Full Length Research Article

Determinants of Incomplete Vaccination Among Children Age 12-23 Months in Southwest Ethiopia: A Case-Control Study

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ABSTRACT

Many children in the world particularly in low resource countries are still left unvaccinated and it remains to be a public health problem. So, the main objective of this study was to identify determinants of incomplete vaccination among children 12-23 months of age in Semen Bench district, Bench Maji *Zone*, Southwest Ethiopia, 2018. A community based unmatched case-control study was undertaken among randomly selected children aged 12 to 23 months and with a total sample size of 316 (106 cases and 212 controls). Simple random sampling was used to get representative cases and controls. Data was collected using a structured questionnaire and analyzed using SPSS version 21. Bivariate and multivariable logistic regression analyses were done to identify independent factors for incomplete immunization status of children. P-values <0.05 was used as cut value. A total of 104 cases from 106 and 208 controls from 212 were selected giving a response rate of 98.2%. Based on the multivariable analysis the incomplete immunization status of children was significantly associated with having no antenatal care visits, [AOR=8.3(95%CI; 1.87-36.91], home delivery [AOR=4.5(95%CI; 1.411-14.27], having no postnatal care visit [AOR=4.2(95%CI; 1.67-10.41], and inconvenient appointment time [AOR=3.44(95% CI:1.65-7.16)]. Children of mothers having no antenatal and postnatal care, having home delivery, and with an inconvenient appointment time were significantly associated with incomplete vaccination. Therefore, integrating the immunization service to other elements of primary health care is crucial.

Keywords: Determinates, incomplete vaccination, Ethiopia

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1. INTRODUCTION

Vaccination is one of the most worthwhile public health interventions to prevent child mortality and morbidity (Subaiya *et al*., 2014). Each year, vaccinated averts more than 2 million vaccine-preventable deaths globally (Anderson and May, 1990; WHO, 2015). Despite this enormous use, vaccination coverage in developing countries has reported being low. In 2011 alone, 1.5 million children died from Vaccine-Preventable Diseases (Schuster *et al*., 2015; Mereckiene *et al.*, 2008; Feldstein *et al.*, 2017). In 2013, coverage of third-dose diphtheria, tetanus, and pertussis vaccine (DTP3) among children aged < 12 months was 84% globally, ranging from 75% in the African Region to 96% in the Western Pacific and European Regions. About 14.8 million (68%) children who did not receive the DTP3 vaccine during the first year of life lived in 10 countries including Ethiopia (Burton et al., 2009; WHO, 2017; Vakili et al., 2015).

Even though vaccination offers greater benefits of health, well-being, and survival of children than any other interventions, vaccine-preventable diseases are still responsible for about 25% of deaths of under-five children. Most of the deaths are from diarrheal diseases, acute respiratory infections, and measles. More than a quarter of these are reported in low- income countries including Ethiopia (Waheed, 2010; UNICEF, 2012; Bangure *et al*., 2015;).

In Ethiopia, a routine immunization program was launched by providing six traditional antigens in 1980. The program was revised subsequently and was capable of providing 10 vaccines to under 1 year of age at the moment. In addition to the traditional vaccines that are given without any charge, new vaccines are continuously introduced into the Immunization program. Recently, the program has successfully introduced additional antigens which have resulted in the protection of millions of children from vaccine-preventable diseases (WHO, 2016; Berhane *et al.*,1995). Based on the Ethiopian Demographic Health Survey (EDHS) report around 39% of children aged between 12 to 23 months receive all basic vaccination and in the study area 24.4% of children aged between 12-23 months have not received all basic vaccination (Berhane *et al*.,1995). In Ethiopia measles is one of the five major causes of childhood illnesses, which together contribute to 70% of under-five morbidity and mortality (Berhane *et al*.,1995).

According to the WHO measles burden estimator, Ethiopia contributes to 46% of the cases and 51% of the deaths from measles among eight eastern African countries (WHO, 2017; Vakili R *et al*., 2015, WHO, 2016). Previous studies done in Ethiopia indicated that the main factors lead to incomplete vaccination are multiple such as mothers age, educational status of the father, mother's knowledge on vaccination, fear of side effects, shortage of vaccines in the health facility, inconvenient appointment time, and political instability (Berhane *et al*.,1995; JSL, 2015). High immunization coverage is essential to control and eventually eliminate vaccine-preventable diseases and understanding the level ofimmunization among children is vital to design appropriate interventions. This study was therefore conducted to determine and identify factors associated with incomplete vaccination among children aged 12–23 months.

2. METHODS AND MATERIALS

2. 1. Study Design and Setting

A community-based unmatched case-control study was conducted from February to March 2018 in Semen Bench district, Bench Maji Zone, Southwest Ethiopia. It has 31 kebeles and an estimated total population of 138,556. The study was conducted in seven kebeles (the smallest administrative units in Ethiopia with population size of 27,711.

2.2. Source population

Source population are all households with mothers/caregivers who had children in the age group 12-23 months of age residing in semen Bench district for both cases and controls.

2.2. Study population

The study population for cases included households with children in the age group of 12 to 23 months and who did not complete the recommended vaccination.

The study population for controls was households with children in the age group of 12 to 23 months and complete the recommended vaccination.

2.3. Sample Size Determination

The sample size was determined by using Stat Calc program of the Epi Info version 7 which is used to calculate the sample size with the consideration of exposure to antenatal follow-up care among case that was 84.4% and among control was 94.4% from a previous study in Tigray region (18). 5% marginal error, 95% confidence interval, power of 80%, case to control the ratio of 1:2 and 10% of non-response rate was considered. Calculated sample size in all independent (exposure) variables are considered and place of residence is chosen as an independent variable since it gave maximum sample size as compared to other exposure variables. The largest sample size was 287+29 (10% non-response rate) =318 (106 cases and 218 controls).

2.4. Sampling Technique and Procedures

A simple random sampling technique was used to reach the household level. The seven kebeles were selected by simple random sampling (lottery method) and the calculated sample size was allocated proportionally according to their population. The family folder list of cases and controls were selected from the past two years, then samples were selected by Computer Generated Simple Random Sampling Techniques.

The required number of cases and controls were selected as follows. From Sporty kebele 38 samples (case 13 control 25); Muya kebele 47 samples (case 16 control 31); Yikir Demoze kebele 58 samples (case 19 control 39); Kasha kebele 50 samples (case 17 control 33); Boseka kebele 30 samples (case 10 control 20); Endekal kebele 53 samples (case 17 control 36: Genga kebele 36 samples (case 12 control 24). If a household has more than one child, a child with a first birthday celebration and the youngest one was taken for the study.

2.5. Operational Definition

Complete (full) vaccination: The childhood vaccination status once a child has received all recommended vaccines, including BCG, three doses of pentavalent, three doses of PCV, two doses of Rota vaccine, three doses of polio and measles vaccines by the age of 12 months (Aregawi *et al*., 2017).

Incomplete (partial) vaccination/Defaulter: The childhood vaccination status if the child missed at least one of the recommended vaccines (the recommended vaccines include BCG, three doses of pentavalent, three doses of PCV, two doses of Rota vaccine, three doses of polio and measles vaccines by the age of 12 months) (Aregawi *et al*., 2017).

Inconvenient appointment time: The appointment time for vaccination was inconvenient for an individual who takes the child to visit health institution for vaccination

Maternal/Caregiver knowledge on vaccination was assessed using 24 questions. Correct answers were given a score of one and incorrect answers were scored zero. Those scoring greater than the mean were considered as knowledgeable and those who scored below the mean were considered as less knowledgeable.

Poor knowledge: Those mothers /respondents who scored below the mean score of the knowledge questions.

Good knowledge: Those mothers /respondents who scored equal and above mean score of the knowledge questions.

Data collection tool and quality control

The data were collected using a structured questionnaire adapted from previous studies. Before undertaking data collection, the questionnaire was pretested on other similar population taking 5 % of the total sample outside the study area and necessary modifications were made. The questionnaire was prepared originally in English and translated to Amharic. The questionnaire was further translated back from the local language to English to check for consistency.

The primary respondents were the mothers of the children. In case of their absence, the questionnaire was also completed by the fathers or any other adult in the household acting as the primary caregiver. The data were collected by trained, diploma midwife, fluent in the local language, using the structured questionnaire translated to the local language. Three health

professionals with bachelor degrees in health supervised the data collection process. Before data collection, the data collectors and supervisors recruited were given training on the objective of the study and techniques of data collection for two days. Children are usually certified if they have complete vaccination. In this case, a certificate is checked for completeness and also interview was made to check the status of vaccination.

Data Processing and Analysis

Data were entered using EPI- Info version 7 and analyzed using SPSS-version 21 statistical software. Descriptive statistics were used to summarize the data, and a bivariable analysis was carried out to describe associations between exposure variable and childhood immunization status, and odds ratio with a significance level of *P*-value ≤ 0.05 was used to see the association between incomplete vaccination and independent variable. Variables with *P*-value ≤ 0.25 in bivariable logistic regression were included in the final model (multi-variable logistic regression). In the multi-variable analysis, additionally, model fitness was checked by Hosmer and Lemeshow goodness of test and *P*-value ≤ 0.05 was applied to identify independent factors of incomplete childhood immunization.

3. RESULTS

3.1. Socio-Demographic Characteristics of respondents

A total of 208 controls and 104 cases (with a 98.2% response rate) were included in the study. The majority of respondents for controls 198(95.2%) and cases 85 (81.7%) were mothers. About religion, most caretakers/mothers for cases and controls were protestant which accounts for 85(81.7%) and 169(81.3%), respectively. Regarding maternal educational status, 82.7% of cases and 61.1% of controls had no formal education **(Table 1**).

Table 1. Socio-demographic characteristics of mothers/caretakers living in Semen Bench district in Bench Majii zone, Southern Ethiopia, 2018.

Variables		Case (104)) No (%)	Control (208) No (%)
Resident of respondent	Urban	13(12.5)	27(13.0)
	Rural	91(87.5)	181(87.0)
Relationship to child	Mother	85(81.7)	198(95.2)
	Caretaker	19(18.3)	10(4.8)
Age of mother/caretaker(years)	20-24	11(5.3)	39(13.9)
	25-29	45(22.1)	98(47.1)
	30-34	28(26.9)	56(26.9)
	35-45	20(19.2)	15(7.2)
Marital status	Single	3(2.9)	14(6.7)
	Married	101(97.1)	190(91.3)
	Divorced	0(.0)	2(1.0)
	Widowed	0(.0)	2(1.0)
Religion	Protestant	85(81.7)	169(81.3)
	Orthodox	18(17.3)	35(16.8)
	Other*	1(1.0)	4(1.9)
Ethnic group	Bench	78(75.0)	152(73.1)
	Kefa	23(22.1)	48(23.1)
	Other**	3(2.9)	8(3.8)
Educational status of mothers	No formal education	86(82.7)	127(61.1)
	Able to write and read	4(3.8)	17(8.2)
	Elementary	12(11.5)	55(26.4)
	Secondary and above	2(1.9)	9(4.3)
The educational level of fathers	No formal education	47(45.2)	59(28.4)
	able to write and read	44(42.3)	70(33.7)
	Elementary	9(8.7)	70(33.7)
	Secondary and above	4(3.8)	9(4.3)
Monthly family income (birr)	< 500	32(30.8)	18(8.7)
	500-1000	46(44.2)	25(12.0)
	>1000	26(25.0)	165(79.3)

**Muslim and Catholic, ** Gurageh and Woliyta*

All cases and controls of respondents reported that there was a vaccination site in their district. Of the mothers/ caretakers, 50(48.1%) of cases and 33(15.9%) of controls returned home without getting vaccination for their child due to inconvenient appointment time. The majority of respondents were two to four birth orders which comprise 67.3% of cases and 63.9% of controls. Regarding ANC visits, 75(72.1%) and 208(98.6%) of cases and controls have ANC visits respectively **(Table 2).**

Table 2. Information of the Index Child and Mother/Care Taker in Semen Bench district, Bench Majii zone, Southern Ethiopia, 2018.

Variables		**Cases (N= 104) No (%)**	**Controls (N= 208) No (%)**
Vaccination prevent communicable disease	Yes	99(95.2)	207(99.5)
	No	5(4.8)	1(0.5)
Knew the benefits of immunization	Yes	86(82.7)	204(98.1)
	No	18(17.3)	4(1.9)
Knew the type of diseases prevented by the vaccine	Yes	27(25.9)	124(59.6)
	No	77(74.0)	84(40.4)
Knew the schedule of vaccines	Yes	91(87.5)	208(100.0)
	No	13(12.5)	0(0.0)
knowledge on when measles vaccine is given	Yes	95(91.3)	205(98.6)
	No	9(8.7)	3(1.4)
Knew about vaccine side effects	Yes	87(83.7)	204(98.1)
	No	17(16.3)	4(1.9)

3.2 Mothers or caretakers Knowledge about vaccination

The majority of mothers/ caretakers were knowledgeable about vaccination which accounts for 88 (84.6%) for cases and 202 (97.1%) for controls (**Table 3).**

Table 3. Mothers/caretakers knowledge on vaccination in Semen Bench district, Bench Majii zone, southern Ethiopia 2018

3.3 Determinants of Incomplete Vaccination

Variables		Cases (N= 104) No (%)	Controls (N= 208) No (%)
Vaccination prevent communicable disease	Yes	99(95.2)	207(99.5)
	No	5(4.8)	1(0.5)
Knew the benefits of immunization	Yes	86(82.7)	204(98.1)
	No	18(17.3)	4(1.9)
Knew the type of diseases prevented by the vaccine	Yes	27(25.9)	124(59.6)
	No	77(74.0)	84(40.4)
Knew the schedule of vaccines	Yes	91(87.5)	208(100.0)
	No	13(12.5)	0(0.0)
knowledge on when measles vaccine is given	Yes	95(91.3)	205(98.6)
	No	9(8.7)	3(1.4
Knew about vaccine side effects	Yes	87(83.7)	204(98.1)
	No	17(16.3)	4(1.9)

In bivariate logistic regression analysis, the variables including maternal age, the relationship of caretaker with child, maternal education, father education, family size, place of birth, birth order, ANC visit, PNC visit and turned home without vaccinating child having significant association with incomplete vaccination.

The result of the multivariable analysis showed that the relationship of mother/caretaker with child, father education, postnatal care (PNC), place of birth, antenatal care (ANC) visit, and inconvenient appointment time were independent factors associated with incomplete vaccination. Those mothers who had no antenatal care attendance were 8.3 times more likely to default vaccination than others, [AOR (95%CI) =8.3 (1.869-36.907). Those women who gave birth at home were 4.5 times more likely to incomplete vaccination than those who gave birth at health institutions, [AOR (95%CI) = 4.5(1.411-14.27). Those children who get care by caretakers (other than their mother) were 5.3 times more likely to default to complete vaccination than those who get care from their mother. [AOR (95% CI) = 5.3(1.988-14.094). Inconvenient appointment time is a predictor of incomplete vaccination, those respondents who have inconvenient appointment time were 3.4 times more likely to default to complete vaccination than others [AOR (95% CI) = 3.443(1.654-7.165). Respondents who do not have Postnatal care visits were 4.2 times more likely to default to

complete vaccination than those who have Postnatal care visits [AOR (95% CI) = 4.2(1.67-10.41) (**Table 4).**

Table 4. Bivariate and Multivaraible logistic regression results for determinants of incomplete vaccination in Semen Bench district, Bench Maji zone, Southern Ethiopia 2018.

Variables		Cases 104	Controls 208	COR (95% C.I)	AOR (95% C.I)
Postnatal care visit	No	45(43.3)	16(7.7)	9.15(4.82,17.37)	**4.2(1.67-10.41) ***
	Yes	59(56.7)	192(92.3)	1	1
Relation of respondent to child	Care taker	19(18.3)	10(4.8)	4.43(1.97-9.92)	**5.3(1.98-14.09) ***
	Mother	85(81.7)	198(95.2)	1	1
Mother/Care taker educational status	No formal education	86(82.7)	127(61.1)	0.35(.11,1.07)	0.45(0.11-1.83)
	Able to write and read	4(3.8)	17(8.2)	0.32(0.16-.66)	0.38(0.145-1.04)
	Elementary	12(11.5)	55(26.4)	0.33(0.07,1.56)	0.63(0.05-8.07)
	Secondary and above	2(1.9)	9(4.3)	1	1
Father educational stratus	Able to write and read	44(42.3)	70(33.7)	0.79(.46, 1.35)	0.29(0.36-2.461)
	Elementary	9(8.7)	70(33.7)	0.16(0.73, .36)	**0.97(0.12-.79)**
	Secondary and above	4(3.8)	9(4.3)	0.56(0.16, 1.93)	.030(.12-1.540)
	No formal education	47(45.2)	59(28.4)	1	1
Family size	≥5	68(65.4)	98(47.1)	2.12(1.30, 3.45)	1.58(0.77-3.23)
	<5	36(34.6)	110(52.9)	1	1
Place of birth	Home	16(15.4)	9(4.3)	4.02(1.71, 9.45)	**4.5(1.41-14.27) ***
	Health facility	88(84.6)	199(95.7)	1	1
Parity	2-4	70(67.3)	133(63.9)	2.34(1.07, 5.09)	1.67(0.60-4.63)
	≥5	25(24.0)	35(16.8)	3.17(1.31, 7.70)	1.37(0.39-4.85)
	1	9(8.7)	40(19.2)	1	1
Antenatal care Attendance	No	29(27.9)	3(1.4)	26.4(7.82, 89.3)	**8.3(1.87-36.91) ***
	Yes	75(72.1)	205(98.6)	1	1
Inconvenient appointment time	Yes	50(48.1)	33(15.9)	4.9(2.87, 8.38)	**3.44(1.65-7.16)** *
	No	54(51.9)	175(84.1)	1	1

*Statistically significant at $p < 0.05$

4. DISCUSSION

The finding of this study showed that having an antenatal care visit was statistically significant predictors on multivariable analysis. The finding of this study is consistent with the same study conducted in Mozambique, Wonago district, and central Ethiopia (Jagrati, 2008: Kindie *et al*., 2015; Tadesse, 2009).

Similarly giving birth at home was found to be an independent factor that leads to incomplete vaccination status of the child. The finding of this study is consistent with similar studies conducted in other parts of Ethiopia (Kindie *et al*., 2015; Tadesse, 2009). The possible explanation for this may be that those mothers who give birth at health institutions are more likely to use the health service than those mothers who gave birth at home.

In this study father's educational status was a determinant for incomplete vaccination. This may be as educational level increases the health-seeking behavior of family may increase and this in turn may have a positive impact on childhood vaccination. It might also be due to paternal education influence to practice child vaccination. As the father better knows about the importance of vaccination, the probability of influencing the mother to vaccinate her child is high.

The finding of this study showed that a mother's educational status is not a significant predictor for incomplete vaccination. This is contrary to the study conducted in Jamaica which revealed that having maternal education level collage and above were more likely vaccinate a child than others (Faisal *et al*., 2010).

Inconvenient appointment time was a significant factor for incomplete vaccination. This is also consistent with other studies conducted in Ethiopia (Kindie *et al*., 2015). The reason might be poor counseling, prioritizing the other activities to vaccination appointment by the caretaker. When mothers came to immunize their child and were denied the service because of a vaccine shortage, they are unlikely to bring their child back for vaccination.

In this study children and mothers/ caretaker's relationship was a significant factor for incomplete vaccination. This may be due to a mother being able to give good care for her child including vaccinating her child timely and completely. In contrast to this study, a study conducted in Jamaica revealed that there is no association between mothers/caretakers and child vaccination (Faisal *et al*., 2010).

This research made an effort to avoid miss classification bias as it is a case-control study that checked immunization cards during data collection. However, the researchers believed that the current study is not 100% free of misclassification bias.

5. CONCLUSIONS

The finding of this study showed that the absence of antenatal and postnatal care attendance, having home delivery, low level of father educational status, and the inconvenient appointment time were significantly affecting vaccination in the study area. Based on the finding of the study we recommend that governmental and non-governmental organizations working in neonatal and child health improvement should intervene and promote awareness of the community on the importance of post-natal care, antenatal care, and institutional delivery to optimize children's complete vaccination status. To reduce the number of children with incomplete immunization status, Bench Maji Zone also needs to consider specific planning for mothers with these risk profiles. A focus should also be given for strengthening healthy communication activities to raise immunization awareness and address concerns of vaccine side effects in the community. This could be achieved by integrating the immunization service to other elements of primary health care.

Ethics approval and consent to participate

Ethical clearance was obtained from Arba Minch University, College of medicine and health sciences, Institutional Research Ethics Review Board and support letter was also obtained from Bench District Health Bureau. Before data collection, the purpose of the study was clearly explained and written consent was obtained from the mothers/caretakers.

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