this district population residing in urban area are 15278(14.3%). The district has two urban and 16 rural administrative kebeles with one primary hospital, four health centers, 18 health posts and minimum two health extension workers in each health posts owned by the government which gives health service to the population.Moreover, each of the health post has static and outreach immunization sites that the service is delivered.

4.2 **Study design**

A community based cross-sectional study design was conducted.

4.3 **Population**

4.3.1 Source of population

The source population was All mother/caregiver who have12-23 months of age children in Ankesha Guagusa district.

4.3.2 **Study Population**

All 12-23 months of age children who were vaccinated, have vaccination card and residing permanently in the Ankesha Guagusa district during the study period.

4.4 Eligibility criteria

4.4.1 Inclusion criteria

Mothers/caregivers who have 12-23months of age children residing permanently (12 months or more than) in Ankesha Guagusa district who were vaccinated and have vaccination card with recorded vaccination date.

4.4.2 Exclusion criteria

Mothers/Caregivers who have 12-23 months of children were not get severely ill during data collection

4.5 Sample size determination and sampling technique

4.5.1. Sample size determination

4.5.1.1 *Single*population proportion sample size determination

The sample size were described by using a single population proportion formula by considering the following assumptions: 95% confidence level, 5% margin of error, and from a similar study conducted in North Showa zone Menzlalo district,39.1% of pentavalentone,36.3% pentavalent two,30.3% pentavalent three and 26.4% measles coverage of age appropriate vaccination(2). $n = z^2 x P (1-p)/d^2$,

Table 1: Sample size calculation by using $n = z^2 x P (1-p)/d^2$ (Single population proportion formula) for each vaccine

	Proportion(p)	95% CI	5%expected margin of error(d)	Calculated as
Pentavalent one	39.1%	1.96	0.05	n=1.96*1.96*0.391(1-0.391)/0.05*0.05=366 Non-respondent 10%=37 ,Total 403
Pentavalent two	36.3%	1.96	0.05	n=1.96*1.96*0.363(1-0.363)/0.05*0.05=355 Non-respondent 10%=36,total 391
Pentavalent three	30.3%	1.96	0.05	n=1.96*1.96*0.303(1-0.303)/0.05*0.05=325 Non-respondent 10%=33,total 358
Measles	26.4%	1.96	0.05	n=1.96*1.96*0.264(1-0.264)/0.05*0.05=299 Non-respondent 10%=30,total 329

The finalmaximum sample size was 403 children.

4.5.1.2. **Associated factor sample size determination**

Table 2: Sample size calculation using epi info version 7.2.1.0 for associated factors done at different region of Ethiopia.

Variables	Category	Pentavalent 1 vaccination status		% of outcome in exposed	% of outcome in non-exposed		Confidence		Total sample size	Reference
		Age inappropriate	Age appropriate			Power	Level	AOR		
Pregnant women conference	Not participate	182(71.3)	73(28.6)	76.7	28.6	80	95	2.74	191	(2)
	≥3participate	17(23.2)	56(76.7)							
Residence	Urban	159(36)	282(63.9)	63.9	52.1	80	95	2.1	268	(10)
	Rural	186(47.8)	203(52.1)							
Marital status	Not married	13(25.4)	38(74.5)							
	Married	332(42.8)	447(57.3)	57.3	74.5	80	95	0.45	249	(10)
Knowledge about vaccination	Insufficient	151(78.2)	42(21.7)							(2)
	Sufficient	104(46.4	120(53.5)	53.5	21.7	80	95	2.68	217	
Place of delivery	Home	131(62.6)	78(37.3)							(10)
	Institution	214(34.4)	407(65.5)	65.5	37.3	80	95	2.1	277	
ANC follow up from index child	Yes	279(37.9	457(62)	62	29.7	80	95	3.09	137	(10)
	No	66(70.2)	28(29.7)							

When I compare the associated factor sample size of 277 and the single population proportion sample size 366, the largest one is single population proportion sample size. So I use the single population proportion 366 sample size. The non-respondent is the same for both, that is 10%

4.5.2. Sampling technique

All 18 kebelewere included in the study. First of all, the eligible children list of age 12–23 months was taken from all health posts EPI registration. Then proportional to size allocation were made to determine the required sample size from each kebele. Finally, simple random sampling technique were employed to select the required number of children from each kebele using the listed children as a sampling frame.

Proportional allocation were used from each kebele to calculate the required sample size based on the previous September and October average performance of pentavalent one vaccination in three consecutive years. The proportional allocation for 18 kebele related to pentavalent one vaccination service were presented in figure 2.
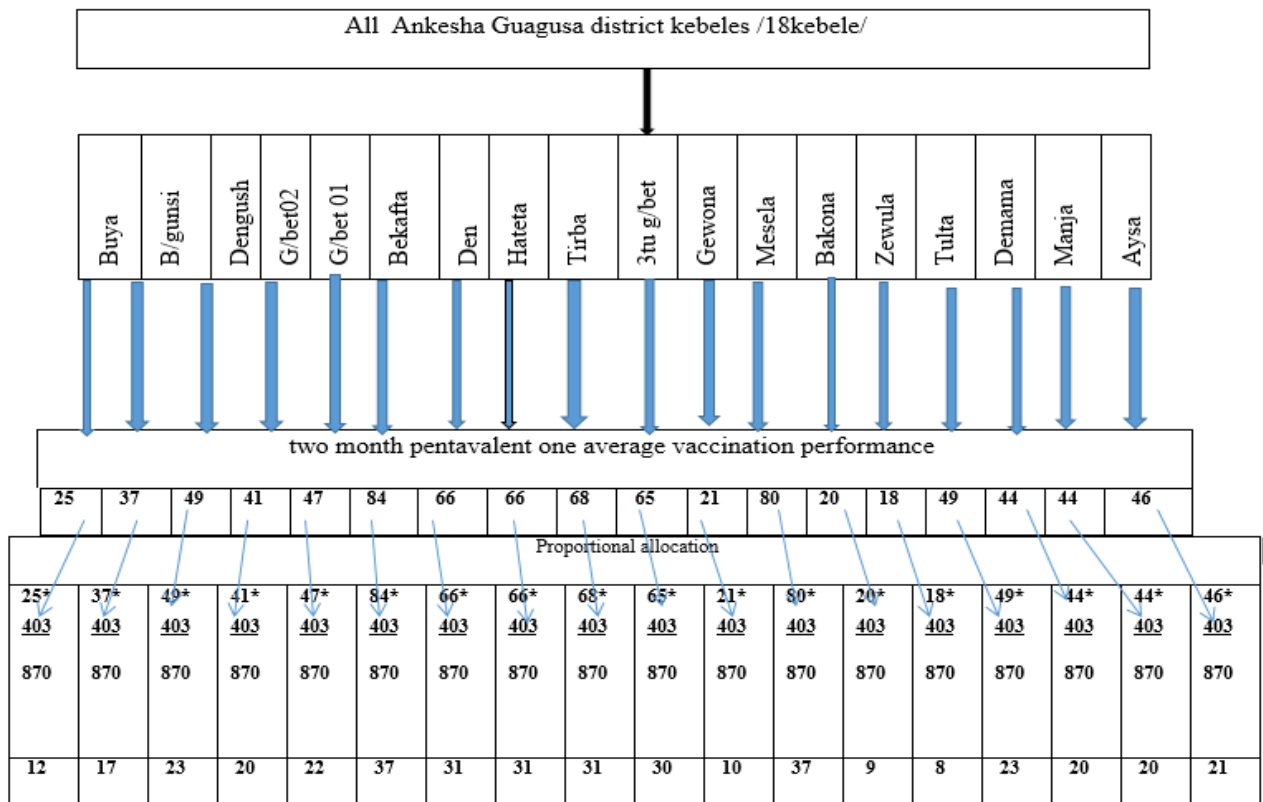
Figure 2: Sampling proportion allocation procedure for twelve health post facilities of Ankesha Guagusa.

Total sample size=403

To calculate proportional sample size from each kebele we use this calculation. example, 25 three year two month average performance, 403 total sample size and 870 three year two month total summation, 25*403/870=12

4.6. Data collection

4.6.1 Data collection tool and procedure

Questionnaire were used to gather data. The questionnaire was prepared in English language was translated into Amharic and administered into face to face interview approach. The questionnaire includes socio-demographic and economic factors, vaccination status of child, maternal health service utilization, knowledge and attitude of vaccination and mothers/caregivers reason for early or late vaccination. The tool adapted from WHO recommendation vaccination schedule and other literature age appropriate vaccination questionnaire included(2). The vaccination status of childrenwere collected from children's vaccination card, registration book. For data collection eighteen diploma nurses were participating. All children houses were addressed. When the mothers/caregiver's are not present at first visit, the second visit were conducted and addressed. However temporary residing population were not included.

4.7 Dataquality assurance

For the common understanding from each questions and the study objectives on-site training were carried out on the contents of the questionnaire, on the steps of data collection, quality assurance techniques and ethical conduct of human research were provide for all data collectors prior to the commencement of the study. When the eligible children is missed, we were cross- checked on the list of eligible. Pretest were conducted on 5% from the total sample size outside the study area (in Ayehu Guagusa district health posts (10 samples from 3tu shumata health post)and Guagusa shikudad district health post (10 samples Zala health post). Feedback, suggestions, and comments were obtained from the pre-tested questionnaire were incorporated in the final version of the instrument. Generally the principal investigator was supervise the overall data collection process.

4.8 Study variable

Dependent variable

❖ Age appropriate vaccination coverage status of BCG, pentavalent 1-3 and measles vaccine (outcome)

Independent variable

Socio demographic: -Maternal age, marital status, maternal and husband occupation, maternal and husband education, religion, income, knowledge of vaccination, residence, sex of child, family size, distance of vaccination site, place of delivery.

Obstetrics factors: birth order, planned/unplanned pregnancy, parity.

Source of information about age appropriate vaccination: Mass Media and other communication materials of Telephone, Radio, Television.

Maternal health service: ANC visit, pregnant mother conference, PNC.

4.9. Operational definitions

A pentavalent vaccine: is Five individual conjugated vaccines combined in to one vial to protect from five infectious disease and pentavalent one at 6 weeks, pentavalent two at 10 weeks and pentavalent three at 14 weeks. The five vaccines are diphtheria, tetanus, pertussis (whooping cough), hepatitis B and Haemophilus influenza type b (Hib).

Age-appropriate vaccination(timely):a child is vaccinated at the time of vaccine administration or within one month after the minimum age to administer the dose as recommended by WHO(1).

Age-inappropriate vaccination (untimely): a child is vaccinated before and/or after the WHO recommended age.

Delayed vaccination: is measured as not having received the recommended vaccine doses within one month beyond the minimum age. Accordingly, BCG, the pentavalent1–3 and measles vaccine doses were categorized as delayed at>28, >70, >98, and >126 and >300 days respectively (Table 3).

Early vaccination: doses given before the minimum age of pentavalent one <42 days, pentavalent two <70 days, pentavalent three<98 days, measles <270 days and BCG has no (Table 3).

Permanent residing: a mother /caregiver living 12 month and above in the study area.

Kebele: the administrative unit that contains average 1500 households in Ethiopia.

Caregiver:A person that take responsibility and provide care for the index child when the biological mother couldn't give care.

Pregnant woman conference: meeting that conduct monthly at each health post level to aware about pregnancy, delivery, postnatal care, child vaccination and other related health(43).

Distance of vaccination; distance that take greater than or less than 30 minutes on foot to reach vaccination site.

Sufficient knowledge; from 10 assessment knowledge questions who scored 70% was classified as sufficient knowledge (41).

Session: appointment time that child take vaccine to complete vaccination.

Table 3: Operational definition in relation to WHO & national vaccination schedule(36, 37).

Vaccine type	Minimum interval	Early	Age appropriate	Delay
BCG	4 weeks	-	Birth to 4week	>4weeks
Pentavalent one	4 weeks	<6weeks	6 weeks to 10weeks	>10weeks
Pentavalent two	4 weeks	<10weeks	10 weeks to 14weeks	>14weeks
Pentavalent three	4 weeks	<14weeks	14 weeks to 18 weeks	>18weeks
Measles	4 weeks	<9month	9 months to 10 months	>10months

4.10 Data processing and analysis

Collected data were entered into Epi info version 7.2.1.0 and excel and finally exported to SPSS version 23 for statistical analysis. Socio-demographic, obstetric characteristics, maternal health service and information source of the respondents with descriptive statistics were used to describe the data. Tables and graphs were used to present the findings. Association between variables were assessed by using Odds Ratio, 95% confidence level and p-value <0.05. Bi-variable logistic regression analysis were done and all a p-value <0.2 in bi-variable logistic regression were entered to multivariable logistic regression analysis model with backward logistic regression procedure.Hosmer–Lemeshow goodness-of-fit was used to test model fitness that was > 0.05. Explanatory variables were tested for chi-square test before entering them into the multivariable model. Confidence interval of 95% and variables with a p - value of < 0.05 consider as a significantly associated variable for age appropriateness vaccination coverage of BCG, pentavalent 1-3 and measles vaccine.

4.11 Ethical considerations

Ethical approval was obtained from Research Ethical review board of the College of medicine and health science of Bahir Dar University. The district health office wrote permission letters to all health posts. Written informed consent were obtained from each participant (mother/caregiver). Confidentiality were assured at all levels of the study using a password-protected computer and identification of each participant was deleted and were done through numerical coding. Furthermore, all information that were obtained from the respondents were kept confidential. The data were not provided to a third party without the participant's permission. Participants had the right to refuse to participate in this research and they also had full right to withdraw from the interview at any time they wish. This study were not harm children directly or indirectly. Beneficence to children and treatment were

facilitated by principal investigator. Safety of children and mothers/caregivers were protected during data collection period by arranging free and safe data collection time.

4.12 Dissemination of the Finding

The finding of this study will be submitted to Bahir Dar University College of medical and Health Science School of Public Health in Reproductive Health. It was also be presented to Reproductive Health Department Awi Zone Health Department, Ankesha Guagusa district health offices and health facilities, administrators, responsible persons, and health professionals and publish the research finding into reputable and indexed journals.

5. Results

5.1 Socio-demographic characteristics of respondents and their children

From a total of 403 mothers/caregivers who had children aged 12 to 23 months were interviewed and the response rate were 98.9%. The median (±SD) age of mothers/caregivers was 31(±6.3) years and the range is from 15 to 50 years. All of interviewed mothers/caregivers were Orthodox Christian believers.Six(1.5%) children have no vaccination cards and their vaccination status was checked from Expanded Program of Immunizationregistration book. Three hundred fifty three (87.6%) were married. Three hundred fifty nine respondents (89.1%) were living in a rural area and 379 (94%) were self-employed. eighty three (20.6%) of children were born from unplanned pregnancy and seventy six (18.9%) were born at home.

From 403 respondents, 386(95.8%) were mothers and 17(4.2%) were caregivers. One hundred fifty four interviewers (38.2%)were not able to read and write. The proportion of female children was 217(53.8%) and fifty five (13.6%) of children were living without their fathers a minimum of two month during their one year of life. Two hundred fifty five (53.3%) pregnant women were attend pregnant women's conference at least three times until delivery. However, One hundred seventy eight (44.2%) mothers weren't attend ANC follow up three and above times (Table 4).

Table 4: Socio-demographic characteristics and maternal health service utilization and knowledge of respondents and their children in Ankesha Guagusa district, northwest Ethiopia, 2022.

Variables	Category	Frequency	percent
Relation to the index child	Mother	386	95.8
	Caregiver	17	4.2
Age of Mother/Caregiver	15-20	4	1
	21-30	186	46.2
	31-40	173	42.9
	41-50	40	9.9
Residence	Rural	359	89.1
	Urban	44	10.9
Mother's/Caregiver's education	Cannot read and write	154	38.2
	Primary	142	35.2
	Secondary	57	14.1
	Tertiary/college and above	50	12.4

Mother's/Caregiver's occupation	Government employee	24	6
	Daily Labor	34	8.4
	Merchant	11	2.7
	Farmer	334	82.9
Marital status	Married	353	87.6
	Single	28	6.9
	Divorced	10	2.5
	Widowed	12	3
Child sex	Male	186	46.2
	Female	217	53.8
Family size	1-5 members	201	49.9
	>5 members	202	50.1
Pregnancy status	Planned	303	75.2
	Unplanned	83	20.6
Telephone/mobile	Availability	320	79.4
	Unavailability	83	20.6
ANC follow up	No follow up	131	32.5
	1-2 follow up	142	35.2
	≥3 follow up	130	32.3
Pregnant women conference participation	No participation	207	51.4
	1-2 participation	132	32.8
	≥3 participation	64	15.9
PNC follow up	Not received	78	19.4
	At least once received	325	80.6
Husband's level of education	Cannot read and write	103	25.6
	Primary	180	44.7
	Secondary	55	13.6
	Tertiary/college and above	65	16.1
Husband's occupation	Government employee	34	8.4
	Daily Labor	34	8.4
	Merchant	10	2.5
	Farmer	325	80.6
Place of vaccination	Outreach	188	46.7
	Health facility	215	53.3
Knowledge about vaccination	Sufficient	355	88.1
	Insufficient	48	11.9
Vaccination sessions needed for a child to complete vaccination	Not known	51	12.7
	1-3 sessions	194	48.1
	4 sessions	158	39.2
Knowledge of vaccination schedule/program in your locality	Yes	146	36.2
	No	257	63.8

5.2 Age-appropriate vaccinations coverage

The children who received age appropriate vaccination was 7.7% (95% CI: 5.0 to 10.4) for BCG, 30% (95% CI: 25.6 to 34.7) for pentavalent one, 28.3% (95% CI: 24.3 to 33.5) for pentavalent two, 24.8% (95% CI: 20.4 to 29.3) for pentavalent three and 26.8% (95% CI: 22.1 to 31.0) for measles (Table 5).

Table 5: Timely vaccination among 12-23 months of age children in Ankesha Guagusa district, North West Ethiopia, 2022.

Time frame	BCG	Pentavalent 1	Pentavalent 2	Pentavalent 3	measles
Age appropriate	31(7.7%)	121(30%)	114(28.3%)	100(24.8%)	108(26.8%)
Early	-	56(13.9%)	32(7.9%)	1(0.2%)	134(33.3%)
Delayed	372(92.3%)	226(56.1%)	257(63.8%)	302(74.9%)	161(40%)
Total	403(100%)	403(100%)	403(100%)	403(100%)	403(100%)

5.3 Reasons for not vaccinated on time

Table 6: Reasons for age-inappropriate BCG, pentavalent 1-3 and measles vaccination among children 12–23 months of age in Ankesha Guagusa district, Northwest Ethiopia, 2022.

Reasons	Frequency	Percent
BCG	**N=372**	
the vaccine not opened for a single child	335	83.1
Mother/caregiver being too busy	12	3
For religious issue	6	1.5
Place of vaccination too far	6	1.5
Pentavalent one	**N=282**	
Mother/caregiver being too busy	72	17.9
For religious issue	46	11.4
Forgotten vaccination appointment day	38	9.4

Place of vaccination too far	26	6.5
The health worker vaccinated too early	56	13.9
Pentavalent two	**N=289**	
Mother/caregiver being too busy	70	17.4
the health worker vaccinated too early	98	24.3
Forgotten vaccination appointment day	32	7.9
Place of vaccination too far	23	5.7
Pentavalent three	**N=279**	
Forgotten vaccination appointment day	138	34.2
Mother/caregiver being too busy	89	22.1
Place of vaccination too far	21	5.2
Vaccinator being absent	17	4.2
Measles one	**N=295**	
The health worker vaccinate too early	134	33.3
the vaccine not opened the for a single child	121	30
The mother/caregiver being too busy	21	5.2
Forgotten vaccination appointment day	16	4

5.4 Age appropriate vaccination and its associated factors

There were different factors associated with untimely vaccination for BCG, pentavalent one, pentavalent two, pentavalent three and measles vaccinations.

5.4.1 Bi-variable and multi variable logistic regression analysis for BCG vaccine

Distance of vaccination, ANC follow up, birth order, family size, place of vaccination, knowledge of vaccine side effect, child sex, PNC follow up and vaccination schedule were analyzed in Bi-variable logistic regression analysis.For multivariable logistic regression analysis four variables such as distance of vaccination, ANC follow up, PNC follow up, birth order were analyzed. However, no significantly associated in multivariable logistic regression analysis(Table7).

Table 7; Factors associated with age appropriate BCG vaccination in bi-variable and multivariable logistic regression analysis among 12-23 months of age children in Ankesha Guagusa district, Northwest Ethiopia, 2022.

Variables	Category	BCG age appropriate vaccination		COR (CI, 95%)	AOR (CI, 95%)
		Age inappropriate	Age appropriate		
Distance of vaccination site	<30 minutes	201(49.9%)	22(5.5%)	1	1
	≥30 minutes	171(42.4%)	9(2.2%)	0.481(0.216-1.072)	0.553(0.245-1.245)
Birth order	1st	96(23.8%)	5(1.2%)	1	1
	2nd	51(12.7%)	7(1.7%)	**2.635(0.796-8.722)**	2.537(0.753-8.542)
	3rd	46(11.4%)	5(1.2%)	2.087(0.575-7.570)	1.954(0.532-7.179)
	4th	49(12.2%)	5(1.2%)	1.959(0.541-7.092)	1.877(0.512-6.878)
	5th and above	130(32.3%)	9(2.2%)	1.329(0.432-4.093)	1.379(0.441-4.311)
Family size	1-5 members	185(45.9%)	16(4%)	1	
	>5 members	187(46.4%)	15(3.7%)	0.927(0.446-1.931)	
Place of vaccination	Outreach	176(43.7%)	12(3%)	0.703(0.332-1.490)	
	Health facility	196(48.6%)	19(4.7%)	1	
Knowledge of Vaccine side effect	Yes	171(42.4%)	14(3.5%)		
	No	201(49.9%)	17(4.2%)	0.968(0.464-2.021)	
Knowledge of vaccination schedule/program in your locality	No	237(58.8%)	20(5%)	0.966(0.449-2.076)	
	Yes	135(33.5%)	11(2.7%)	1	
Sex of Child	Male	172(42.7%)	14(3.5%)	1	
	Female	200(49.6%)	17(4.2%)	1.044(0.500-2.180)	
PNC follow up	No	76(18.9%)	2(0.5%)	**3.723(0.869-15.949)**	3.723(0.869-15.949)
	Yes	296(73.4%)	29(7.2%)	1	1
ANC follow up	No participation	128(31.8%)	14(3.5%)	**1.937(0.757-4.961)**	1.056(0.366-3.045)
	1-2 times participation	120(29.8%)	10(2.5%)	1.476(0.544-4.005)	0.766(0.254-2.313)
	≥3 times participation	124(30.8%)	7(1.7%)	1	**1**

NB: Variables having AOR P-value ≤ 0.05* were consider as significant or associated with the independent variables.

5.5.2 Bi-variable and multivariable logistic regression analysis of pentavalent one

In bi-variable logistic regression analysis, pregnant women conference participation, ANC follow up, mother/caregivers educational level, residence, knowledge of bringing a sick child to vaccinate, pregnancy status, distance of vaccination site, place of vaccination, birth order, knowledge of vaccination session need to complete vaccination, PNC follow up, family size, place of delivery, knowledge of vaccine side effect, relation to index child, sex of index child, information source(availability of telephone) and knowledge of vaccination schedule were analyzed.In the present study, multivariable logistic regression tests were done to see factors of age appropriate vaccination in the study area. For multivariable analysis 16 variables, pregnant women conference participation, ANC follow up, mother/caregivers education, residence, knowledge of bringing a sick child to vaccinate, pregnancy status, distance of vaccination site, birth order, knowledge of vaccination session need to complete vaccination, PNC follow up, place of delivery, knowledge of vaccine side effect, relation to index child, sex of index child, information source(availability of telephone), knowledge of vaccination schedule and were considered and analyzed. ANC follow up, residence, mother/caregiver education were significantly associated with age inappropriate pentavalent one dose vaccination.

Pregnant mother who had 1-2 ANC follow up were 4.21 times (AOR: 4.21, 95% CI: 2.14-8.29) less likely to vaccinate their children timely of pentavalent one vaccination as compared to three and above ANC follow up. Children whose residence in rural area were 86.2% (AOR: 0.14, 95% CI: 0.06-0.33) less likely to receive pentavalent one vaccine timely vaccination than children whose residence were in urban area.In addition, mother/caregiver who cannot read and write were 67.2% (AOR: 0.33, 95% CI: 0.14-0.79) less likely to vaccinate their children of age appropriate pentavalent one vaccination than mother/caregiver who had tertiary educational level (Table 8).

Table 8; Factors associated with age appropriate pentavalent one vaccination of bi-variable and multivariable logistic regression analysis among 12-23 months of age children in Ankesha Guagusa district, North West Ethiopia, 2022.

Pentavalent 1 age appropriate vaccination					
Variables	Category	Age in appropriate	Age appropriate	COR (CI, 95%)	AOR (CI, 95%)
Pregnant women conference participation	No participation	163(40.4%)	44(10.9%)	**0.347(0.191-0.630)**	0.482(0.184-1.267)
	1-2 times participation	83(20.6%)	49(12.1%)	0.759(0.414-1.393)	0.937(0.460-1.910)
	≥3 times participation	36(8.9%)	28(6.9%)	1	**1**
ANC follow up	No follow up	103(3.2%)	39(9.7%)	**1.688(0.949-3.003)**	1.456(0.766-2.768)
	1-2 follow up	72 (17.9%)	58(14.4%)	**3.591(2.048-6.298)**	**4.207(2.135-8.287)**
	≥3 follow up	107(26.6%)	24(6%)	1	**1**
Mothers/Caregivers education	Cannot read and write	122(30.2%)	32(7.9%)	**0.135(0.067-0.273)**	**0.328(0.137-0.787)**
	Primary	107(26.6%)	35(7.9%)	**0.169(0.084-0.339)**	0.579(0.243-1.379)
	Secondary	36(8.9%)	21(5.2%)	**0.301(0.136-0.665)**	0.764(0.296-1.974)
	Tertiary/College and above	17(4.2%)	33(8.2%)	1	1
Residence	Rural	271(67%)	88(21.8%)	**0.108(0.053-0.223)**	**0.138(0.058-0.332)**
	Urban	11(2.7%)	33(8.2%)	**1**	**1**
Knowledge of Bringing a sick child to vaccination	No	23(5.7%)	37(9.2%)	**4.960(2.789-8.821)**	0.813(0.897-3.666)
	Yes	259(64.3%)	84(20.8%)	1	**1**
Pregnancy status	Planned	206(51.1%)	97(24.1%)	1	**1**
	Unplanned	61(15.1%)	22(5.5%)	0.766(0.445-1.319)	
Distances of vaccination site	<30 minutes	139(34.5%)	84(20.8%)	1	**1**
	≥30 minutes	143(35.5%)	37(9.2%)	**0.428(0.273-0.673)**	0.847(0.500-1.435)
Place of vaccination	Outreach	137(34%)	51(12.7%)	0.771(0.502-1.185)	
	Health facility	145(35%)	70(17.4%)	1	
Birth order	1st	62(15.4%)	39(9.7%)	1	1
	2nd	44(10. %)	14(3.5%)	**0.506(0.246-1.042)**	0.535(0.226-1.269)
	3rd	33(8.2%)	18(4.5%)	0.867(0.431-1.747)	0.936(0.372-2.354)
	4th	39(9.7%)	15(3.7%)	**0.611(0.298-1.253)**	1.063(0.439-2.574)
	5th and above	104(25.8%)	35(8.7%)	**0.535(0.307-0.931)**	1.460(0.676-3.153)
Knowledge of	Not known	149(37%)	45(11.2%)	0.883(0.433-1.800)	0.797(0.332-1.915)

Vaccination session	1-3 sessions	95(23.6%)	63(15.6%)	**1.938(0.957-3.926)**	0.894(0.338-2.366)
	4 sessions	38(9.4%)	13(3.2%)	1	1
PNC follow up	No follow up	65(16.1%)	13(3.2%)	**2.488(1.314-4.713)**	0.840(0.325-2.171)
	At least one follow up	217(53.8%)	108(26.8%)	1	**1**
Family size	1-5 members	135(33.5%)	66(16.4%)	1	
	>5 members	147(36.5%)	55(13.6%)	0.765(0.499-1.173)	
Place of delivery	Health facility	218(54.1%)	109(27.0%)	1	1
	Home	64(15.9%)	12(3%)	**0.375(0.194-0.724)**	1.021(0.164-6.374)
Knowledge of vaccine side effect	Yes	146(36.2%)	72(17.9%)	1	**1**
	No	136(33.7%)	49(12.2%)	**0.731(0.474-1.125)**	0.927(0.542-1.584)
Sex of child	Male	132(32.8%)	54(13.4%)	1	
	Female	150(37.2%)	67(16.6%)	1.092(0.712-1.675)	
Telephone/mobile	Not available	70(17.4%)	13(3.2%)	**2.743(1.543-5.180)**	1.496(0.740-3.024)
	Available	212(52.6%)	108(26.8%)	1	1
Knowledge of vaccination schedule/ program in your locality	Yes	193(47.9%)	64(15.9%)	1	1
	No	89(22.1%)	57(14.1%)	**0.518(0.335-0.801)**	1.470(0.784-2.757)

NB: Variables having AOR P-value ≤ 0.05* were consider as significant or associated with the independent variables.

5.5.3 Bi-variable and multivariable logistic regression analysis of pentavalent two

In bi-variable logistic regression analysis, pregnant women conference participation, ANC follow up, mother/caregivers educational level, residence, distance of vaccination site, place of vaccination, birth order, knowledge of vaccination session to complete vaccination, PNC follow up, family size, place of delivery, knowledge of vaccine side effect, vaccination schedule, information source(availability of mobile), sex of index child, knowledge of bringing sick child to vaccinate, were analyzed.

For multivariable logistic regression tests were done to see factors of age appropriate vaccination in the study area. For this analysis 14 variables, residence, mother/caregiver education, distance of vaccination site, birth order, place of delivery, ANC follow up, pregnant women conference, information source (availability of telephone), PNC follow up, knowledge of vaccination session need to complete vaccination, knowledge of vaccine side effect, knowledge of bringing sick child to vaccinate, and knowledge of vaccination schedule were considered and analyzed. Residence, pregnant women conference participation, family size and knowledge of vaccination side effect were play a significant role in age inappropriate pentavalent two dose vaccination (Table 9).

Children whose residence rural area were 89% (AOR: 0.11, 95% CI: 0.05-0.23) less likely to receive pentavalent two vaccine age appropriate vaccination as compared to children's whose residence were urban area. Pregnant mother who had no pregnant women conference participation were 2.48 times (AOR: 2.48, 95% CI:1.42-4.31) less likely to vaccinate their children age appropriate vaccination of pentavalent two vaccine as compared to pregnant mother who had ≥3times pregnant women conference participation. Mothers/Caregivers who had >5members in the household were 45% (AOR: 0.55, 95% CI: 0.34-0.90) less likely to vaccinate their children timely vaccination of pentavalent three vaccine than mother/caregiver who had ≤5members in the household. Moreover, mother/caregiver who had no knowledge about vaccine side effect were 1.69 times (AOR: 1.69, 95% CI: 1.03-2.76) less likely to vaccinate their children on time (Table 9).

Table 9; Factors associated with age appropriate Pentavalent two vaccination of bi-variable and multivariable logistic regression analysis among 12-23 months of age children in Ankesha Guagusa district, Northwest Ethiopia, 2022.

Variables	Category	Age in appropriate	Age appropriate	COR(CI, 95%	AOR (CI, 95%)
		Pentavalent 2 age appropriate vaccination			
Residence	Rural	276(68.5%)	83(20.6%)	**0.126(0.063-0.252)**	**0.107(0.051-0.225)**
	Urban	13(3.2%	31(7.7%)	1	**1**
Mothers/Caregivers education	Cannot read and write	125(31%)	29(7.2%)	**0.155(0.077-0.310)**	0.556(0.204-1.517
	Primary	105(26.1%)	37(9.2%)	**0.235(0.119-0.463)**	0.991(0.388-2.528)
	Secondary	39(9.7%)	18(4.5%)	**0.308(0.139-0.681)**	0.964(0.359-2.590)
	Tertiary and above	20(5%)	30(7.4%)	1	1
Distances of vaccination site	<30 minutes	148(36.7%)	75(18.6%)	1	1
	≥30 minutes	141(35%)	39(9.7%)	**0.546(0.348-0.856)**	1.093(0.631-1.894)
Birth order	1st	62(15.4%)	39(9.7%)	1	1
	2nd	41(10.2%)	17(4.2%)	0.659(0.330-1.318)	0.618(0.268-1.427)
	3rd	34(8.4%)	17(4.2%)	0.795(0.392-1.611)	0.807(0.319-2.040)
	4th	43(10.7%)	11(2.7%)	**0.407(0.188-0.882**	1.063(0.173-6.518)
	5th and above	109(27.0%)	30(7.4%)	**0.438(0.248-0.773)**	1.562(0.268-9.093)
Family size	1-5 members	131(32.5%)	70(17.4%)	1	1
	>5 members	158(39.2%)	44(10.9%)	**0.521(0.335-0.811)**	**0.552(0.337-0.904)**
Place of delivery	Health facility	223(55.3%)	104(25.8%)	1	1
	Home	66(16.4%)	10(2.5%)	**0.325(0.161-0.657)**	0.597(0.249-1.347)
ANC follow up	No follow up	105(26.1%)	37(9.2%)	1.357(0.771-2.389)	0.429(0.179-1.031)
	1-2 follow up	80(19.9%)	50(12.4%)	**2.407(1.387-4.179)**	0.602(0.213-1.702)
	≥3 follow up	104(25.8%)	27(6.7%)	1	1
Pregnant women conference participation	No participation	165(40.9%)	42(10.4%)	**1.964(1.197-3.225)**	**2.476(1.422-4.312)**
	1-2 times participation	88(21.8%)	44(10.9%)	**3.056(1.679-5.561)**	**4.406(2.296-8.458)**
	≥3 times participation	36(8.9%)	28(6.9%)	1	**1**
Place of vaccination	Outreach	140(34.7%)	48(11.9%)	0.774(0.500-1.199)	
	Health facility	149(37%)	66(16.4%)	1	
Telephone /mobile	Not available	68(16.9%)	15(3.7%)	**2.031(1.106-3.727)**	1.023(0.512-2.045)
	Available	221(54.8%)	99(24.6%)	1	**1**

PNC follow up	No follow up	66(16.4%)	12(3%)	**2.516(1.303-4.859)**	0.393(0.068-2.279)
	At least one follow up	223(55.3%)	102(25.3%)	1	**1**
Knowledge of vaccination session need to complete vaccination	Not known	155(38.5%)	39(9.7%)	0.915(0.430-1.945)	1.081(0.455-2.567)
	1-3 sessions	94(23.3%)	64(15.9%)	**2.476(1.182-5.184)**	1.869(0.739-4.729)
	4 sessions	40(9.9%)	11(2.7%)	1	1
Knowledge of vaccination side effect	No	143(35.5%)	42(10.4%)	**1.679(1.076-2.620)**	**1.690(1.034-2.764)**
	Yes	146(36.2%)	72(17.9%)	1	1
Knowledge of vaccination schedule/	No	195(48.4%)	62(15.4%)	**1.740(1.117-2.710)**	0.689(0.371-1.280)
	Yes	94((23.3%)	52(12.9%)	1	**1**
Sex of child	Male	133(33%)	53(13.2%)	1	
	Female	156(38.7%)	61(15.1%)	0.981(0.635-1.516)	
Knowledge of bringing the sick child to vaccination	No	27(6.7%)	33(8.2%0	**3.953(2.244-6.965)**	1.673(0.794-3.527)
	Yes	262(65%)	81(20.1%)	1	1

NB: Variables having AOR P-value ≤ 0.05* were consider as significant or associated with the independent variables.

5.5.4 Bi-variable and multivariable logistic regression analysis for pentavalent three

In bi-variable logistic regression analysis, pregnant women conference participation, ANC follow up, mother/caregivers educational level, residence, distance of vaccination site, birth order, knowledge of vaccination session need to complete vaccination, PNC follow up, family size, place of delivery, vaccination schedule, information source(availability of telephone), place of vaccination, knowledge of vaccine side effect, knowledge of bringing of sick child to vaccinate and were analyzed.

Multivariable logistic regression tests were done to see factors of age appropriate vaccination in the study area. For multivariable analysis 11 variables were used. Mother/caregiver education, distance of vaccination site, birth order, family size, place of delivery, ANC follow up, pregnant women conference, PNC follow up, knowledge of vaccination session need to complete vaccination, and knowledge of vaccination schedule, knowledge of bringing sick child to vaccinate and analyzed. Mother/Caregiver educational level and pregnant women conference participation were play significant association to age inappropriate pentavalent three dose vaccination.

Regarding to educational level of mother/caregiver, mother/Caregiver who cannot read and write were 68% (AOR: 0.32, 95% CI: 0.16-0.66) less likely to vaccinate their children timely vaccination of pentavalent three vaccination when compared to tertiary educational level of mother/caregiver. Pregnant mother who had 1-2 times pregnant women conference participation were 2.53 times (AOR: 2.53, 95% CI: 1.29—4.94) less likely to vaccinate their children timely vaccination of pentavalent three vaccine. (Table10).

Table 10; Factors associated with age appropriate Pentavalent three vaccination of bi-variable and multivariable logistic regression analysis among 12-23 months of age children in Ankesha Guagusa district, Northwest Ethiopia, 2022.

	Pentavalent 3 age appropriate vaccination				
Variables	Category	Age in appropriate	Age appropriate	COR (CI, 95%)	AOR (CI, 95%)
Residence	Rural	272(67.5%)	87(21.6%)	0.763(0.382-1.522)	
	Urban	31(7.7%)	13(3.2%)	1	
Distances of vaccination site	<30 minutes	157(39%)	66(16.4%)	1	1
	≥30 minutes	146(36.2%)	34(8.4%)	**0.554(0.346-0.887)**	0.850(503-1.438
Mothers/Caregivers education	Cannot read and write	125(31%)	29(7.2%)	**0.295(0.148-0.588)**	**0.320(0.156-0.656)**
	Primary	110(27.3%)	32(7.9%)	**0.370(0.187-0.733)**	**0.461(0.228-0.931)**
	Secondary	40(9.9%)	17(4.2%)	**0.541(0.244-1.199)**	0.678(0.299-1.536)
	Tertiary/college and above	28(6.9%)	22(5.5%)	1	1
Birth order	1st	70(17.4%)	31(7.7%)	1	1
	2nd	43(10.7%)	15(3.7%)	0.788(0.382-1.625)	0.718(0.321-1.604)
	3rd	35(8.7%)	16(4%)	1.032(0.499-2.136)	1.313(0.558-3.091)
	4th	44(10.9%)	10(2.5%)	**0.513(0.229(1.149)**	1.383(0.244-7.832)
	5th and above	111(27.5%)	28(6.9%)	**0.570(0.315-1.030)**	1.824(0.335-9.932)
Family size	1-5 members	141(35%)	60(14.9%)	1	1
	>5 members	162(40.2%)	40(9.9%)	**0.580(0.367-0.919)**	0.709(0.408-1.229)
Place of delivery	Health facility	235(58.3%)	92(22.8%)	1	1
	Home	68(16.9%)	8(2%)	**0.301(0.139-0.650)**	0.687(0.107-4.428)
ANC follow up	No follow up	111(27.5%)	31(7.7%)	1.184(0.656-2.137)	0.488(0.218-1.090)
	1-2 follow up	86(21.3%)	44(10.9%)	**2.169(1.230-3.826)**	0.692(0.260-1.837)
	≥3 follow up	106(26.3%)	25(6.2%)	1	1
Pregnant women conference participation	No participation	169(41.9%)	38(9.4%)	**1.732(1.032-2.907)**	1.547(0.871-2.746)
	1-2 times participation	95(23.6%)	37(9.2%)	**2.851(1.544-5.204)**	**2.525(1.289-4.944)**
	≥3 times participation	39(9.7%)	25(6.2%)	1	**1**
Telephone/ mobile	Not available	66(16.4%)	17(4.2%)	1.360(0.755-2.450)	
	Available	237(58.8%)	83(20.6%)	1	

PNC follow up	No follow up	70(17.4%)	8(2%)	**3.455(1.599-7.464)**	2.060(0.885-4.799)
	At least one follow up	233(57.8%)	92(22.8%)	1	**1**
Knowledge of vaccination session need to complete vaccination	Not known	154(38.2%)	40(9.9%)	1.633(0.684-3.897)	1.480(0.591-3.704)
	1-3 sessions	105(26.1%)	53(13.2%)	**3.173(1.338-7.522)**	1.946(0.708-5.348)
	4 sessions	44(10.9%0	7(1.7%)	1	1
Knowledge of vaccination schedule/ program in your locality	No	205(50.9%)	52(12.9%)	**1.931(1.219-3.060)**	1.436(0.828-2.491)
	Yes	98(24.3%)	48(11.9%)	1	1
Place of vaccination	Outreach	143(35.5%)	45(11.2%)	0.915(0.581-1.441)	
	Health facility	160(39.7%)	55(13.6%)	1	
Knowledge of vaccine side effect	Yes	164(40.7%)	54(13.4%)	1	
	No	139(34.5%)	46(11.4%)	1.005(0.639-1.582)	
Knowledge of bringing sick child to vaccinate	No	36(8.9%)	24(6%)	**2.342(1.317-4.166)**	1.045(0.484-2.256)
	Yes	267(66.2%)	76(18.9%)	1	1

NB: Variables having AOR P-value ≤ 0.05* were consider as significant or associated with the independent variables.

5.5.5 Bi-variable and multivariable logistic regression analysis for measles

In bi-variable logistic regression analysis, pregnant women conference participation, ANC follow up, mother/caregivers educational level, distance of vaccination site, birth order, knowledge of vaccination session to complete vaccination, PNC follow up, family size, place of delivery, vaccination schedule, information source (availability of telephone), place of vaccination, sex of index child, knowledge of bringing sick child to vaccinate, vaccination side effect were analyzed.Multivariable logistic regression tests were done to see factors of timeliness of vaccination. For multivariable analysis four variables were used, mother/caregiver education, ANC follow up, knowledge of vaccination session to complete vaccination, knowledge of vaccine side effect were considered and analyzed. Knowledge of vaccination session need to complete vaccination was   significantly associated to untimely measles dose vaccination.

Mother/caregiver who had knowledge about one to three vaccination sessions need to complete vaccination were 2.29 times (AOR: 2.29, 95% CI: 1.036-5.058) less likely to vaccinate timely for measles vaccination as compared to mother/caregiver who know four session need to complete vaccination (Table 11).

Table 11; Factors associated with age appropriate measles vaccination of bi-variable and multivariable logistic regression analysis among 12-23 months of age children in Ankesha Guagusa district, North West Ethiopia,2022.

		Measles age appropriate vaccination			
Variables	Category	Age in appropriate	Age appropriate	COR (CI, 95%)	AOR (CI, 95%)
Distances of vaccination site	<30 minutes	167(41.4%)	56(13.9%)	1	
	≥30 minutes	128(31.8%)	52(12.9%)	1.211(0.779-1.885)	
Mothers/Caregivers education	Cannot read and write	110(27.3%)	44(10.9%)	0.850(0.427-1.694)	1.025(0.504-2.081)
	Primary	103(25.6%)	39(9.7%)	0.805(0.400-1.619)	1.045(0.510-2.144)
	Secondary	48(11.9%)	9(2.2%)	**0.398(0.158-1.007)**	2.086(0.812-5.364)
	Tertiary/college and above	34(8.4%)	16(4%)	1	1
Birth order	1st	72(17.9%)	29(7.2%)	1	
	2nd	39(9.7%)	19(4.7%)	1.210(0.602-2.430)	
	3rd	39(9.7%)	12(3%)	0.764(0.351-1.662)	
	4th	39(9.7%)	15(3.7%)	0.955(0.458-1.992)	
	5th and above	106(26.3%)	33(8.2%)	0.773(0.432-1.383)	
Family size	1-5 members	143(35.5%)	58(14.4%)	1	
	>5 members	152(37.7%)	50(12.4%)	0.811(0.521-1.262)	
Place of delivery	Health facility	239(59.3%)	88(21.8%	1	
	Home	56(13.9%)	20(5%)	0.970(0.551-1.708)	
ANC follow up	No follow up	107(2.5%)	35(8.7%)	1.101(0.630-1.925)	0.924(0.510-1.673)
	1-2 follow up	87(21.6%)	43(10.7%)	**1.664(0.963-2.876)**	1.248(0.637-2.444)
	≥3 follow up	101(25.1%)	30(7.4%)	1	1
Pregnant women conference participation	No participation	154(38.2%)	53(13.2%)	1.048(0.638-1.723)	
	1-2 times participation	97(24.1%)	35(8.7%)	1.321(0.715-2.440)	
	≥3 times participation	44(10.9%)	20(5%)	1	
Place of vaccination	Outreach	134(33.3%)	54(13.4%)	1.201(0.773-1.868)	
	Health facility	161(40%)	54(13.4%)	1	
Telephone/mobile	Not available	57(14.1%)	26(6.5%)	0.755(0.446-1.280)	
	Available	238(59.1%)	82(20.3%)	1	
PNC follow up	No follow up	56(13.9%)	22(5.5%)	0.916(0.528-1.590)	
	At least one follow up	239(59.3%)	86(21.3%)	1	

Knowledge of vaccination session.	Not known	147(36.5%)	47(11.7%)	1.492(0.676-3.292)	1.492(0.676-3.292)
	1-3 sessions	106(26.3%)	52(12.9%)	**2.289(1.036(5.058)**	**2.289(1.036-5.058)**
	4 sessions	42(10.4%)	9(2.2%)	1	1
Knowledge of vaccination side effect	Yes	143(35.5%)	42(10.4%)	1	**1**
	No	152(37.7%)	66(16.4%)	**0.676(0.432-1.060)**	0.699(0.444-1.101)
Knowledge of vaccination schedule/	Yes	191(47.4%)	66(16.4%)	1	
	No	104(25.8%)	42(10.4%)	0.856(0.543-1.348)	
Sex of child	Male	57(14.1%)	51(12.7%)	1	
	Female	160(39.7%)	135(33.5%)	0.943(0.606-1.467)	
Knowledge of bringing sick child to vaccinate	No	42(10.4%)	18(4.5%)	1.205(0.660-2.200)	
	Yes	253(62.8%)	90(14.9%)	1	

NB: Variables having AOR P-value ≤ 0.05* were consider as significant or associated with the independent variables.

6. Discussion

The main objective of this study is to determine the age-appropriate vaccination coverage. In this study, age-appropriate vaccination coverage were7.7%, 30.0%, 28.3%, 24.8% and 26.8% for BCG, pentavalent one, pentavalent two, pentavalent three and measles respectively. However, in the previous study pentavalent one 39.1%, pentavalent two 36.3%, pentavalent three 30.3% and measles 26.4%of age-appropriate vaccination coverage of the study conducted in Menzlalo district, eastern part of Ethiopia (2). Thislowcoveragesimilarity might be due to similar living standards between two districts. We did not found significant association for timeliness dose of the predictor variable BCG vaccine. More over the predictor BCG variable could be explained by high rate of delayed (92.3%) administration of BCG vaccine by thevaccinator.This is to prevent open vial dose wastage due to multi dose vial presentation of BCG vaccine.

In this study, educationallevelof mothers/caregiverswere a significant predictor of age-appropriate vaccinationofpentavalentone.Mother/Caregiver who cannot read and write were 67.2%(AOR: 0.33, 95%, CI: 0.14-0.79) less likely to vaccinate their children on time for pentavalent one vaccination.This result is consistent with the study conducted in Senegal, Bangladesh, Kenya and Uganda study (1, 14, 29, 39).This consistency might be due to being educated increase knowledge of mother about on the advantage of on time vaccination between different countries and it requires further investigation.

Pregnant women who had 1-2 times ANC follow up were 4.21 times(AOR:4.21, 95% CI: 2.14-8.29) less likely to timely vaccination of pentavalent one as compared to 3 and above follow up. This finding congruent with Menzlalo district eastern part of Ethiopia(2). This similarity might be due to similar attention given by the health facility professional in the district.Mothers/Caregivers place of residence had a significant predictor for age-appropriate vaccination coverage. Children who were born a place where in rural residence were 86.2% (AOR: 0.14, 95% CI: 0.06-0.33) less likely to vaccinate pentavalent one vaccination age-appropriate vaccination as compared to children born from urban area. The study finding in line with Bangladesh study and Mongolian study (29, 30, 40).This alignment might be because of place of residence is very important to get appropriate information early and helps to vaccinate the infant on the recommended time.

Family size is also another factor that affect age-appropriate vaccination of pentavalent two vaccination. Mother/Caregiver who had more than five members in the household were 45%

(AOR: 0.55, 95%, CI: 0.34-0.90) less likely to vaccinate their children on time for pentavalent two vaccine as compared to mother/caregiver who had less than or equal to five members in the household.This study result in the contrary to Bangladesh study(29).Inthis study, we found mother/caregiver who had no knowledge about vaccination vaccine side effect were 1.69 times (AOR: 1.69, 95%, CI: 1.03-2.76) less likely to receive their pentavalent two timely vaccination. This finding is congruent to Mongolian and Senegal national study (1, 30).This might be due to similar study design conducted between two countries and it requires further investigation.Mother/Caregiver who had no pregnant women conference participation were 2.48 times (AOR: 2.48, 95%, CI: 1.42-4.31) less likely to vaccinate their children age appropriate for pentavalent two vaccination than pregnant mothers who had participation of three and above conference participation. This finding is consistent with Menzlalo district eastern part of Ethiopia(2). This similarity might be because two and above conference participation and health education can change vaccination practice timely.

Pregnant mother who had 1-2 times pregnant women conference participation were 2.53 times (AOR: 2.53, 95% CI: 1.29—4.94) less likely to vaccinate their children timely vaccination of pentavalent three vaccine. On the other hand, this study finding showed that, mothers/caregivers who cannot read and write were 68% (AOR: 0.32, 95% CI: 0.16-0.66) less likely to vaccinate their children timely of pentavalent three vaccine than mothers/caregivers who had tertiary educational level.This result is consistent with the study conducted in Senegal, Bangladesh, Kenya and Uganda study (1, 14, 29, 39).

Knowledge about all vaccination session is mandatory to complete each vaccination on time. Mother/caregiver who had knowledge about one to three vaccination sessions needed to complete vaccination were 2.29 times (AOR: 2.29, 95% CI: 1.03-5.06) less likely to vaccinate timely vaccination of children for measles vaccination as compared to mother/caregiver who had knowledge of four vaccination session. This finding in line with Senegal national study and timely vaccination of measles in east China(1, 28).

7. Limitation of the study

- The limitations of this study were the study participants might have problem of remembering the frequency of maternal health service utilization factors and some of the reasons for age-inappropriate vaccination especially if the child is aged near to two years.The other limitations were the children who had vaccination records on vaccination card and vaccination registration book were included only. This exclusion of children without vaccination card and vaccination registration may lead to low age-appropriate vaccination coverage if the children were more likely receive timely.

8. Conclusions and recommendations

8.1 Conclusions

In this study area, age appropriate vaccination coverage proportion of BCG,pentavalent 1-3 and measles vaccine were low. Family size, vaccine side effect, educational level of mother/caregiver, not participating pregnant women conference, lack of information due to rural residence, failure to ANC follow up and insufficient knowledge of vaccination session need to complete vaccination are significant factors for pentavalent one, pentavalent two, pentavalent 3 and measles vaccine.

8.2 Recommendation

- Health facilities at all level should focus on timeliness of vaccination to minimize early and delayed vaccination.
- The kebele health post, cluster health centers, district health office and Zone health department should also repeatedly aware on vaccine side effect, ANC follow up, advantage of pregnant women conference and vaccination session.
- Maternal knowledge should be improved about on time vaccination of pentavalent one,pentavalent two, pentavalent three and measles and continuous follow up should be conducted to recognize the appointment day of each vaccine to increase timeliness of vaccination coverage.

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Annex 1: Information Sheet (English version)

Information sheet:

Greeting

Hello, how are you dear respondents?

My name is -------------------. I am a member of the research team conducted by GirmayeMamo in Reproductive health department of public health conducting << age appropriate vaccination coverage and its associated factors of BCG, pentavalent 1-3 and measles vaccine for children 12-23 months of age >> in Ankesha Guagusa district, Awi Zone, Amhara regional state, northwest, Ethiopia. I am here to gather information about age appropriate vaccination coverage and its associated factors of BCG, pentavalent 1-3 and measles vaccine for children 12-23 months of age. Therefore, I want to ask you some questions to take parts in this research. Your name will not be included in the information. I promise to keep the confidentiality of your response. The interview will take about 30 minutes.

Are you willing to participate in the study? Yes_____   No_____

B.Consent form:

I have been requested to participate in the study of '' age appropriate vaccination coverage and its associated factors of BCG, pentavalent 1-3 and measles vaccine for children 12-23 months of age. I clearly understood the objective. Since it doesn't affect my personal life, I don't need any remedy. Consequently, I here approve my consent to take part in the study as an Interviewee with my signature. It is therefore with full understanding of this situations that I agreed to give the informed consent voluntarily to the researcher to give an information.

I---------------------------- after being fully informed about the detail of this study here by give my consent to participate in this study.

 Name of Participant----------------------------Signature_____ date_____

 Name of data collectors _____ signature------------------ date_____

Name of Principal Investigator_____ signature------------------ date_____

Bahir Dar University College of Medical and Health Science School of Public Health in Reproductive Health Department

Annex II: Questionnaire Date……..…./………../2021

Questionnaires' to assess age appropriate vaccination coverage and its associated factors of BCG,pentavalent 1-3 and measles vaccine for children 12-23 months of age in AnkeshaGuagusa district, July 2021.

This questionnaires is prepared for collecting data about age appropriate vaccination coverage and its associated factors of BCG,pentavalent 1-3 and measles vaccine for children 12-23 months of age.

Questionnaire Number: _____

Name of data collector _____ Signature _____Date_____

Name   ofsupervisor_____Signature_____Date_____Part I:PartI;Socio demographic characteristics

S,N	Question	Choice of response	code	skip
1	Relation to the child	A. Mother B. Caregiver		
2	Age	---------------		
	Religion	----------------		
	Residence	A. Urban B. Rural		

3	What is your level of education?	A. Cannot read and write B. primary C. secondary D. Diploma E. Level----------(1,2,3,4,---) F. University degree G. Other (specify) ……		
4	What is your job?	A. House wife B. Farmer		
		C. Government employee D. Merchant E. Daily laborer F. Others, specify_____		
5	What is your current marital status?	A. married B. Single C. Divorced D. windowed.		
6	What is the sex of the index child?	A. Male B. Female		
7	Date of birth of index child?	------month------date------year		
8	What is the birth order of the index child?	-------------------		

9	Number of children ever born by the mother/caregiver?	--------------------		
10	What was the pregnancy status of the index child?(Ask only mothers)	A. Planned B. unplanned C. wanted D. unwanted		
11	How many people are living in your household?/including index child	----------------------		
12	Is the father of the index child living with him/her since birth?	A. Yes B. No If no, for how long …………..................		
12	Is the father of the index child living with him/her since birth?	A. Yes B. No		
13	Was there any one who give care for this child for more than a week in the absence of you?	A. Yes B. No If yes, for how much days?		
14	Do you have the telephone in your home?	A. Yes B. No		

15	What is your husband's level of education?	A. Cannot read and write B. Primary C. Secondary D. Diploma E. Level--------(1,2,3,4---) F. University degree G. Other (specify)		
16	What is your husband's job?	A. Farmer B. Merchant Daily laborer Government employee E. others, specify_____		
17	From where your child gets vaccination?	A. Health centers B. Health post C. Hospital D. Outreach site		
18	How far is your home from the place where your child gets vaccination?	………………minute/Hour		
19	What mode of transport you use to go to vaccination site?	A. On foot B. By horse C. By car		

Part II; Maternal health health service utilization(only for mothers)

20	Have you attended antenatal care during	A. Yes		

	your last pregnancy?	B. No		
21	If yes, how many times did you attend?	---------------		
22	Have you received tetanus vaccination during your last pregnancy?	Ayes B. No		
23	If yes, how many injections did you received?	---------------------		
24	Have you participated on pregnant women conferences held at health facilities or anywhere?	A. Yes B. No		
25	If yes, how many times	---------------------		
26	Where have you delivered your last child?	A. At hospital B. Health centers C. Health Post D. At home		
27	Have you received postnatal care service from health facilities during your last birth child?	A. yes B. No		
28	If yes, how many times did you received PNC?	--------------------		

Part III Knowledge Questions

29	Have you heard about vaccination?	A. Yes B. No		

30	What is the importance of vaccinating a child?	A. To prevent the disease B. For child health C. Don't know D. Other, specify -------		
31	Have you heard about vaccine preventable disease?	A. Yes B. No		
32	What vaccine preventable diseases do you know?	A. Polio B. Measles C. Tuberculosis D. Diphtheria E. Diarrhea/rotavirus F. Tetanus G. Hepatitis B H. Hib infection I. Pneumococcus J. Pertussis K. BCG		
33	Do vaccines have side effect?	A. Yes B. No		
34	If yes, what side effect do you know?	A. fever & pain B. swelling & irritation at the injection C. Anaphylactic stocks		

		D. Needle stick injury		
		E. vaccine induced disease.		
		F. Intussusception		
35	How many vaccination sessions are needed for a child to be completely vaccinated?	-------------		
36	Do you know the vaccination program/schedule/ of your locality?	A. Yes B. I don't know		

37. If yes, do you tell me the 1st, 2nd, 3rd and 4th appointment weeks for each vaccine?

Antigen	Weeks/Dates vaccine to be given		
38.Pentavalent 1/ask when to start/			
39..Pentavalent 2/ ask the next appointment/			
40.Pentavalent 3/ask the 3rd appointment/			
41.Measles 1/ask the when to complete/			
42.BCG/ask when to vaccinate			
43	Do you think vaccinating a child have harmful effects?	A. Yes, negative effect outweighs benefits B. No, benefit out weight negative effect		

| 44 | Do you bring a sick child for vaccination? | A. Yes   B. No | | |
| 45 | Do you advice vaccinating a child for your friends? | A. yes   B. no | | |

Part IV. Vaccination status of the index child

46.Date of birth of infant……………….. Sex…………….

Antigen	*Date given/did/mm/my*	*Data source / VC or FR*	*Reasons for delayed or too early administration of each dose. Each reason has a code in Part V. So enter the code her for each dose*
BCG			
Pentavalent 1			
Pentavalent 2			
Pentavalent 3			
Measles l			

Note: VC= Vaccination card   FR= Facility register

Part V: Reasons given by mother/caregiver for delayed or too early vaccination

Ask mothers/caretakers who did not bring their infant for vaccination within the recommended vaccination schedule and the reasons for the delay or too early vaccination. Circle each of the response given by respondents.

1. Mother being too busy

2. Fear of side effect/Pain, fever, needle injury /after injection

3. My child get ill after injection /Pain & fever developed/, that is why I couldn't returned

4. The vaccine will not be opened for a single child said health workers

5. For religious issue/ ክርስትና መስላልወጣ ዉ

6. Child get ill on appointment day

7. I do not know when the vaccination will be started or given

8. Being unaware of the need to return for subsequent doses

9. Forgotten vaccination appointments

10. Place of vaccination too far away

11. Place of vaccination unknown

12. Day or time of vaccination inconvenient

13. Place of vaccination inconvenient

14. Long waiting time at vaccination site

15. De-satisfied with health facility staffs

16. Vaccinator being absent

17. Mother get ill on appointment day

18. Child is taking other drugs

19. Post phoned by health professionals due to medical illness

20. Vaccine stock-outs

21. Being unaware of the need to vaccinate her child

22. Vaccination did not prevent disease

23. No appointment for subsequent doses

24. Health professional vaccinated the child too early

25. Others……………………………………………………………………………………

Part VI Additional Note by Interviewer

1.
Note………………………………………………………………………………………………
…………………………………………………………………………………………

The impression of interviewer about the interview

Fully trustable   2.Moderate   3. Not trustable

Name and Signature of the interviewer…………….……………….

Date……<u>ክፍል 2፡ የ ስነ ህዝብእናኢኮኖሚክስታሪከበአሚርኛ</u>

1.የ ተሳታፊዋግነ ትህ .እናትለ. ተንከባካቢ

2. እድሜዎስንትነ ዉ…………... የ መዓሪያቦታህ. ገጠርለ. ከተማ   ህይጧት………………

3. የ ትምህርትደረጃዎንሊነ ግሩኝይችላሉ ?

ሀ .አላነ ብምእልጽፍም   ለ. አነ ባለሁእጽፋለሁ   ሐ. ----------- ክፍልጨርሻለሁ

መ. ዲፕሎማሥ. ሌቨል --------- ረ .ዩኒቨርሲቲዲግሪሽ. ሌላካለይጠቀስ …………….

4. ስራሽምንድንነ ዉ? ……………………………………………………...

ሀ. የ ቤትእሜቤተለ. አርሶአደርሐ. የ መነግስትስራተኛም. ነ ጋዴ ሠ. የ ቀንስራተኛረ. ሌላ------

5. የ አሁነ የ ጋብቻሽሁኔ ታምንድንነ ዉ?ሀ. ያገ ባለ. ብቸኛሐ. የ ተፋታዉ በሞትምክንያትየ ተለያየ

6. ከ 12 እስከ 24 ወርእምክልልወስጥያለዉየ ሚጪሻ ወልጅሽ/Index child/ ጾ ታ…………

7.መቼነ ወያ ተወለደዉ.?……………ወር ………ቀን ………ዓ. ም (ወሩብቀጥሳይሆንበስማማጣቀስአለበት)

8.ህጻኑሲወለድለ ቤቱስንተኛልጅነ ዉ.?…………………

9.ህጻ ኑ/ index child/ስንትታላ ቅወንድምኖ ህትአለ ዉ?

10. እስካሁንድረስምንያክልልጆችን ወልደሻል ? …………………

11.የ ህጻ ኑ/ index child/ የ እርግዝናሁኔ ታምንይመስለነ በር ? (ለወላ ጅእናትብቻየ ሚጠየ ቅጥያቄ)

ሀ .የ ታቀደ   ለ .የ ተፈለገ   ሐ. የ ሚጄ ገ ፍሙ ያልታቀደ   ሰ .የ ሚየፈሊግ

ሸ .ያልተደገ ፈ

12.በቤትወስ ጥስንትህናችሁነ ወያ ምትኖሩት ? ………………………

13.የ ህጻ ኑአባትከተወለደጄምሮየ ሜጣረ ወከህጻ ኑጋርአብሮትነ በርእንዴ?ሀ. አዎለ. አይደለም

ሜሱአይደለምክሆነ ፤ ለምንያክልግዜተለይቶትያ ዉቃል……….................

14.የ ህጻ ኑእድሜክ 1 አመትበታችእያለከሳምንትበላይለሆነ ግዜተለይተሽዉታዉቂነ በርእንዴ

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ሀ. አዎ   ለ. አልተለየ ሁትም

ሜሱአዋከሆነ ፤ ለምንያክልቀንተለይተሽ ወታወቂያለሽ ?...

15,በቤታችሁ ውስጥስልክትጠቀማችሁእንዴ? ሀ.አዎለ. የለም

16.የ ባለቤትዎ የ ትምህርትደረጃእንደትነ ዉ ?

ሀ. አነ ብም እይጽፍም   ለ. ያነ ባልይጽፋል   ሐ. ----------- ክፍልጨፈ ሷል

መ. ዲፕሎማ. ሌብል --------- ረ. ዩኒቨርሲቲድግሪ   ሽ. ሌላካለይጠቀስ.........

17. የ ባለቤትሽ የ ስራድር ሻ መ ምንድነ ዉ?

ሀ. አርሶአደር   ለ. ነጋዴ   ሐ.የ ቀንስራተኛ መ. የ መንግስትስራተኛስ. ሌላ------------

18. ልጅዎንየ ሚያስከትቡየ ትቦታነ ዉ?

ሀ. ጤና ጣቢያ   ለ. ጤፍኬላ   ሐ. ደርሶ ሜስጣቢያ   መ. ሆስፒታል

19.ቤትሽ ልጅሽንክምታስከትቢበትቦ ታምንያክልይርቃል ?

ሀ. --------------- ደቂቃ/ስዓትለ. ቅርብነ ዉ.ሐ. ሌላ ....

20. ልጅሽንለ ማስከተብወደክትባ ታጣቢያ ዉ/ጤፍ ተቆማ ምትሄጅወበ ምንድነ ዉ?

ሀ. በእግር   ለ. በክብትእግር/በፈረስ፤ በበቅሎ ሐ.በ ሚና /በባጃጅ

Part II: Maternal health service utilization (Only for mothers)

21. ህጻኑንአርግዘሽበነ በረበትስዓትየ እርግዝናክትትልነ በረሽ ?ሀ. አዎ ለ. አልተከታተልኩም

አዋከሆነ ሜሱለምንያክልግዜተከታትለሽነ በር ? _____

22. ህጻኑንን ፍሰጡርበሆንሽበትግዜየ መጋጋቆልፍበሽታሜላከያክትባትወስደሻል?

ሀ. አዎ   ለ. አልወሰድኩም

ሜሱኦዎከሆነ ምንያህልግዜሜርፌተመግተሽ በር ? _____

23.ነ ፍሰጡርበነ በርሽበትግዜየነ ፍሰጡርእኖቾቾኮንፈረንስላይተሳትፈሽታወቂያለሽ ?

ሀ. አዎ   ለ. አልተሳተፍኩም

ሜሱኦዎከሆነነ ምንያህልግዜ ....

24. ህጻኑንየ ትነ ወየ ወለድሽዉ?

ሀ. ጤናማቢያ   ለ. ጤፍኬላ ሐ. ሆስፒታልሜ. ቤት ሰ. ሌላቦታ ....

25.የ ድህረ ወሊድአ ገልግሎትከጤፍተቋምኣ ግኝታሽታወቂያለሽ ?   ሀ. አዎ ለ. አላገ ኘሁም

አዎከሆነ፣ ሜሱ፣ ምንያህልግዜወስደሻል ....?

Part III. Knowledge Questions

26.የ ህጻናት ክትባትሲባልሰምተዉወቂያሉ ?ሀ. አዎ   ለ. ሰምቼአላወቅም

27. ህጻናትን ማስከተብለ ምንለ ምንይጠማ?

ሀ.በሽታንለ ሜካላከል   ለ. .... የ ተባለበሽታንለ ሜካከል

ሐ.ለ ህጻና ጤ ጎ ነ ት   ሜ.አላ ወቀወም   ረ. ሌላካላይጠቀስ _____

28. በክትባት ስለ ምንከላ ከላቾወ ህጻናት በሽታዎች ሰምታሽ ምተሻታወቂያለሽ ?ሀ = አዎለ = አልስ ማሁ ዎም

29. በክትባት የ ምንከላ ከላቾወ ምን በሽታዎቾታወቂያለሽ ?_____

ሀ. የ ልጅነ ትልም ሻ/ፖሊዮ   ለ. መጋጋቆልፍ ሐ.ከፍኝ/አንከሊስ   ሜ. የ ጉበትቫይርስ

ሠ. የ ሳም ነ ቀርሳ ረ. ሳም ጋም ኾ ስ. የ ጀሮህ ሜም ሽ. እንጥልመረድቅ. ተቅ ጥ   ተ.   ትክትክ/ቁቁትቸ.
ማጅራትገ ትር ኘ. ሌላ ------

30. ክትባትየ ጎንዮ ሽጉዳትአለ ወእንዴ ?ሀ. አዎ   ለ. የ ለወም

ሜሱኦዎከሆነ የ ም ታወቂ ወን የ ጎንዮ ሽጉ ዳ ትንገ ሪ ኝ?

31. አንድህጻንከተወለደጀምሮክትባትባትለማጠናቀቅምንያክልያክልይ ክትባትቀጠሮ ያስፈልገዋል? ------

32.አንድ

ህጻንከተወለደጀምሮክትባትባትለማጠናቀቅ ማየ ስፈልገ ወንይ ክትባትቀጠሮቾመቾእንደሆነ ታወቂዋለሽ ?

ሀ = አዎ   ለ = አላወቀወም

አዎከሆነ ሜሱየ መጀመሪያወ፤ 2ኛወ፤ 3ኛወ፤ እና 4ኛዉ የ ክትባትቀጠሮቾመቾእንደሆነ ልትነ ግሪኝትችያለሽ?

የ ክትባቱአይነ ትእናየ ሜበ ቁጥያቄዎች	የ ሜ ጥበ ትግዜ የ እናት ዎንምሽ ያ ስቀማ ጠ/
BCG/የ ሳምባ ነ ቀርሳክትባትመቾይ ስጣል	
Penta 1/የ መጀመሪያ ወቀጠሮመቾነ ወ/	
Penta2/ 2ኛ ወቀጠሮመቾነ ወ/	
Penta3/3ኛ ወቀጠሮመቾነ ወ/	
Measel/ የ ኩፍኝክትባት የ ሜ ጠወመቾነ ወ(4ኛ ዉ ቀጠሮመቾነ ወ)/	

33.ህጻናት መከተብአለባቸወየ ለባቸወማ ሜ ወሀ ሳብዙሪያ አንቺምን ትያለሽ

ሀ. በ ጣሜ እ ስማ ጠ ሁ ለ. እ ስማ ጠ ሁ ሐ. ገ ለ ልተ ኛ መ. አል ስማ ጣም ሰ. በ ጣሜ አል ስማ ጣም

34.ህጻናትን ማክ ተ ብ ህ ጻ ና ትን የ ማ ዳ ነ ገ አ ለ መወ ይ ስ ጥ ቅ ማ ቻ ን ወ?

ሀ. አዎክ ጥቅ ሙ ዳ ቱ በ ል ጣል   ለ. አ ይ ደለ ም፤ ጥ ቀ ጣ ጉ ዳ ቱ በ ል ጣል

35.ህጻን ሽ በ ክት ባ ት ቀጠ ሮ ቀ ን ቢ ታ ማ ጣ ሽ ለ ክት ባ ት ት ወ ስ ጀ ዋ ለ ሽ ?ሀ. እ ወ ስ ደ ዋ ለ ሁ ለ. አ ል ወ ስ ደ ወ ም

36.ጎ ደ ኞ ች ሽ ን ና ጎ ረ ቤ ቶ ች ሽ ን ል ጀ ቻ ቸ ወ ን እ ን ዲ ያ ስ ክ ት ቡ ም ን ታ ደ ር ጊ ያ ለ ሽ?

ሀ. ስ ለ ክት ባ ት እ ጣ ራ ቸ ዋ ለ ሁ   ለ. አ ል ጣ ር ም

Part IV. Vaccination status of the index child

37.ይህቅጽከህጻኑ የ ክትባትካርድላይ ማ ጣ ሳ ሲ ሆን በ ክትባትካርዱ ላ ይ ስ ር ዝ ድ ል ዝ እ ና ላ ማ ነ በ ብ የ ማ የ ዳ ግ ት ወ ይ

ን ማ ክ ፍ ት ቦ ታ ካ ለ ወ ደ ጬ ተ ቂ ማ ሜ ዴ ክ ክ ት ባ ት መ ዘ ጋ ቡ ጋ ር ያ ረ ጋ ግ ጡ፤ :

38.Date of birth of infant………………….. Sex…………….

Vaccine	Date given/dd/mm/yy	Data source / VC or FR	Reasons for delayed or too early administration of each dose ይጠይቁት፤ እናትየ ዋየ ዘገ የቸመይምቅድሟ ስከተበቸዉ Penta1,penta2,penta3 OR measles የ ሟ ወንለይተወከወቁ � ላለምን እንደሆነ ይጠይቁት፤ ከዚያምካታች በ Part VI ያለወንኮድ ያስገ በ፤ ተ ጨ ሞ ምክን ያ ትካለባ ጭ ኡይጻ ፉ ት
BCG			
Penta 1			
Penta2			
Penta3			
Measel			

Note: VC= Vaccination card   FR= Facility register

Part VI: Reasons given by mother/caregiver for delayed vaccination

1.እናትየ ዋን/ተንከባባካቢዎንበ ሟ ባ ትሟ ኩህ ጸ ኑ ንለ ምን *ከ ትባ ት ሞር ህ ግ ብ ሩ አ ዘ ግ ታ ወ ይ ን ም ኤ ስ ቀ ድ ሟ* ን ዳስከተበቸወይጠቁት፤ እናትየ ዋየ ዘገ የ ቸ እን ደ ተወለ ደ በ 6 ኛ ፤ 10 ኛ ወ፤ 14 ኛ ወ ሳ ም ን ትወይ ስ በ 9 ኛ ወ ወ ር የ ሟ ወ ን ለ ይ ተ ወ ከ ወ ቁ በ ሓ ላ በ እ ን ዳ ን ዳ ቀ ጠ ሮ ለ ም ን እ ን ደ ዘ ገ የ ቸ ለ የ ብ ቻ ይ ጠ ይ ቁ ት ፤ እ ን ድ ታ ስ ታ ወ ስ ም ግ ዚ ት ፤ ፤ በ ተ ቻ ለ ጣ ጠ ን እ ና ት የ ዋ የ ም ት ሰ ጠ ው ሟ ሽ ት ክ ክ ለ ኛ ም ሁ ኑ ያ ረ ጋ ግ ጡ ፤ ለ ም ሳ ሌ አ ል መ ቻ ኝ ብ ሎ ጣ ካ ለ ች ለ ም ን እ ን ዳ ል ተ መ ቻ ት በ ሟ ጠ ቅ ወ ኑ ተ ኛ ነ ቱ ን ያ ረ ጋ ግ ጡ ፤ እ ያ ን ዳ ን ዱ ን ሟ ስ ያ ክ ብ ፤ በ ተ ጨ ሞ ም ተ ራ ቁ ጥ ሩ ን ከ ላ ይ ወ ዳ ለ ወ ስ ን ጠ ረ ሽ እ ወ ጥ ተ ወ ሟ ት ፤ ፤ ከ ተ ጠ ቀ ሰ ወ መ ጣ ሳ ብ ከ ሰ ጣ ች ግ ል ጽ አ ድ ር ገ ወ ይ ጻ ፉ ት ፤ ፤

1.አልመቻኝብሎ/ስራበዝቶብኝ

2.ሟ ፈ መ ህ ጸ ኔ ን ያ ም በ ኛ ል ብ ዬ ነ ወ.

3.ል ጄ ከ ተ ከ ተ በ ቸ በ ሓ ሟ ፈ መ አ ም በ ሽ ለ ነ በ ር / አ ተ ኮ ሳ ት ፤ ጸ ባ ዩ ተ ለ ወ ጠ / በ ድ ጋ ሟ ም በ ኛ ል ብ ዬ ነ ወ.

4.ከ ት ባ ቱ ለ እ ን ድ ህ ጸ ኑ አ ይ ከ ፈ ት ም በ ለ መ ጣ ሱ ኝ

5.ክ ር ስ ት ና ወ ስ ላ ል ወ ጣ ወ.

6.በ ቀ ጠ ሮ ወ ቀ ን ህ ጸ ኑ ታ መ ሞ በ ኝ

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7.ክትባቱመቼቀንእንደማጀመሪ ወይንምኤንደማስጥአላወቅም

8.ድጋሜክክተብእንደማ ስፈልግአላወቅኩም፣ ቀጦምኤልተሰጠኝም

9.ቀጦ ዬንረስቸዋለፈ

10.የ ክትባትቦ ታወፍቅነ ዉ

11.ክትባቱየ ትቦ ታእንደማስጥአላወቅም

12.ክትባቱየ ማስጥበትቀን/ሰዓትምቸአይደለም

13.ክትባቱየ ማስጥበቦ ታምቸአይደለም

14.ክትባትየ ማስጥበቦ ታወረ ፋስለማ ዘነ ዉ

15.ከታቢዎች/ባለ መ ዎ ች በ ማ ጠ ተአ ገ ል ግ ሎ ት ቅ ታ ስ ላ ለ ኝ ነ ዉ

16.ከታቢዎችስለሌሉ/ ስላል ጣጠ ዉ

17.በቀጦ ቀን እ ኔ ታ ማ ካ ኡ

18.ህ ፃ ኑ ሴ ላ መ ድ ኃ ኒ ት ስ ለ ማ ዎ ስ ድ ብ ዮ ነ ዉ

19.ህ ጸ ኑ ስ ለ ታ ማ ማ ጠ ፍ ባ ለ መ ዎ ች ክ ት ባ ቱ እ ን ድ ዘ ገ ይ ነ ገ ሩ ኝ

20.የ ክ ት ባ ት መ ዲ ሃ ኒ ቱ ስ ላ ለ ቀ

21.ማ ስ ክ ት ብ እ ን ደ ማ ስ ፈ ል ግ አ ላ ወ ቅ ሁ ም ነ በ ር

22.ዘ ግ ይ ቶ ቪ ክ ተ ብ ም ን ች ግ ር አ ለ ዉ

23.ክ ት ባ ት በ ሽ ታ ን መ ቼ ይ ከ ላ ክ ላ ል

24.የ ጠ ፈ ባ ለ መ ዎ ች ክ ት ባ ቱ ን ያ ለ ቀ ጦ ዉ ስ ቀ ድ መ ሰ ጠ ት

25.ሌ ላ ካ ለ ይ ጠ ቀ ስ ---

ማ ስ ታ ወ ሻ …………………………………………………………………………

………………………………………………………………………………………

……

……………………………………………………………………………………………

በአጠቃላይ ከላይየ ተሞላ ወን መሂ ጃታሞሃነ ትእንደትይ1 ልጹታል

ሀ . ማሉ ብ መሉ ታሞሃነ ትየ ለ ዉ   ለ . በ ሟከ ለ ኛደረ ጃየ ማታመን   ሐ. ዝቅተ ኛ ታሞሃነ ትየ ለ ዉ

መሂ ጃ ወን የ ለ ቀ መ ባ ለ መያ ስ ሞኝ ፈር ማ…………………………………………………ቀን ……

Declaration statement

I, the undersigned, MPH student declare that this thesis is my original work in partial fulfillment of the requirement for the degree of public health in Reproductive health and population study.

Student Name   GirmayeMamoMera Signature ----------------Place of submission: Bahir Dar University, College of Medicine and Health Sciences.

Date of submission   JULY, 2022

Advisors name

1. Dr. Elena Admass/Ass. Professor   signature---------------date------------

2.   Mr.   MekonnonMelkie/Ass.Professor   signature--------------date-------------

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1. Dr. Elena Admass/Ass. Professor   signature---------------date 21.4.7.2014

2. Mr. MekonnonMelkie/Ass.Professor   signature---------date 9/4/2014

Internal Examiner
Endalkachew Horfo

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