1 **Determinant of Vaccination Status among Under-Five Year-Old-Children: In Case of**

2 **Mattu Town, Oromia Regional State, Ethiopia**

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10 **Abstract**

11 ***Objectives***: *vaccination prevents 2-3 million deaths from diphtheria, tetanus, and measles. The*

12 *research conducted in Ethiopia (2012) showed that only 50% of under-five year-old-children*

13 *fully complete their vaccination. Therefore, this study aimed to assess vaccination status and*

14 *associated factors among under-five year-old-children in Mettu town.*

15 ***Methods***: *The structured questionnaires were used to collect data from 118 respondents in the*

16 *study area. To assess the determinant factors of vaccination status among under-five year-old-*

17 *children, the Chi-square test of association and Binary logistic regression were used, and data*

18 *was analyzed using SPSS 20.*

19 ***Results***: *Of a total of 118 children, only 68 (57.6%) completed the vaccination, and 50(42.4%)*

20 *of them did not complete their vaccination. The result from logistic regression revealed that*

21 *vaccination status under-five year-old-children was significantly related to the marital status*

22 *mother's (Widowed: p-value: 0.007; CI:1.701, 28.818), educational status of the household head*

23 *(illiterate: p-value: 0.032; CI:0.024, 0.848), monthly income of the household (income>154.9*

24 *USD: p-value: 0.024*; CI: 1.322, 48.460), and residence area of the household (Urban: p-value:*

25 *0. 015; CI: 1.297, 10.981).*

26 ***Conclusions****: Of a total of 118 children, only 68 (57.6%) completed the vaccination, and*

27 *50(42.4%) of them did not complete their vaccination. The findings of this study showed that*

28 *marital status, educational status, income, and residence were the major factors related to*

29 *vaccination status among under-five age children. Therefore, the region, zone and district*

30 *administration and health offices give attention through different methods like training via*

31 *extension workers to complete the vaccination in the study area.*

32 **Keywords:** Vaccination status, under-five year, children, caretaker, mother

33 **Introduction**

34 Vaccination is an intervention that can be used to save children from vaccine avertable diseases

35 at an early age. Immunization programs have improved the primary care infrastructure in

36 developing countries, lowered mortality in childhood, and empowered women to better plan their

37 families, with consequent health, social and economic benefits. It benefits individuals,

38 communities, countries, and the world. The vaccine platform was established in 1974 against six

39 vaccine-preventable diseases: diphtheria, polio, tuberculosis, measles, Pertussis, and tetanus.

40 Currently, vaccine continues to save children against 14 diseases. These are diphtheria, pertussis,

41 tetanus, measles, polio, tuberculosis, hepatitis B, Haemophilus influenza type B. (Hib), rubella,

42 meningococcal disease, pneumococcal, rotavirus diarrhea, and Japanese encephalitis and yellow

43 fever **(1)**.

44 For the first time, a vaccine program was established in Ethiopia in 1980 with the objective of

45 100% vaccination coverage for all children under the age of two years by 1990. The national

46 vaccine calendar targets children under one year providing Bacillus Calmette-Guerin (BCG)

47 vaccine given at birth, three doses of oral polio vaccine given at 6, 10, and 14 weeks of age; two

48 doses of Rota vaccine given at 6 and 10 weeks, and measles vaccine given at 9 months of age,

49 respectively **(2)**. In the updated Ethiopian vaccine policy of 2007, children under one year and

50 women of 15-49 years are the targets for the vaccine services in Ethiopia **(3)**.

51 Vaccine-preventable diseases are covers about 25% of the 10 million deaths occurring annually

52 among under 5 years children **(4)**. The research conducted in Indonesia **(5)** showed that 32% of

53 the children were fully immunized in 2012. The result also showed that this coverage was

54 significantly lower among children who lived in Maluku and Papua region, who were 36–47

55 months old, who had higher birth order, who had greater family size, whose mothers had no

56 education, and from the poorest households.

57 The research conducted in Cameroon **(6)** showed that all children had received at least one

58 routine vaccination, the Oral Polio Vaccine coverage was greater than 90 %, and 73.4 % of

59 children completed the recommended vaccinations before 1-year of age. The result from the

60 multilevel logistic regression model showed that incomplete immunization status was

61 significantly associated with retention of immunization cards, lower mothers' utilization of

62 antenatal care (ANC) services, being the 3rd or more born child in the family, younger mothers'

63 age, parents' negative attitude towards immunization, poorer parents' exposure to information on

64 vaccination and longer distance from the vaccination centers.

65 According to the survey conducted in Ethiopia, the result showed that only 39% of children aged

66 12-23 months have received all basic vaccinations. 16% of children in this age group have not

67 received any vaccinations. The study also showed that 69% of children have received the BCG,

68 73% the first dose of pentavalent, 81% the first dose of polio, 67% the first dose of the

69 pneumococcal vaccine, 64% the first dose of rotavirus vaccine, and 54% of children have

70 received a measles vaccination(3).

71 The 2011 EDHS report also showed that only 24% of Ethiopia children in the age group of 12-13

72 months received all the recommended vaccines which represents a 19% increase from the level

73 reported in the 2005 EDHS. The result also showed that 66% of children had received the BCG

74 vaccine, and 56% had received the measles vaccine; about 64% of children received the first

75 Diphtheria Pertussis and Tetanus (DPT) dose, and 37% received the third dose of DPT which

76 indicated a dropout rate of 43%. The result indicated that about 82% of children received the first

77 dose of polio and only about 44% received the third dose which showed a dropout rate of 46%

78 (7).

79 The 2016 EDHS report showed that about 39% of those aged 12-13 months received all basic

80 vaccination, and 22% were vaccinated by the appropriate age. In Ethiopia, vaccination coverage

81 was very low, among this, 38% of vaccine coverage was in the Oromia region, of Ethiopia (7).

82 The study conducted in Ihe, Nigeria showed that Out of 972 children, 63% (613/972) were

83 immunized for DPT3 while 63.7% (619/972) were immunized for DPT1 with overall dropout

84 rates were 6% and 1%, respectively (8).

85 The study conducted in Sinana District, Southeast Ethiopia showed that 76.8% of the children

86 aged 12 to 23 months were complete their vaccination. This was due to the following factors that

87 were significantly associated with it: being with secondary and above educational level, having

88 household family income greater than 1000 ETB or 52 USD, those whose average walking time

89 from home to health facilities is less than an hour, etc. The study also indicated that more than

90 half of the respondents 289(61%) knew that the vaccination program should be finished at the

91 age of nine months. The result revealed that care giver's educational level, knowledge of the

92 benefit of vaccinating a child and age to complete vaccination, ANC follow up and institutional

93 delivery were significantly associated with incomplete vaccination **(9)**.

94 The study conducted in Wadera District, South East Ethiopia showed that only 41.4% were fully

95 vaccinated and 58.6% of the children were not fully vaccinated. The study also showed that there

96 was a significant association between vaccination status and the number of ANC visits, number

97 of Tetanus Toxoid (TT) received, place of delivery, Post Natal Care follow-up, Average walking

98 time to reach vaccination services, and knowledge of mothers who had vaccine **(10)**.

99 The study conducted in Yirgalem Town, South Ethiopia indicated that 96(20.3%) of the sample

100 size didn't complete their vaccination. The study also indicated that more than half of the

101 respondents 289(61%) knew that the vaccination program should be finished at the age of nine

102 months. The result revealed that care giver's educational level, knowledge of the benefit of

103 vaccinating a child and age to complete vaccination, ANC follow up and institutional delivery

104 were significantly associated with incomplete vaccination **(11)**.

105 As the health office of Mettu town reports showed that Mettu town has a high vaccination

106 problem (by using interview office workers). To the best of my knowledge, there were no studies

107 have been conducted in Mettu town regarding the determinant of vaccination status among

108 under-five year-old-children. Therefore, this study aimed to identify the determinant of

109 vaccination status among under-five year-old-children in Mettu town.

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113 **Material and Methods**

114 **Study Design and Period**

115 A community-based cross-sectional study design was used to collect 118 samples from January

116 2020 to March 2020.

Study Area

118 Mettu is a market town and separate district in south-west Ethiopia, located in the Ilu Ababor

119 zone of Oromia region, about 600km west of the country from the capital city of Addis Ababa.

120 Mettu has been an important market of the coffee trade since 1930. It is also well-known place

121 for ever green forest and a variety of tourist attractions such as Sor Rivers.

Study Population

123 The data was obtained from the parents of children aged between 1-5 years in Mettu town as per

124 the reported dates of birth, within the eligible households in the selected cluster. The population

125 size of Mettu town was 17121 in 2019. Our target population is under five year-old-children

126 were Mettu town. The validity of the questionnaire used for the study was checked through the

127 pilot survey by taking samples of 10% of the population.

Inclusion and exclusion criteria

129 Children whose ages were above five years were excluded from the study and Children aged five

130 and fewer years were included in the study.

Sample Size Determination

132 To find the sample size for this study, the proportion of children who are completely vaccinated

133 and not completely vaccinated would be used. The sample size determination formula is given as

134 follows**(12)**:

135     $n_o = \dfrac{Z^2_{\alpha/2}PQ}{d^2}$ and $n = \dfrac{no}{1+\dfrac{no}{N}}$, $no = \dfrac{1.96^2(0.5)(0.5)}{0.09^2} = 118$ (1)

136   Since no/N<5%, we take n=no=118.

137   d=0.09 is the margin of error; $Z_{\alpha/2} = 1.96$

138   P= 0.5 is the proportion of children who are complete vaccination.

139   Q=0.5=1-p is a proportion of children who are not complete vaccination.

140   **Method of data collection**

141   The data used in this study was primary data which is collected by using administered structured

142   questionnaire from parents of children in Mettu town. The validity of the questionnaire used for

143   the study was checked through the pilot-test by taking a sample of 10% of the population **(13)**.

144   **Study Variables**

145   **Dependent Variables**: The dependent for this study was vaccination status among under-five

146   age children which has two categories: not complete vaccinated and complete vaccinated(Y=1,

147   complete vaccinated or Y=0, not complete vaccinated).

148   **Independent Variables were:**

149   ➢ Sex of child

150   ➢ Age of primary caretaker

151   ➢ primary caretaker of the child

152   ➢ Mother marital status

153   ➢ Educational status of caretaker

154   ➢ Occupation of the primary

155   caretaker

156   ➢ The Religion of the primary

157   caretaker

158   ➢ Monthly income

159   ➢ Residence area

160   **Statistical Analysis**

161   In this study, the data was analyzed using descriptive statistics (percentage, frequency, graph,

162   etc.), Chi-square Test, and a logistic regression model. SPSS version 20 was used for data

163   analysis.

164   **Binary Logistic Regression**

165   Logistic regression is a type of regression that is used when the dependent variable is Qualitative

166   and the independent variables are any type **(14)**. In this study, the most appropriate method is

167   binary logistic regression since the response variable is dichotomous (Y= 0, is incomplete

168   vaccination and Y=1, is complete vaccination).

169   The logistic regression model is given as follows:

170 $\text{Logit(p)}=\log(\frac{p}{1-p}) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_k X_k$ (2)

171   where P is the probability of success   **174** $X_1, X_2, X_3, ..., X_k$ are independent variables

172   Q=1-P is the probability of failure   **175** $\beta_1, \beta_2, \beta_3 ... \beta_k$ are coefficients.

173 β_0- constant,

176   Logistic regressions work with odds so it is necessary to define both odds and odds ratio. The

177   odds are simply the ratio of the probabilities for the two possible outcomes. If p is the probability

178   of children will be complete vaccinated and 1-p is the probability of children that incomplete

179   vaccine, then the formula for Odds ratio is given by **(14)**:

180 $\text{Odds ratio}=\text{odds1/odds2}=\dfrac{(P1/1-P1)}{(P2/1-P2)}$ (3)

181   There are some issues considered while using binary logistic regression model. Among these,

182   coefficient estimation techniques (Maximum likelihood and non-iterative weighted least

183 squares), significance of each model coefficient (Wald test), the overall significance of the model

184 coefficient (Likelihood-Ratio test) and overall goodness fit of the model (Hosmer-Lemeshow

185 test) are common**(14)**.

186 **Results**

187 Among a total of 118 children included in the study, 68(57.6%) were female and 50(42.4%) were

188 female. The result form descriptive statistics showed that, from the total of 118 children, 50

189 (42.4%) did not complete their vaccinations and 68 (57.6%) completed their vaccinations. Of a

190 total of 118 children includes in the study, 67(56.8%) were living in urban areas and 51(43.2%)

191 were living in rural areas. When we mention marital status of the mother, from a total of 118

192 samples, 79(66.9%) of them were married, 17 (14.4%) of them were widowed and the rest

193 22(18.6%) were separated. The results also showed that 16(13.6%) of the respondents were

194 illiterate, 34(28.8%) of the respondents had elementary education, 44(37.3%) were between

195 grades 9 and 12, and 24(20.3%) had a high-school education. Concerning occupation, the result

196 also showed that 13 (11.0%) were housewives, 50(42.4%) were merchants, 18(15.3%) were

197 daily laborers and 37 (31.4%) were government employees. Concerning religion, 36(30.5%)

198 were Orthodox, 33(28.0%) were Protestant, 30(25.4%) were Muslim and 19 (16.1%) were other

199 religions. Concerning the income of respondents, 29 (24.6%) had a monthly income between

200 62.2 and 92.9 USD, 30(25.4%) were with monthly income between 93.0 and 123.8 USD,

201 26(22.0%) were with monthly income between 123.9 and 154.8 USD, 33(28.0%) were with

202 monthly income above 154.8 USD. Concerning the age of the respondents, the results revealed

203 that 15 (12.7%) were between 15 and 25 years, 41(34.7%) were between 26 and 36 years,

204 45(38.1) were between 37 and 47 years, and 17(14.4%) were greater than 47 years (Table 1).

205 The result from pie-chart showed that among a total of 118 children included in the study,

206 50(42.4%) of them didn't complete their vaccination and 68(57.6%) were completed their

207 vaccination (Figure 1).

208 The result from Chi-square test showed that marital status, education, occupation, income, and

209 residential area were significantly associated with vaccination status at a 5% level of

210 significance. On the other hand, the sex of the child, Age of the primary caretaker, the primary

211 caretaker of the child, and religion had no association with the vaccination status at a 5% level of

212 significance (Table 2).

213 The result from Logistic regression showed that the Mother's marital status, educational status of

214 the caretaker, monthly income, and residence area were significant factors in affecting

215 vaccination status among under five years children. Whereas the sex of the child, the Age of

216 primary caretaker, the occupation of the primary caretaker, the primary caretaker of the child,

217 and the religion of the primary caretaker had no significant effect on vaccination status among

218 under five years children (Table 3).

219 The result from Hosmer and Lemeshow test indicated that the model fit the data adequately as

220 the p-value was not less than a 5% significance level. Therefore, the logistic regression model

221 fits the data very well (Table 4).

222 **Discussion**

223 This study aimed to assess incomplete vaccination and associated factors among under 5 years

224 children in Mettu town. The results of this study might be used as a source of information for

225 concerned bodies like regional, zonal and district admiration offices, and health offices as well as

226 for future researchers. The details of discussion for the result obtained from the study are given

227 below.

228 This study revealed that the percentage of vaccination status for those who completed

229 vaccination was 57.6% as compared to who didn't complete (42.4%) vaccination. This

230 descriptive result is similar with the previous study conducted in Mecha district, North West

231 Ethiopia showed that about 49.3 % of children aged 12–23 months were fully vaccinated, 49.1 %

232 did not complete the vaccination, and 1.6% of children have not started the vaccine**(9,15)**.

233 The Chi-square test was employed to examine the association between vaccination status and

234 others categorical variables. The result showed that vaccination status was significantly

235 associated with marital status, education of household head, occupation of household head,

236 income household, and residential area at a 5% level of significance.

237 The logistic regression model (odds ratio) was used to examine the relationship between the

238 vaccination status and one or more independent variables. The result showed that the odds of

239 vaccine status for those whose education is College/University were 0.143 times more likely than

240 those whose education is illiterate at a 5% level of significance, keeping all other factors

241 constant. This result is consistent with the previous studies conducted in different area/regions

242 (5,9,11,15–17). This might be due to the fact that educated people have more knowledge about

243 the use of vaccination and treat their children on time. The result also showed that the odds of

244 vaccine status for those whose income was greater than 154.8 USD were 0.300 times more likely

245 than those whose income was from 62.2 and 92.9 USD at a 5% level of significance, keeping all

246 other factors constant. This result is in line with the previous studies conducted in different

247 area/regions/countries (9,15). This might be because those people whose income is high might

248 took their children where ever the vaccine is available. The result indicated that the odds of

249 vaccine status for those who live in urban areas were 3.773 times more likely than for those who

250 live in rural, keeping all other factors constant. This result is similar to the previous studies

251 conducted in different regions (5,9,10,16).

252 This research paper is limited to the Determinant of Vaccination Status among under five year-

253 old-children in Mettu town. This is due to the fact that the researchers face financial constraint to

254 expand the study area to zone and region.

255 **Conclusions**

256 This study aimed to assess incomplete vaccination and associated factors among under 5 years

257 children in Mettu town using descriptive statistics, chi-square of association and binary logistic

258 regression model. Of a total of 118 children, only 68 (57.6%) children completed the

259 vaccination, and 50(42.4%) of them didn't complete their vaccination. The findings of this study

260 showed that marital status, educational status, income, and residence are major factors related to

261 vaccination status among under-five age children. Therefore, the region, zone and district

262 administration and health offices give attention through different methods like training via

263 extension workers to complete the vaccination in the study area.

264 **List of abbreviations**

265 ANC=Antenatal Care; BCG=Bacillus Calmette-Guerin; ETB=Ethiopian Birr. EDHS=Ethiopia

266 demographic and health survey; DPT=Diphtheria Pertussis and Tetanus; EPI=Expanded Program

267 on Vaccination; Hib= Haemophilus influenzae type B; OR=Odds Ratio; WHO=World Health

268 Organization; LMIC=Low and middle-income countries; TT=Tetanus Toxoid

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272 **Author Declaration**

273 **Ethics approval and consent to participate**

274 Ethical approval for this study was obtained from Mettu University Ethical Review Board

275 (Reference No: Meu/925/1090)

276 **Consent for publication**

277 Not applicable

278 **Informed consent**

279 Written informed consent was obtained from legally authorized representatives before the study.

280 **Trial registration**

281 Not applicable.

282 **Availability of data and material**

283 Upon request, the data in excel format is available for this manuscript.

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286 **Competing interests**

287 The authors have declared that no competing interests exist.

288 **Authors' contributions**

289 DGA, DJD, TAB and ATZ designed the research, collect the samples, wrote the paper, and

290 analyzed data; DGA conducted the research and had primary responsibility for the final content.

291 All authors read and approved the final manuscript.

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362   Table 1: Summary descriptive result for categorical data

Variable	Category	frequency	percent
Sex	Female	68	57.6
	Male	50	42.4
Age	15-25	15	12.7

	26-36	41	34.7
	37-47	45	38.1
	>47	17	14.4
Primary caretaker	Father	35	29.7
	Mother	59	50.0
	Other	24	20.3
Marital status	Married	79	66.9
	Widowed	17	14.4
	Separated	22	18.6
Education	Illiterate	16	13.6
	Grade 1-8	34	28.8
	Grade 9-12	44	37.3
	College/university	24	20.3
Occupation	Housewife	13	11.0
	Government employee	37	31.4
	Merchant	50	42.4
	Daily labor	18	15.3
Religion	Orthodox	36	30.5
	Muslim	30	25.4
	Protestant	33	28.0
	Other	19	16.1
Income status (in USD)	62.2-92.9	29	24.6
	93-123.8	30	25.4
	123.9-154.8	26	22.0
	>154.9	33	28.0
Vaccination	No	50	42.4
	Yes	68	57.6
Residence	Urban	67	56.8
	Rural	51	43.2

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366   Table 2: Results of chi-square test of association between categorical and vaccination status

Categorical variables	chi-square value	Df	p-value
Sex	0.467	1	0.494
Age	0.777	3	0.855
Primary caretaker	2.459	2	0.292

Marital status	9.675	2	0.008	
Education	14.522	3	0.002	
Occupation	15.512	3	0.001	
Religion	3.835	3	0.280	
Income status (in USD)	21.002	3	0.00	
Residence area	9.955	1	0.002	

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383   Table 3: Logistic regression model results

Variables	B	S.E.	Wald	df	Sig.	Exp(B)	95%C.I.for EXP(B)	
							Lower	Upper
Female(ref) Male	.112	.549	.042	1	.838	1.119	.382	3.281
Age15-25 (ref)			.178	3	.981			

26-36	.083	1.027	.006	1	.936	1.086	.145	8.134
37-47	.290	.809	.129	1	.720	1.337	.274	6.522
>47	.263	.813	.104	1	.747	1.300	.264	6.404
Caretaker father(ref)			.317	2	.854			
Mother	.436	.808	.292	1	.589	1.547	.318	7.530
Other	.321	.704	.207	1	.649	1.378	.347	5.476
Marital status married(ref)			7.487	2	.024*			
Widowed	1.946	.722	7.266	1	.007*	7.001	1.701	28.818
Separated	1.116	.934	1.427	1	.232	3.051	.489	19.027
Education level College/ University (ref)			7.258	3	.064			
Grade 9-12	-.715	1.129	.401	1	.527	.489	.054	4.475
Grade 1-8	-2.319	1.489	2.425	1	.119	.098	.005	1.821
Illiterate	-1.942	.907	4.587	1	.032*	.143	.024	.848
Occupation house wife(ref)			.544	3	.909			
Government employee	-.166	1.291	.017	1	.897	.847	.067	10.625
Merchant	.020	.843	.001	1	.981	1.021	.196	5.324
Daily labour	.411	.754	.296	1	.586	1.508	.344	6.610
Religion orthodox(ref)			1.102	3	.777			
Muslim	.083	.969	.007	1	.932	1.087	.163	7.266
Protestant	-.626	.967	.419	1	.517	.535	.080	3.556
Other	-.231	.964	.058	1	.810	.793	.120	5.253
Income status (in USD) 62.2-92.9 (ref)			10.965	3	.012*			
93-123.8	-1.204	1.064	1.281	1	.258	.300	.037	2.413
123.9-154.8	.874	.867	1.016	1	.313	2.397	.438	13.110
>154.9	2.080	.919	5.125	1	.024*	8.004	1.322	48.460
Rural (ref)					.015*			
Urban	1.328	.545	5.938	1		3.773	1.297	10.981

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385   Table 4: Hosmer and Lemeshow Test

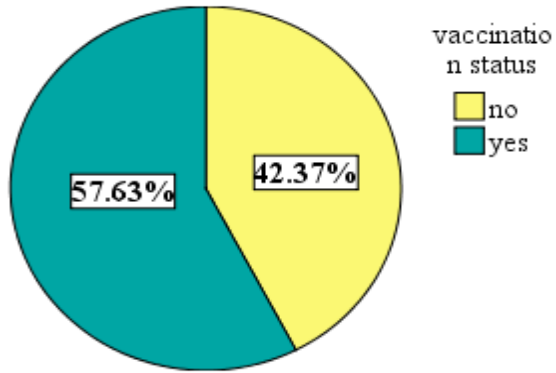| Step	Chi-square	df	Sig.
1	10.484	8	.833

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393   Figure 1: Pie chart for Vaccination status