Factors Associated With Incomplete Childhood Vaccination among Children 12-23 Months of Age in Machakel Woreda, East Gojjam Zone: A Case Control Study

Melaku Kindie Yenit*, Sahilu Assegid1 and Hailay Abrha2
1Department of Epidemiology and Biostatistics, College of Medicine and Health Sciences, Institute of Public Health, University of Gondar, Gondar, Ethiopia
2Department of Epidemiology, College of Public Health & Medical Sciences, Jimma University, Jimma, Ethiopia

Abstract

Introduction: Immunization is an effective public health intervention to reduce morbidity and mortality among children and it will become more effective if the child can receive the full course of recommended immunization doses. However this, due to various reasons many fail to complete the full course of immunization. Therefore the objective of the study was to identify factors associated with incomplete childhood vaccinations among children 12-23 months of age in Machakel Woreda, East Gojjam Zone, Northeast Ethiopia.

Method: Community based unmatched case control study design with quantitative and qualitative methods of data collection were conducted in Machakel district, North east Ethiopia from March20 – April 30, 2014. Quantitative data were collected from mothers who had 12-23 months aged children. Census was done to identify all cases and controls. For quantitative method, a sample of 154 cases and 154 controls were selected using stratified multistage random sampling technique. Data were collected using a pretested structured questionnaire using interview data collection technique and data were entered into Epinfo software and analyzed using Statistical Package for Social Sciences for windows version 16 and logistic regression methods were used.

Result: predictors of defaulting from completion of childhood vaccination were being delivered at home [AOR=4.113, (95% CI: 2.263, 7.475)], children born from mothers who had no antenatal care visit during pregnancy [AOR=2.549, (95% CI: 1.312, 4.955)], Mothers/caretakers of child who had misperception on vaccine contraindication (AOR: 2.834, 95%CI: (1.558, 5.166)) and children born from mothers who had no Post natal care visit (AOR=2.512, 95%CI (1.184, 5.330)).

Conclusion: Health service related factors like child place of delivery, antenatal care and postnatal care service; knowledge related factors like Misconception on vaccine contraindication were independent predictors for incomplete vaccination. So mothers should be educated on vaccine contraindication and on provision of maternal health service.

Keywords: Incomplete vaccination; Determinants; 12-23 months children; Ethiopia

Introduction

Childhood vaccination is one of the most cost-effective public health interventions to reduce child morbidity and mortality. Besides attainment of high coverage with potent vaccines, receiving child full course of recommended immunization doses administered at the appropriate age is essential to curb the incidence of vaccine-preventable diseases in children. So assuring that children receive all doses of all vaccines before their first birthday is necessary for childhood vaccination status [1,2]. According to guidelines developed by the WHO, children are considered as fully vaccinated when they have received a vaccination against tuberculosis (BCG), three doses of pentavalent vaccine DPT-HepB-Hib and polio vaccines, and a measles vaccination by the age of 12 months. Considering this incomplete vaccination can be defined children who missed at least one dose of the eight vaccines before 12 months [3,4].

Globally it is estimated that about 22.6 million children under one year of age were partially protected. One out of five infants worldwide does not receive 3 life-saving doses of the diphtheria, tetanus and pertussis vaccine. More than seventy percent of these children live in ten countries including Ethiopia: Democratic Republic of the Congo, Ethiopia, India, Indonesia, Iraq, Nigeria, Pakistan, Philippines, Uganda and South Africa [5,6]. Studies evidenced that vaccine-preventable diseases are still responsible for about 25% of deaths occurring annually among children under five years of age and it is estimated that between two and three million child deaths are averted annually through vaccination against diphtheria, tetanus, pertussis and measles. In developing countries, most of the deaths in under five years of age group occur from preventable infectious diseases; that are mostly due to diarrheal diseases, acute respiratory infections, measles, and malaria [7,8].

According to Ethiopian demographic and health survey report, in 2011 only 24 percent of children age 12-23 months in Ethiopia was fully vaccinated. However; there is a 19 percent increase from the level reported in the 2005 EDHS, the percentage of children who are fully vaccinated remains far below the goal of 66 percent coverage set in the HSDP IV. There is a wide variation among regions in full vaccination coverage, ranging from 79 percent in Addis Ababa, 26.3% in Amhara in which the study was conducted and 9 percent in Affar [3,9].

*Corresponding author: Melaku Kindie, Department of Epidemiology and Biostatistics, College of Medicine and Health Sciences, Institute of Public Health, University of Gondar, Gondar, Ethiopia, Tel: +251913002871; E-mail: melaku98@gmail.com

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Children who have not been fully immunized are at far greater risk of becoming infected with serious vaccine-preventable diseases. Studies showed that children who had not received the measles vaccine were 35 times more likely to get the disease. So the decision not to fully vaccinate a child is a decision to put the child and others at risk of contracting a disease that could be dangerous or deadly [10].

Numerous studies documented that socio-economic status of the household, mother's age, level of education particularly mothers’ education, History of ANC attendance, child’s age, sex of the child, birth place, birth order, place of residence, mother's knowledge about immunization, mother’s TT status, health workers house hold visit, missing opportunity, distance to health institutions, perception about benefit of immunization, and misconception about vaccine contraindication are factors associated with immunization [3,11-15]. However, the relationship of these factors not always consistent between studies. In addition; acceptance of immunization, fear of adverse effects and other determinants were considered as predictors for incomplete immunization. Even though there is a consensus about the above problems to the contribution of low coverage of complete vaccination, the problem still persisted with much little improvement posing a challenge to the country health care delivery system [3].

Studies have been conducted earlier to identify reasons of incomplete immunization most of them are a part of coverage evaluation surveys so there is greater chance of recall bias. Therefore, conducting this study will minimize this research gap and draw attention to the largely unexplored factors that may be associated with incomplete childhood vaccination. Therefore, the aim of this study will assess factors associated with incomplete vaccinations among children 12-23 months of age in Machakel district, North east Ethiopia and to generate data that could be used for better planning and strengthening of routine immunization services

Methods

Study design and period

Community-based unmatched case control study design was conducted from March 20 to April 30, 2014 in Machakel district, East Gojjam zone, Amhara regional state. The district is found 348 kms to the north of Addis Ababa, capital city of Ethiopia; and 264 kms to East of Bahirdar, capital city of Amhara regional state and has a total population of 133,188 and there are 26 kebeles; (1 urban and 25 rural ). Initially, kebeles in the district were stratified in to urban and rural. From the total 25 rural kebeles, 6 kebeles were selected randomly by proportionate size from study population of each kebele.

Participants

The study populations were children aged 12-23 months of age in 6 rural and one urban kebele. Cases were children in the age group of 12-23 months of age who did not complete the vaccination before her/his 1st birthday in the selected kebele while, controls were in the age group of 12-23 months and completed the vaccination which include BCG, three doses of Pentavalent and PCV, three doses of OPV and a measles vaccine before her/his 1st birthday in selected kebele. The required sample size was calculated using two population proportion formula of 1:1, the final sample size was 308(154 cases and 154 controls). Study participants were children 12-23 months of age in 6 rural kebels and one urban kebele selected by stratified multistage random sampling. The final sample size that can be included was allocated based on proportional size from study population of each kebele.

Data collection procedures

Structured interview administer questionnaire was used to collect the data. Closed-ended items were adapted from various literature sources. The questionnaire was first developed in English and translated in to local language for appropriateness and easiness in approaching the study participants and back to English. The questionnaire was pre-tested. The content of questionnaire includes socio-demographic and economic characteristics, maternal factors and health service related factors. In order to support information collected through structured questionnaire, in depth interview using tape recording was conducted from key informants immediately after the quantitative data collection. Besides the principal investigator, five diploma Nurses data collectors and two health extension supervisors (supervisors) which are outside the study area were participated throughout the data collection process. Training was given to the data collectors and supervisors. The survey was conducted one week prior to data collection and cases and controls were identified during the survey. Child vaccination card and mothers oral response was used to verify vaccination status of the child. Mothers/caregivers having children aged 12-23 months identified from the survey were asked based on the questionnaire.

Data management and analysis

Completed questionnaire was checked for their completeness and consistency at every step of data management. A pretest was done on 5% of the sample and training was given for data collectors and supervisors. The data were entered, cleaned and edited using EPI-Info 7 and transferred to SPSS version 16 statistical package for further analysis. Data cleaning were performed to check for accuracy, consistencies and missing values and variables. Descriptive statistics like frequency tables and percentages were used. Bivariate analysis was conducted primarily to check which variables have association with the dependent variable individually. Variables which have association with the dependent variables at 0.25 P-value was candidate in to multivariable logistic regression. The technique was backward stepwise method. Variables with below 0.05 p-values were used to identify independent factors of incomplete vaccination. The goodness of the model was assessed whether the required assumptions for the application of multivariate logistic regression was fulfilled and showed that the model adequately fits the data (Hosmer and Lemeshow test as the P - value = 0.71 and multi-collinearity was assessed.

Ethical considerations

The study was carried out after getting approval from the ethical clearance committee of Jimma University, collage of public health and Medical sciences. Then, data were collected after getting written consent from district health office. Informed verbal consent was obtained from all study participants. Each respondent were informed about the objective of the study.

Result

Socio-demographic characteristics of respondents showed that a total of 152 controls and 150 cases (with 98% response rate) were included in the study. The mean age (Standard deviation) of mothers...
and children were 29.53(5.104) years, and 16.92(3.172) months, respectively. Majority of caretakers of case and controls 119(79.9%) and 116(76.3%) respectively were from rural community. The sex distribution of children shows that 96(64.0%) of cases and 59(39.1%) of controls were males. With regard to types of caretakers, majority of care taker for controls 150(99.3%) and for cases 140 (93.3%) were mothers. Current marital status of the caretaker indicates that 137(93.3%) cases and 151(99.3%) controls were married. About 105(70.0%) of cases and 97(63.8%) controls did not have some level of educational level. Birth interval between the child and preceding birth interval indicates that 102(68.5%) of cases and 88(58.3%) controls were had less than 24 months of birth interval. And the mean (SD) preceding birth interval and mean number of live children of the mother (SD) were 21.66(11.439) months and 102(68.5%) of cases and 88(58.3%) controls were had less than 24 months of birth interval. And the mean (SD) preceding birth interval and mean number of live children of the mother (SD) were 21.66(11.439) months and 2.89 (±1.180) children respectively. With regard to child birth order more than half of case 95(63.3%) and controls 97(63.8%) were born in the second and third birth order. Respondents family size in the house hold indicated that 113(75.3%) of cases and 74(48.7%) controls were had more than five family size. And the mean household family size was 4.90 having standard deviation of (± 1.195) (Table 1).

Health service related characteristics of respondents showed that most of cases 143(95.3%) and controls 148(98.7%) were heard about immunization from health workers, radio, TV or from other sources. And 111(73.0%) of the controls have ANC follow up at least once during their pregnancy. And 90 (61.2%) of cases were not visited by health worker in the last one month. Besides these, 32(64%) of cases attend antenatal care service for not more than two round. With regard to child place of delivery, majority of controls 119(78.8%) were delivered at health institutions. The mean time (in minute) of respondents to reach the nearest vaccination site was 24.30 minute with standard deviation of 8.909 (Table 1).

Factors Associated With Childhood Vaccination

Result of bi-variate analysis showed that caretakers age, health worker home visit, ANC, PNC, mothers TT vaccine, child place of delivery, parity, child age, birth order, knowledge on schedule of vaccination, level of satisfaction, misconception about vaccination, missed opportunity were significantly associated with incomplete childhood vaccination and candidate for multivariate analysis.

Multivariate logistic regression analysis illustrate that; place of delivery, parity, child age, birth order, knowledge on schedule of vaccination, level of satisfaction, misconception about vaccination, missed opportunity were significantly associated with incomplete childhood vaccination and candidate for multivariate analysis.

Table 1: Socio-demographic and economic character characteristics of mothers/ caretakers of children in Machakel woreda, East Gojjam Zone, Amhara region, 2014.

| Variables                                | Category                          | Vaccination status |
|------------------------------------------|-----------------------------------|-------------------|
| Place of residence                       |                                   | Cases | Controls |
| Urban                                    |                                   | 30(20.1%) | 36(23.7%) |
| Rural                                    |                                   | 119(79.9%) | 116(76.3%) |
| Caretaker of the child                   |                                   | 140(93.3%) | 151(99.3%) |
| Mother                                   |                                   | 137(91.3%) | 151(99.3%) |
| Grandparent/older sibling                |                                   | 10(6.7%) | 1(7.7%) |
| Single                                   |                                   | 2(1.3%) | 0(0.0%) |
| Marital status                           |                                   | 30(20.4%) | 6(3.9%) |
| Married                                  |                                   | 137(91.3%) | 151(99.3%) |
| Divorced/Separated                       |                                   | 9(6.0%) | 1(7.7%) |
| Widowed                                  |                                   | 2(1.3%) | 0(0.0%) |
| Caretaker age                            |                                   | 39(26.2%) | 58(38.4%) |
| <=26                                     |                                   | 29(19.7%) | 48(31.6%) |
| >26                                      |                                   | 88(59.9%) | 98(65.4%) |
| Caretakers educational status            |                                   | 30(20.4%) | 6(3.9%) |
| No education                             |                                   | 105(70.0%) | 97(63.8%) |
| Primary education                        |                                   | 20(13.3%) | 32(21.1%) |
| Secondary education                      |                                   | 10(6.7%) | 6(3.9%) |
| More than secondary education            |                                   | 15(10.0%) | 17(11.2%) |
| Sex of the child                         |                                   | 96(64.0%) | 59(39.1%) |
| Female                                   |                                   | 54(36.0%) | 92(60.9%) |
| Child age in month                       |                                   | 78(52.0%) | 105(68.9%) |
| 12-18                                    |                                   | 72(48.0%) | 47(30.9%) |
| 19-23                                    |                                   | 1(0.6%) | 27(17.9%) |
| Parity                                   |                                   | 2(1.3%) | 53(35.1%) |
| 1                                        |                                   | 111(74.5%) | 71(47.0%) |
| 2                                        |                                   | 95(63.3%) | 97(63.8%) |
| 3+                                       |                                   | 36(24.0%) | 19(12.5%) |
| Birth order                              |                                   | 102(68.5%) | 88(58.3%) |
| <=24                                     |                                   | 39(26.2%) | 58(38.4%) |
| >23                                      |                                   | 8(5.4%) | 5(3.3%) |
| Family size                              |                                   | 113(75.3%) | 74(48.7%) |
| <=750                                    |                                   | 51(34.0%) | 51(33.6%) |
| 751-1000                                 |                                   | 36(24.0%) | 33(21.7%) |
| >1001                                    |                                   | 63(42.0%) | 68(44.7%) |

Table 2: Health service related characteristics of mothers/caretakers of children in Machakel woreda, East Gojjam Zone, Amhara region, 2014.

| Variables                                | Category                          | Vaccination status |
|------------------------------------------|-----------------------------------|-------------------|
| Visited by health workers in the last one month |                                   | Yes | No |
| Attend antenatal care service(ANC)       |                                   | Yes | No |
| Total round of ANC                       |                                   | Yes | No |
| Attend post natal care(PNC)              |                                   | Yes | No |
| Receive tetanus toxoid vaccine(TT)       |                                   | Yes | No |
| Time to take to nearest vaccination site(in minute) |                                   | <15 | >=15 |
| Child place of delivery                  |                                   | Home | Health institution |
| Missed opportunity                      |                                   | Yes | No |
| Heard about vaccination                  |                                   | Yes | No |

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Children place of delivery was a significant variable for children vaccination status. As suggested in this study, children whose place of delivery at home was 4.113 times more likely to have incomplete vaccination status than children born at health institution (AOR=2.512, 95% CI: (1.184, 5.330)). Children whose ages between 12-18 months were 52% less likely to default vaccination than children of age 19-23 months (AOR: .515, 95%CI: (.280,.946)) (Table 3).

Furthermore, 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. (AOR=2.512, 95%CI: (1.184, 5.330)). And 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 (AOR: 3.550, 95% CI: (1.315,9.583)). Children whose ages between 12-18 months were 52% less likely to default vaccination than children of age 19-23 months (AOR: .515, 95% CI: (.280,0.946)) (Table 3).

Mothers/caretakers who were had inappropriate perception on vaccine contraindication were 2.834 more likely to be their child default to complete vaccination than mother who had negative misconception about vaccine contraindication (AOR: 2.834, 95%CI: (1.558,5.156)) (Table 4).

### Discussion

Immunization is one of the most powerful and cost-effective health interventions. It prevents debilitating illness and disability, and saves millions of lives every year. Vaccines have the power not only to save life, but also to transform lives, giving children a chance to grow up healthy, go to school, and improve their life prospects. However, Immunization will become more effective if the child can receive the full course of recommended vaccination doses. This study shows that antenatal care service during pregnancy is one of the variables significantly associated

### Table 3: Mother/caretaker related characteristics in Machakel woreda, East Gojjam zone, Amhara region, 2014.

| Variables                          | Category | Vaccination status | Crude OR (95%CI) | Adjusted OR (95%CI) |
|------------------------------------|----------|--------------------|------------------|---------------------|
|                                   | Cases    | Controls           |                  |                     |
| Mothers/caretakers age            | <=26     | 29(19.7%)          | 48(31.6%)        | .673(.391,1.159)    | .773(.382,1.565)    |
|                                   | 27-34    | 88(59.9%)          | 98(64.5%)        | 1.00                | 1.00                |
|                                   | =>35     | 30(20.4%)          | 6(3.9%)          | 5.568(2.213,14.008) | 2.619(865.7936)    |
| Health worker home visit          | Yes      | 57(38.8%)          | 106(69.7%)       | 1.00                | 1.00                |
|                                   | No       | 90(61.2%)          | 46(30.3%)        | 3.638(2.253,5.876)  | 1.094(527.273)     |
| ANC                               | Yes      | 52(34.7%)          | 111(73.0%)       | 1.00                | 1.00                |
|                                   | No       | 98(65.3%)          | 41(27.0%)        | 5.102(3.122,8.339)  | 2.549(1,312,4955)  |
| PNC                               | Yes      | 20(13.3%)          | 51(33.6%)        | 1.00                | 1.00                |
|                                   | No       | 130(86.7%)         | 101(66.4%)       | 4.601(2.602,8.142)  | 2.512(1,845,330)   |
| TT                                | Yes      | 47(31.3%)          | 76(50.0%)        | 1.00                | 1.00                |
|                                   | No       | 103(68.7%)         | 76(50.0%)        | 2.191(1,371,503)    | .554(277.1,110)    |
| Child place of delivery           | Home     | 97(64.7%)          | 32(21.2%)        | 6.806(4.070, 11.382) | 4.113(2,623,477)  |
|                                   | Health institution | 53(35.3%) | 119(78.8%) | 1.00 | 1.00 |
| Parity                            | 1        | 10(6.7%)           | 27(17.9%)        | 1.00                | 1.00                |
|                                   | 2        | 28(18.8%)          | 53(35.1%)        | 1.426(605.3,364)    | 1.483(499,405)     |
|                                   | =>3      | 111(74.5%)         | 71(47.0%)        | 4.221(1927.9,248)   | 3.550(1,315,583)   |
| Child age                          | 12-18    | 78(52.0%)          | 105(69.1%)       | .485(.303,776)      | .515(280,946)      |
|                                   | 19-23    | 72(48.0%)          | 47(30.9%)        | 1.00                | 1.00                |
| Birth order                       | 1        | 19(12.7%)          | 36(23.7%)        | .279(127,611)       | .776(333,809)      |
|                                   | 2-3      | 95(63.3%)          | 97(65.8%)        | .517(277,964)       | 1.416(412,486)     |
|                                   | =>4      | 36(24.0%)          | 19(12.5%)        | 1.00                | 1.00                |
| Knowledge on schedule of vaccination | Good   | 78(52.0%)          | 97(65.8%)        | 1.00                | 1.00                |
|                                   | Poor     | 72(48.0%)          | 55(36.2%)        | 1.628(1027.2,580)   | 1.179(636,2187)    |
| Level of satisfaction             | Satisfied| 49(32.7%)          | 92(60.5%)        | 1.00                | 1.00                |
|                                   | Not satisfied | 101(67.3%)     | 60(39.5%)        | 3.161(1973.5,004)   | .936(452,937)      |
| Misconception about vaccination   | Positive | 100(66.7%)         | 49(32.2%)        | 4.204(2.600,7.988)  | 2.834(1,558,516)   |
|                                   | Negative | 50(33.3%)          | 103(67.8%)       | 1.00                | 1.00                |
| Missed opportunity                | Yes      | 90(61.6%)          | 56(37.1%)        | 2.726(1705,4360)    | 1.233(637,2388)    |
|                                   | No       | 56(38.4%)          | 95(62.9%)        | 1.00                | 1.00                |

### Table 4: Multi-variate logistic regression showing factors associated with incomplete childhood vaccination, Machakel woreda, East Gojjam Zone, Amhara region, 2014.
to vaccination status of the child. This result indicates that children who were born from mothers who had no antenatal care visit during pregnancy were 2.761 times more to default to complete vaccination compared to infants who were born from mothers who had antenatal care visit during pregnancy likely [AOR=2.761, (95% CI: 1.520, 5.015)]. This finding is in line with study done in Bangladesh which shows, children of mothers who received sufficient antenatal care were more likely to be fully immunized than children of those mothers who received insufficient antenatal care and those who had received no antenatal care. And post natal care service after delivery was other health service related factor associated to incomplete childhood vaccination. Mothers who had no postnatal service after delivery were 2.512 times more likely to default vaccination compared to mothers who were had postnatal care service (ANC). This result is consistent with study Wanago, South west Ethiopia, case control study [12]. This can be due to mothers who had Visit of antenatal care service and post natal care service gives chance to communicate with health workers to hear about the benefit of completion of vaccination to their child better than didn't follow these health care services. This justification was highlighted in study conducted in Bangladesh [17] which showed that higher proportion of full vaccination coverage was found for families receiving visits from health worker.

Child place of delivery was also other significantly associated factor for childhood incomplete vaccination. The study showed that children who were born at home were more likely to default to complete vaccination compared to children born at health facility. This result is inconsistent with study conducted in Malaysia [18]. This can be due to variation in study population, study design and study period.

Perception on vaccine contraindication was significant factor for incomplete vaccination. Mothers who had misconception on vaccine contraindication were more likely to default vaccination than mothers appropriate perception on vaccine contraindication. This finding was in accordance with study conducted in Kombolcha district of Oromia regional state that stated as wrong ideas about contraindication were significantly associated with partial vaccination [16]. This can be suggested mothers who had wrong ideas about vaccine contraindication may bring their child to vaccination site less likely.

Mother who had more than three children was more likely to have defaulted children from vaccination compared to mothers who had one child. This finding is consistence with study conducted in Bangladesh [17], which stated that children of mothers with lower parity were more likely to be fully immunized. This finding also in line with study conducted in Kenya [19].

Children of age between 12-18 months were less likely to default to complete vaccination when compared to children aged 19-23 months. This finding was consistent with study conducted in Athens, which showed that the child's age remained a strong predictor for incomplete immunization with older and newer vaccines. This can be due to mothers whose child ages as increased, provide less attention for child completion of vaccination.

There was no significant relation between childhood vaccination status, and mothers' educational level, knowledge on vaccine schedule, and mother's age in the present study in comparison to other studies who found that maternal education, knowledge on vaccine schedule and mother's age were a significant predictor of completeness of vaccination as the highly educated mothers will be more aware of the full course vaccination. These roles of maternal knowledge and knowledge on vaccine schedule as an important determinants of completion of vaccination has been shown by several researchers. The possible explanation for this disagreement could be due to difference in study design and sample size. Our study had also some limitations where mother might forget the immunization status of their children and cases and controls could be misclassified.

**Conclusion**

The result of this study showed that factor associated with childhood incomplete vaccination are factors related to health service related and mother/child related characteristics. The major predictors for incomplete vaccination were antenatal care, postnatal care, misconception about vaccine contraindication, child place of delivery, number of live children and child age. Considering these, interventions improving mother's health service utilization, provision of information on vaccine contraindication and side effect should be an inevitable measure to curb poor immunization practice of related to completion vaccination in the community.

**Recommendations**

- Health personnel better to advice for those mothers' who attend delivery at health facilities on completion of vaccination.
- Antenatal care and postnatal care service also has a very important role on improving vaccination status of the children.
- Health workers provide awareness for mothers on vaccine side effects and contraindication.
- Continuous vaccination Campaign by district health office also important improvement on children's
- Health personnel should work on pregnant mother to utilize health care services like health facility delivery, ANC, PNC
- Mothers' should be give concern for at any age group of a child and birth order equally towards childhood vaccination.
- Further research has to be done especially qualitative study.

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**Competing Interests**

The authors declare that they have no competing of interests.

**Authors' Contributions**

MKY involved in the conception, design, data collection, analysis and report writing. SA and HA assisted with the design, approved the proposal with some revisions, participated in data analysis and revised subsequent drafts of the paper. All authors read and approved the final manuscript.

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