

Magnitude and Associated Factors of Delayed Immunization Among Children Aged 11 -23 Months in Edagahamus Town, Tigray, Ethiopia, 2018.

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Abstract

Background: Delayed immunization is a major public health problem that is associated with vaccine-preventable disease epidemics. In Ethiopia, many children don't receive the benefits of age-appropriate immunization; thus more than 90% of child deaths are largely due to preventable communicable diseases. Therefore, the aim of this study to assess the magnitude and factors associated with delayed immunization among 12 -23 months old children in Edagahamus Town, Tigray, Ethiopia, and 2018 G.C. Methods: A community-based Cross-Sectional study was carried out on July1-30, 2018. A simple random sampling method was used to select study participants. Information was collected using a structured, pre-tested questionnaire. The date of vaccinations was obtained from children's immunization cards and timeliness assessed based on the recommended age ranges. Data were entered and analyzed using SPSS version 20.0. Variable with P-value < 0.2 in bivariate was exported to multivariate. The strength of association was identified using the odds ratio with a 95 % confidence interval (CI) and the P-value of <0.05 in multivariate was taken statistically significant. Results: In this study, the overall magnitude of delayed immunization was 29.5% (95%CI 26.7-45). Private firm work of mothers (AOR=0.205 95% CI 0.068-0.617), Mothers who attend tertiary education (AOR 0.169, 95% CI 0.032-0.882), and secondary education (AOR 0.269, 95% CI 0.114-0.636) had the protective effect of delayed immunization. But sickness of a child (AOR= 11.8, 95% CI 6.16-22.65) was a risk for delayed immunization. Conclusions: From the study, it is concluded that the magnitude of delayed immunization for children aged 12-23 months is high (29.5%) in Edagahamus. Delayed immunizations of children were predicted by the Mother's occupation, education, and Mother's consideration in the child's wellness to take the vaccine.

Background

Vaccine-preventable diseases cause over three million childhood deaths each year globally especially in developing countries(1, 2). From the nearly 8.8million yearly deaths of under-five children greater than 20% are due to Vaccine-preventable diseases (VPD)(3). VPD is a major cause of morbidity and mortality in children under five years of age in developing countries including Ethiopia(4). Ethiopia has experienced many outbreaks and hence morbidity and mortality from VPD(5, 6). According to EDHS 2016; childhood mortality rates have declined since 2000, despite that, infant and under-5 mortality rate in Ethiopia was 48/1000 and 67/1000 respectively(7). Immunization is the most important public health interference for VPD(8). It presently averts more than 2.5 million deaths every year in all age groups from diphtheria, tetanus, pertussis (whooping cough), and measles(9, 10).In Ethiopia nearly 4 in 10 children aged 12-23 months have received all eight basic vaccinations; single doses of BCG and measles and three doses for each of Pentavalent, PCV, Rota and polio vaccine. Immunization is a key element of the health extension program package. However, timely and full vaccination coverage has not been completed in Ethiopia as planned, thus more than 90% of child deaths are largely due to preventable communicable diseases and nutritional disorders(20). In Edagahamus, the Expanded Program on Immunization (EPI) schedule is not applied as National advice for the timing of delivery, as a result, many children don't receive the benefits of timely and age-appropriate immunization. So, improving timely and age-appropriate immunization delivery would require a better understanding of reasons for the delay(18). Delays in receiving immunization have been reported globally(21). In the United States of America, up to **40 percent of parents** delay or refuse their children's

vaccine (16). 63.3 % of the Gambian children had a delay in the mentioned age range to receive at least one of the studied vaccines(1). In Uganda, less than half of all children received all vaccines within the recommended time(22). According to different literatures, factors that are associated with delayed immunization includes; marital status, educational status, occupation, income, service accessibility, transportation, distance, place of birth, birth order, number of children in the household, sickness of the child, Forget/don't know the due date and so on(1, 19, 22, 23).

Today, parents' vaccine hesitancy may have been increased by celebrities' public airing of their concerns about vaccines (31-33). Parents commonly mention the fear of side effects as a reason for not vaccinating their children; eg, in Liberia, Somalia, Armenia. In some cases, an older sibling experience of side effects leads to parents refused vaccination for younger children. Little is known about delayed immunization and as per the investigators; no studies conducted to assess delayed immunization. Therefore, this study aimed to assess the magnitude and factors associated with delayed immunization among 12 – 23 months old children in Edagahamus.

Methods

Study setting

A community-based cross-sectional study was conducted from July 1-30/ 2018 at Edagahamus city, Tigray regional state of Ethiopia. Edagahamus is founded in the eastern zone of Tigray, wereda Saesie Tsaida Amba; which is located 885 Km north of the Ethiopian capital city of Addis Ababa, 105 Km east of the Tigray capital city Mekelle and around 20 Km near to Adigrat. Edagahamus is divided into four kebeles and the total population was 21,993; from those 10,031 were male and 11,962 were female (2006/2012 census). There is only one health center in Edagahamus and the total number of under two-year children is 795.

Participants

Sampled children aged 12 – 23 months old living in Edagahamus and who fulfill the inclusion criteria were taken as the study population. Households that have one living child aged between 12-23 months old who have the vaccination card are included, While Households who have children aged between 12-23 months old who do not complete their vaccination (drop out) were excluded.

Sample size determination and sampling technique

The sample size was calculated using a single population proportion formula with the following assumption: Prevalence of children's who had delayed vaccination in Gambia =63.3% (1), 95% of confidence interval(1.96), 5% margin of sampling error tolerated, 10% of non-response rate, then the final sample size are 393. A simple random sampling method was used to select study subjects using a sampling frame obtained from the health extension workers. The mothers' identity and the households' numbers that are used by the Health extension workers were used to identify the selected households. In the case of two or more mothers having a child's in the same household, one mother was selected using the lottery method. First, a list of all eligible participants was prepared in excel after obtained from the health extension workers. Then, the random number was generated using OpenEpi software and marked the selected one against the excel.

Finally, each eligible study participant was contacted through the house to house visits. A second visit was done in case a mother was absent in the house during the first visit. If the mother is not available for the second time, a neighbor's mother with a child was contacted. Samples were allocated to each kebeles using a proportion to the size allocation.

Study Variables

Dependent Variable

Delayed immunization

Independent Variables

Socio-demographic and economic factors, Maternal/caregiver factors, Child's factors, and Service-related factors.

Definition of terms

BCG (birth – 8 weeks), Penta1, PCV1, Rota1 and OPV1 (6 weeks – 14 weeks); Penta2, PCV2, Rota2 and OPV2 (10 weeks – 18 weeks); Penta3, PCV3 and OPV3 (14 weeks – 24 weeks)] and measles vaccine (9 months – 11months). Timeliness of vaccination of a particular antigen was assessed against the WHO recommended range as already indicated above and Children who have delayed at receiving at least one vaccine considered as delayed (1). **Timely:** if the vaccine was received within the recommended period above. **Delayed:** if received after the window period. **Penta-1 to Penta-3 dropout rate:** the % of children vaccinated for Penta-1 who defaulted for Penta-3. **BCG to Measles dropout rate:** the % of children vaccinated for BCG who defaulted for measles.

Health Extension Worker: In Ethiopia, against a backdrop of acute [physician shortage](#), Health Extension Workers are assigned to local health posts and provide a package of essential interventions to meet population health needs at this level. Through the national Health Extension Program, HEWs are recruited among high school graduates in local communities, and undergo a one-year training program to deliver a package of preventive and basic curative services that fall under four main components: hygiene and environmental sanitation; family health services; disease prevention and control; and health education and communication (34).

Data collection tools and techniques

Data was collected by using an interviewer-administered and structured questionnaire adapted from WHO survey questions and related pieces of literature according to the objectives (1, 19, 22, 23,30). The questionnaire includes Socio-demographic and economic factors, Maternal/caregiver factors, Child's factors, and Service-related factors.

Data quality assurance and control

Five Midwife data collectors and supervisors were recruited from another area outside of the study site and they were given training for three days. The supervisors followed the process of data collection daily, checked the data completeness consistency and communicate with principal investigators daily.

Data Processing and Analysis

data was coded, cleaned, recorded and entered into Epi info 7 and finally export to SPSS version 20.00 for analysis. Simple descriptive summary statistics were done. Tables, statements, charts, and graphs were used to present the result of the analyzed data. Associations between independent and dependent variables were analyzed first using bivariate logistic regression analysis. Variables that had $p < 0.2$ on bivariate analysis were entered into multivariable logistic regression analysis. The statistical association between the different independent variables to the dependent variable was measured using OR, AOR, 95% CI and P-values < 0.05 was considered statistically significant.

Results

Socio-demographic Character of the study participants

A total of 393 mothers of children aged between 12-23 months old were interviewed from four kebeles, with a response rate of 100%. Out of the total study subjects, 222(56.5%) have children aged 11-17 months, while 171(43.5%) were aged 18-24 months. The mean (\pm SD) age of the children was 17(\pm 6) months old. Female children were 208 (52.9%) of the total study subjects. The age range of mothers included in the study was 17-43 years, which is a childbearing age range. The mean (\pm SD) age of the mothers was 29.4 (\pm 5.3) years old. (**Table 1**)

Maternity-related characteristics

Overall 327(83.2%) of mothers know the immunization schedule. A total of 278 (70.7%) of the mothers got health education, particularly about immunization during antenatal and postnatal care while they were pregnant and after the birth of the child. (**Table 2**)

Service-related characteristics

Overall 44(11.2%) returned home due to a lack of vaccine. About 246(62.6%) mothers get advice during the immunization period on adverse events following vaccination (**Table 3**).

The magnitude of age untimely vaccination

From the total respondents 116 (29.5%, 95% CI 26.7%-45%) had experienced delay at least one of their immunization. For BCG 41 (10.4%) of the respondents presented after the age of 8 weeks and delayed for up to two months. For the first dose of Pentavalent, PCV, Rota, and polio vaccines 7 (1.7%) of the respondents presented after the age of 14 weeks and delayed for up to one month and a half. For the second dose of Pentavalent, PCV, Rota, and polio vaccines 13(3.3%) of the respondents presented after the age of 18 weeks and delayed for up to two months. For the third dose of Pentavalent, PCV and polio vaccines 26 (6.6%) of the respondents presented after the age of 24 weeks and delayed for up to two months. For the measles vaccine,

29(7.3%) of the children presented after the age of 11 months and 5.2% and 1.4% were delayed for up to three and seven months respectively (figure 1).

Factors associated with delayed immunization

In the bivariate logistic regression maternal occupation, marital status, educational status, lack of vaccines, lack of appointment, sickness of the child's and "don't know" the due date was associated with delayed immunization at p- the value of < 0.2. In multivariate logistic regression analysis sickness of the child, mothers' occupation and education have a significant association. Children's of mothers who were employed at private occupations were less likely to delay their vaccines (AOR 0.205 95% CI 0.068-0.617) compared to children's of mothers who were a housewife. Mothers who had tertiary education (AOR 0.169, 95% CI 0.032-0.882) and secondary education (AOR 0.269, 95% CI 0.114-0.636) were less likely to delay their infant's immunization compared to those mothers with no education. child sickness in the appointment day were more likely to delay (AOR 11.36, 95% CI 4.68-27.55) than those healthy.

Discussion

This study aimed to assess the magnitude and factors associated with immunization delay among 12-23 months old children. In this study, the overall prevalence of delayed immunization among the study participants was found to be 29.5% (95% CI 26.7%-45%). other countries' experiences show the overall prevalence of delayed immunization can vary. For example, the study done in the Gambia showed a prevalence of 63.3 % (1) and the study was done in Atlanta showed 25.8% (24). This difference might be attributed to the difference in educational background, degree of knowledge towards immunization, and the difference in the study population. However, it is similar to the study done among Norwegian children 44.7 % (23). This is justified due to the similarity in the study population, Vaccinations are mainly provided by public health nurses and all services are voluntary and free of charge. The occupation was significantly associated with delayed vaccination; in this study private firm work of mothers was positively associated with timeliness, which is similar to the study done among Gambian children (1). The reasons may be multiple, for example, better knowledge about vaccination and time management and housewife women might be fully engaged at home with domestic tasks hence they tend to forget their children's vaccination appointments. The educational status of the mother/caretaker was a predictor for delayed child immunization; in this study maternal education beyond the secondary level was positively associated with timeliness, Similar to the study done in Nigeria(21), Gambia(1) and Iran(19). This is attributed because highly educated mothers are more willing to seeking care than other mothers. The sickness of the children was also associated with delayed vaccination similar to the study done in Nigeria and Shenzhen, China(21, 30). This may be around missed opportunities to vaccinate with mild illnesses. Socio-economic status and the number of children in the households were not predictors for delayed child's immunization in this study, which is different from studies in Gambia and Uganda, which indicates income-related factors hindered utilization of immunization services so that children's with several siblings were more likely to have untimely vaccinations, that higher cost and demands can easily discourage to vaccinate their children's (1, 22). This difference could be explained by the fact that free service for immunization is implementing in Ethiopia so that higher costs and demands were not a problem among families participated in this study.

Conclusions

From the study, it is concluded that the magnitude of Delayed immunization for children aged 12-23 months is high (29.5%) in Edagahamus. Delayed immunizations of children were predicted by the Mother's occupation, and education which had the protective effect of delay immunization and consideration of the mother the child was too ill to undertake vaccination when it was due was a risk for delayed immunization. Therefore it is important to consider education as vital for the attainment of full immunization which intern raises the need of the community and creates maternal awareness about the importance of child immunization. There is a need to disseminate information on the importance of mothers' occupation that most of the mothers with domestic works have more likely to delay immunization.

Abbreviations

BCG - Bacillus Calmette-Guerin , EDHS – Ethiopia Demographic Health Survey, EPI - Expanded Program on Immunization, FMOH – Federal Ministry of Health ,MDG – Millennium development goal ,MMR – Measles-Mumps-Rubella , MoH - Ministry of Health, MU, CHS – Mekele University College of Health Science, OPV - Oral Polio Vaccine, SE – Side Effect, VPD – Vaccine-Preventable Diseases , PCV - Pneumonia Vaccine, SNNP – Southern Nation and Nationalities, SOS - Sustainable Outreach Services, UNICEF - United Nations International Children's Education Fund, WHO – World Health Organization

Declarations

Ethical consideration

Ethical clearance was obtained from the Institutional Review Committee (IRC), College of Medicine and Health Sciences, Mekele University. Permission letter was received from those administrative bodies of the East Tigray Health Department, Edagahamus City, and selected kebeles written consent was obtained from all participants after they informed on the purpose of the study. Information's obtained from individuals participants was kept secure and confidential. Names and other identifying data of respondents were made by using code throughout the study process to obtain confidentiality. Finally, data were collected according to the standard questionnaire prepared.

Consent for publication

Not applicable

Availability of data and materials

The datasets used during the current study available from the corresponding author on reasonable request (Additional file 1).

Computing interest

The authors declare that they have no competing interests.

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Mekele University was our fund agent to conduct this study. The role of Mekele University was providing appropriate training to develop the proposal, funding money to our data collectors and following how the study is going on, finally, our University provides us basic training which was helpful for our study.

Authors' contributions

MG designed the study, performed statistical analysis, and drafted the paper. TG, SS, BH, and MK participated in paper writing. All authors contribute to the data analysis and read and approved the final paper.

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Tables

Table 1: Sociodemographic characteristics of the respondents in Edagahamus, Tigray, Ethiopia, 2018 (n=393).

Variable	Category	Frequency	Percent (%)
Sex of child	Female	208	52.9
	Male	185	47.1
Age of child	11-17 months	222	56.5
	18-24 months	171	43.5
Age of mother	≤30 yrs.	244	62.1
	≥31 yrs.	149	37.9
Religion	Christian	328	83.5
	Other	65	16.5
Marital status	Married/active	302	76.8
	never married	39	9.9
	Separated/widowed and divorced	52	13.2
Ethnicity	Tigray	372	94.7
	Other	21	5.4
Educational level	no education	57	14.5
	Primary	106	27.0
	Secondary	191	48.6
	University/college	39	9.9
Occupation	Governmental	22	5.6
	Private	59	15.0
	Daily	40	10.2
	Student	16	4.1
	Housewife	256	65.1
Average monthly income	<500 birr	42	10.7
	500-1000	119	30.3
	>1000	192	48.3
	Unknown	42	10.7
Birth order of the child	1 st born	55	14.0
	2 nd born	161	41.0
	>3 rd born	177	45.0

2: Distribution of maternity-related characteristics of Edaghamus, Tigray, Ethiopia, 2018
13)

Variable	Category	Frequency	Percent (%)
Health education about vaccination and related topics during PNC/ANC	Yes	278	70.7
	No	115	29.3
Place of birth	Own home	47	12.0
	Health facility	346	88.0
Illness of child on the appointment period	Yes	42	10.7
	No	351	89.3
Don't know it was due/forget	Yes	28	7.1
	No	365	92.9
Fear of side effect	Yes	27	6.9
	No	366	93.1
Do you think it is important to get a vaccine?	Yes	381	96.9
	No	12	3.1
Do you know immunization commences at birth?	Yes	311	79.1
	No	82	20.9
Do you know the immunization schedule?	Yes	327	83.2
	No	66	16.8
Do you think immunity could be achieved with vaccination?	Yes	362	92.1
	No	31	7.9
Do you think VPD could be serious?	Yes	342	87.0
	No	51	13.0

3: Distribution of service-related characteristics of Edagahamus, Tigray, Ethiopia, 2018

13).

Variable	Category	Frequency	Percent (%)
The child might develop side effect from the shot	Great deal	314	79.9
	A little	61	15.5
	Not at all	18	4.6
Advised you some vaccines had too serious SE during immunization period	Yes	246	62.6
	No	147	37.4
Satisfaction with the practice of providers	Yes	251	63.9
	No	142	36.1
Lack of vaccine	Yes	44	11.2
	No	349	88.8
Lack of appointment	Yes	20	5.1
	No	373	94.9

Table 4: Factors associated with delayed immunization among 11-23 months old children in Edagahamus Town, Tigray, Ethiopia, and 2018G.C

Variable	Delay n (%)	Timely n (%)	COR	P	AOR	P
Occupation						
Governmental	2(9.1)	20(90.9)	0.184(0.042;0.807)	0.025	0.663(0.10-4.384)	0.669
Private	10(16.9)	49(83.1)	0.376(0.182;0.779)	0.008	0.205(0.068-0.617)	0.005
Daily laborer	28(70)	12(30)	4.304(2.088;8.871)	0.000	1.881(0.602-5.874)	0.277
Student	9(56.3)	7(43.8)	2.37(0.855;6.58)	0.097	3.462(0.707-16.95)	0.125
Housewife	90(35.2)	166(64.8)	1	1	1	1
Education						
Primary	4(10.3)	35(89.7)	0.072(0.022;0.23)	0.000	0.169(0.032-0.882)	0.035
Secondary	52(27.2)	139(72.8)	0.235(0.126;0.438)	0.000	0.269(0.114-0.636)	0.003
Tertiary	48(45.3)	58(54.7)	0.520(0.270;1.003)	0.051	0.828(0.340-2.019)	0.678
Uneducated	35(61.4)	22(38.6)	1	1	1	1
Marital status						
Married	90(29.8)	212(70.2)	0.337(0.185;0.614)	0.000		
Unmarried	20(51.3)	19(48.7)	0.835(0.363;1.920)	0.671		
Separated	29(55.8)	23(44.2)	1	1		
Widow	110(32.2)	232(67.8)	1			
Age of vaccine						
1-5	30(68.2)	14(31.8)	4.718(2.406;9.253)	0.000		
6-10	109(31.2)	240(68.8)	1			
Health status of child						
Healthy	30(71.4)	12(28.6)	5.550(2.738;11.25)	0.000	11.36(4.68-27.55)	0.000
Sick	109(31.1)	242(68.9)	1			
Time of appointment						
15-30 min	12(60)	8(40)	2.906(1.158;7.290)	0.023		
30-45 min	127(34)	246(66)	1			
Distance to health center						
1-5 km	17(60.7)	11(39.3)	3.078(1.398;6.776)	0.005		
6-10 km	122(33.4)	243(66.6)	1			

Figures

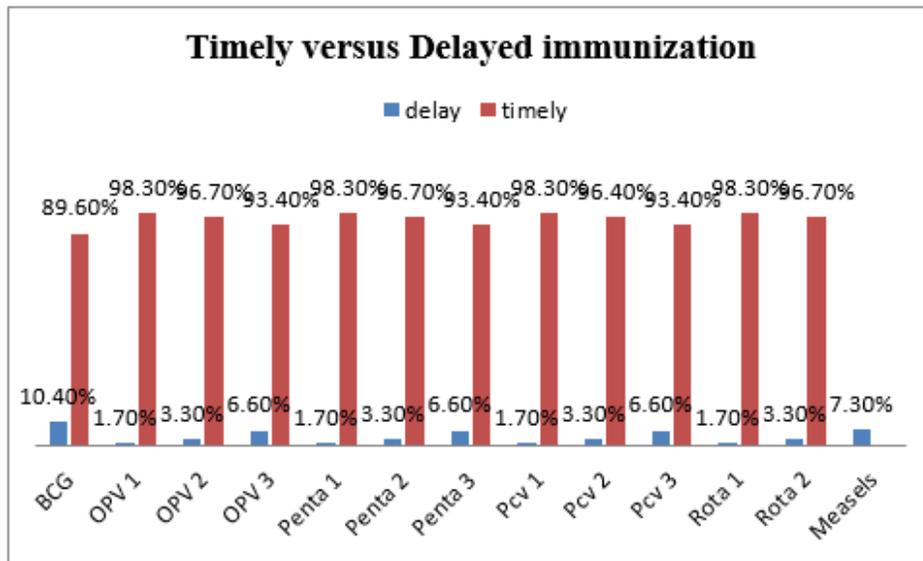


Figure 1

Timely versus delayed immunization among 11-23 months old children in Edagahamus, Tigray, Ethiopia, 2018.