

Original Article

Prevalence of incomplete vaccination and associated factors among children aged 24-35 months in Dale woreda, Sidama region, Ethiopia

Assefa Demissie Dana¹, Deresse Legesse Kebede², Kebede Tefera Betru^{2*}

¹Environmental Health Department, MOHA Soft Drinks Industry S.C Awassa Millennium Pepsi Cola Plant, Hawassa, Ethiopia; ²School of Public Health, College of Medicine and Health Sciences, Hawassa University, Hawassa, Ethiopia

*Correspondence: Kebede Tefera Betru; ktefera2015@gmail.com

Abstract

Background: Immunization is one of the cost-effective public health interventions. Though Ethiopia offers free immunization services, only a small percentage of people have received all the recommended vaccinations. This study aimed to assess the prevalence of incomplete vaccination and associated factors among children aged 24-35 months in the Dale woreda of Sidama region, Ethiopia.

Methods: A community-based cross-sectional study was conducted from March 05-23, 2022. Four hundred forty-one caregivers of children aged between 24-35 months were included from ten *kebeles*. Caregivers were selected by using a systematic sampling technique. Structured questionnaire was used to collect the data through interviews. Descriptive statistics and logistic regression analyses were carried out.

Results: The prevalence of incomplete vaccination among children aged 24-35 months was 37% (95% confidence interval [CI]: 32%, 42%). Married caregivers had 96% lesser odds to have children with incomplete vaccination (AOR: 0.04; 95% CI: 0.002, 0.715). Other significant factors were the number of ANC visits (AOR: 0.23; 95% CI: 0.06, 0.8), the number of PNC visits (AOR: 0.05; 95% CI: 0.008, 0.33), employment status (AOR: 0.004; 95% CI: 0.00, 0.19), place of delivery (AOR: 0.1; 95% CI: 0.013, 0.86), satisfaction rate (AOR: 8.8; 95% CI: 2.2, 3.5) and educational status (AOR: 0.02; 95% CI: 0.004, 0.13).

Conclusion: In the current study, the proportion of children with incomplete vaccination among children aged 24-35 months was high. The identified factors should be the focus of programs and policies to enhance childhood immunization uptake.

Key words: incomplete vaccination, children aged 24–35 months, Ethiopia

Introduction

Vaccination is the artificial induction of active immunity by introducing, into a vulnerable host,

the specific antigen of a harmful organism, which can be a living modified agent, deceased organism, or inactivated toxin. The World Health Organization (WHO) launched the Expanded Program on Immunization (EPI) in 1974 (1).

Every year, more than 2 million children lose their lives to diseases that could have been prevented through vaccination. When comparing it to the developed world, children in sub-Saharan Africa face a significantly higher risk, as they are more than 15 times more likely to die before the age of 5 from diseases that can be avoided and treated with simple, low-cost interventions. In 2020, the global number of children under the age of five who died was 5.6 million. It is estimated that immunization accounts for preventing around 2 to 3 million deaths annually and is considered one of the most cost-effective strategies in public health interventions to combat life-threatening infectious diseases (2-6).

The EPI program is currently expanding its services in Ethiopia. This includes increasing the availability and variety of vaccines over time. Ethiopia follows the WHO's recommendations for immunization schedules in developing countries, specifically for child vaccinations (7).

Presently, Ethiopia offers ten vaccines in its EPI program, which are BCG (Bacillus Calmette Guerin), measles, pentavalent (combining diphtheria, pertussis, tetanus, hepatitis B, and Hib), rotavirus, pneumococcus vaccine (PCV), and OPV (oral polio vaccine). Additionally, the implementation guidelines also direct the introduction of inactivated poliovirus, measles-rubella, meningitis, and yellow fever vaccines for children under one year old (7, 8). This expansion of vaccines and adherence to WHO guidelines is a crucial step in protecting children's health in Ethiopia.

A community-based cross-sectional study conducted in Alentawondo district, south

Ethiopia, to assess the percentage of incomplete childhood immunization revealed that approximately 21.8% of children had not received complete immunization. Among the various factors contributing to incomplete immunization, the study highlighted that the distance from the vaccination site was identified as the main obstacle. This means that the physical distance between the children in the study and the vaccination site was the primary reason for not completing their immunization schedule. The study emphasizes the significance of addressing these barriers to ensure comprehensive immunization coverage for all children in the region (9).

On 11th Feb 2019, Ethiopia launched the inclusion measles vaccine second dose (MCV2) vaccination into the routine immunization program in the second year of life (10). A child is considered to have received all basic vaccinations if he or she has received BCG, three doses of pentavalent and PCV vaccines, two doses of rotavirus vaccine and at least three doses of polio vaccine and two doses of measles vaccine. These should be received in the second year of life (10, 11). Incomplete vaccination was defined as missing any listed vaccines among children over 24 months (12).

The literature that is currently available varies depending on the situation as to what influences a child's vaccination status. For instance, the socioeconomic standing of the family; mother's age; education level particularly of mothers; history of ANC attendance; child's age, sex, birthplace, and birth order; place of residence; mother's knowledge of immunizations; mother's Tetanus Toxoid vaccination (TT) status; health workers' house visit; missing opportunity; distance to health institutions; waiting time; perception about the benefit of immunization and misconception about vaccine contraindication; political instability and mobility from rural to the urban areas due to this problem were identified

as factors associated with incomplete immunization (11-13).

In all WHO regions, the EPI program is being significantly impacted as a result of COVID 19 today and the response measures it prompted (14). It is crucial to identify and comprehend the barriers that caregivers face when trying to access immunization services in order to develop tailored intervention strategies and increase vaccine coverage. Therefore, the present study was conducted in order to determine the prevalence of incomplete vaccination and associated factors among children aged 24-35 months in the Dale woreda of Sidama region, Ethiopia.

Methods and materials

Study design and period

A community-based cross-sectional study was conducted among children aged 24-35 months from March 05 – March 23, 2022, in Dale woreda, Sidama region.

Study area

This study was conducted in Dale Woreda, Sidama Regional state, Ethiopia. It is located 42 KMs far from Hawassa town (the capital of the Sidama region) and 315 KMs south of Addis Ababa. Dale Woreda has 34 *kebeles* — 3 urban and 31 rural *kebeles*. The woreda has 10 health centers and 34 health posts. During the study period, the total population of the woreda was 254652, of which 126562 were males. Expected number of children between 24-35 months of age in the woreda was 7996.

Population

All children aged 24-35 months who lived in Dale woreda during the study period were the source population. All children aged 24-35 months in selected *kebeles* during the study

period constituted the study population. All children aged 24-35 months in selected households in selected *kebeles* of Dale woreda during the study period were the study units.

Inclusion and exclusion criteria

Children aged 24-35 months from mothers or caregivers who lived in the Dalle woreda for at least six months before data collection date were included in this study. Unvaccinated children and mothers/caregivers who were unable to answer appropriately owing to illness during the study period were excluded.

Sample size and sampling procedure

The sample size was calculated using the single population proportion formula using Epi Info version 7 software considering the following assumptions: 33 % proportion of incomplete vaccination in Gindhir district, southeastern Ethiopia (15), a 95% confidence level, 5% precision, 1.5 design effect (DE). With the foregoing assumptions, the sample size becomes 510. Since the total population is less than 10,000, the sample size was modified using the finite population correction formula. After adding 10% for non-respondents, the final sample size was 528. The samples were proportionally allocated to each *kebele*: 28 from Ganie, 33 from Hida Kality, 61 from Kality Simita, 36 from Weyinata, 74 from Semen Mesinkela, 67 from Megara, 82 from Soyama, 59 from Debube Mesinkela, 28 from Naremodella, and 60 from Shoye.

From a total of 34 *kebeles* in the woreda, ten *kebeles* were selected, 9 rural and 1 urban *kebeles*, by using a systematic sampling technique. A sampling frame of households with children aged 24-35 months was prepared from the immunization log book in the health post and nearby health center for each *kebele*. Then by using a systematic sampling, households were selected from each of the selected *kebeles*. For an

eligible participant who was unavailable for two visits, the next household was included in the study. One child was selected from those households having two and more children by lottery method if the children were twins, and the youngest child was taken if they were not twins.

Variables of the study

Dependent variable

Incomplete vaccination status of the child - Children were considered incompletely vaccinated when they miss at least one dose of the vaccines mentioned above in the fully vaccinated definition

Independent Variables

Mothers or caretaker's related variables: Mothers age, Level of education, history of ANC attendance, mother's TT status, knowledge about immunization, employment status, and attitude towards vaccination,

Child related variables: birth place, birth order, place of residence, sex of the child

Health facility related variables: health workers house hold visit, distance to health institutions, availability of vaccines, presence of health education program, attitude of health workers.

COVID 19 related variables: Concerned about being exposed to COVID-19 at health facilities

Data collection technique and tool

The questionnaire was first prepared in the English language after reviewing different literature. Then translated into Amharic language and then to Sidamic language, which was back-translated to English by two translators fluent in both Sidamic and English languages to maintain consistency. The Sidamic version of the questionnaire was used for data collection. The

data was collected by trained health professionals (BSc nurses) using standardized semi-structured and pretested interviewer-administered questionnaires. It was conducted by face-to-face interviews and by observing the information recorded on the child's immunization card. For respondents who don't have the EPI card of the child, their self-reported history about the type and number of vaccines their child took was considered, and then their responses was cross-checked from the EPI registration book in the health center or health post where the child took the vaccine. Completeness and consistency of the collected data were reviewed and checked daily during data collection by the supervisors and principal investigator.

Data management and analysis

Data were exported to IBM SPSS version 21 after being entered using EpiData version 3.1. Descriptive statistics were computed. Logistic regression analysis was used to determine the relationship between the dependent and independent variables. The multivariable analysis included those independent variables whose bivariate analysis had a significant result (p-value 0.05). A significant association in the final model was identified at a p-value lower than 0.05. Finally, the results were displayed in texts and tables along with the adjusted odds ratio (AOR) and the corresponding 95% confidence interval.

Results

Socio-demographic characteristics of the study population

Four hundred thirty-five caregivers of children aged 24-35 months participated in this study with a response rate of 82.4%. Four hundred (91.95%) study participants or caregivers were biological mothers. The mean (standard deviation [\pm SD]) of the age of respondents was

28.96 (± 6.65) years, with a range of 18 and 63 years. The children's mean (\pm SD) age was 30.62(± 3.53) months. Two hundred thirty-five (54%) of the children were males.

One hundred forty-five (33.3%) of the respondents did not have formal education, and about 85.75% were married. Two hundred

seventy-three (62.76%) of them were housewives by occupation and majorities (79.77%) were Protestant by religion. One hundred forty-four (33.1%) of the respondents reported that they had an average monthly household income of less than 1000 Ethiopian birr (ETB) (Table 1).

Table 1: Socio-demographic characteristics of caregivers of children aged 24-35 months in Dale woreda, Sidama Region, Ethiopia, 2022 (n=435).

Characteristics	Categories	Frequencies	Percentage
Age of primary caregiver (in years)	18-24	82	18.85
	25-34	286	65.75
	35-63	67	15.4
Sex of the child	Male	235	54.02
	Female	200	45.98
Education status of primary caregiver	No formal education	145	33.3
	Primary level	139	31.95
	Secondary level	117	26.9
	Certificate and above	34	7.8
Marital status of primary caregiver	Married	373	85.75
	Divorced	37	8.51
	Widowed	21	4.83
	Single	4	0.92
Employment status of primary caregiver	Housewife	273	62.76
	Self employed	55	12.64
	Formal employee	44	10.11
	Causal laborer	34	7.82
	Farmer	29	6.67
Religion	Protestant	347	79.77
	Orthodox	52	11.95
	Catholic	22	5.06
	Muslim	13	2.99
Average monthly household income	<1000	144	33.1
	1000-2000	107	24.6
	2001-3000	114	26.2
	>3000	70	16.1
Family size	2 – 4 families	195	44.83
	5 or more families	240	55.17
Number of children ever born by the mother of the child considered	Only one child	110	25.29
	2-4 children	287	65.98
	5 or more children	38	8.74

Maternal health care utilization

From 435 respondents, majority (91.95%) were mothers of the child included in the study, of which 326 (81.5%) reported that they had started taking TT vaccine. Majorities (85.27%) took two or more doses of the vaccine. From all children considered for this study, 379 (87.13%) were born by planned pregnancy, and from all caregivers who participated, it was reported that 424 (97.47%) had taken at least one antenatal care in their last pregnancy (Table 2).

Knowledge about vaccination

Almost all (99.8%) of the respondents have information (have heard or observed vaccination services in their locality) on vaccination and vaccine preventable diseases. Of the total

respondents, 251 (57.7%) and 242 (55.63%) mothers/caretakers knew three or more types of vaccine and vaccine-preventable diseases, respectively. Majorities (83.41%) of the respondents mentioned health workers, especially health extension workers, as information sources. Of the total respondents, 292 (67.13%) answered that vaccines could be taken by the entire population and 323 (74.71%) stated that vaccination prevents from diseases. More than half (51.72%) answered that six weeks after birth is the best time to take the child for vaccination (Table 3).

When missing the day of vaccination schedule of their child, the most frequently given response was simply going to the following schedule when vaccination service is provided in their locality 239 (54.94%) (Figure 1).

Table 2: Healthcare utilization of caregivers of children aged 24-35 months in Dale Woreda, Sidama Region, Ethiopia, 2022.

Characteristics	Categories	Frequencies	Percentage
Are you biological mother of the child? (n=435)	Yes	400	91.95
	No	35	8.05
Did you receive TT injection before your last pregnancy? (n=400)	Yes	326	81.5
	No	74	18.5
Number of TT vaccine received (n=326)	Only one	48	14.72
	Two or more	278	85.27
Did this child was born by planned pregnancy?	Yes	379	87.13
	No	55	12.6
Did the mother of the baby ANC during her last pregnancy?	Yes	424	97.47
	No	11	2.53
Number of ANC attended (n=424)	0-2	178	41.98
	3-4	246	58.02
Place where the child was delivered	Health facility	350	80.46
	Home unassisted	79	18.16
	Home assisted by health worker	6	1.38
Received PNC after delivery of the child?	Yes	185	42.53
	No	250	57.47
Number of PNC visit (n=185)	Only once	141	76.22
	2-3 times	44	23.78
Advised to vaccinate your child during post-natal visit? (n=184)	Yes	178	96.2
	No	6	3.2

Table 3: Knowledge of caregivers of children aged 24-35 months of age in Dale woreda, Sidama Region, Ethiopia, 2022 (n=435).

Characteristics	Categories	Frequencies	Percentage
Who do you think should take the vaccine?	All of us if it is recommended by health professionals	292	67.13
	Only children	100	22.99
	Children with certain health problem	7	1.61
	Only children whose parents are willing to vaccinate their child	35	8.05
	Other	1	0.23
What do you think are the benefits of vaccination to your child?	Prevent from disease	325	74.71
	Cure from disease	81	18.62
	Don't know	28	6.44
	Other	1	0.23
Do you tell me the age at which the child begins vaccination?	Just after birth	163	37.47
	Four weeks after birth	28	6.44
	Six weeks after birth	225	51.72
	Don't know	19	4.37

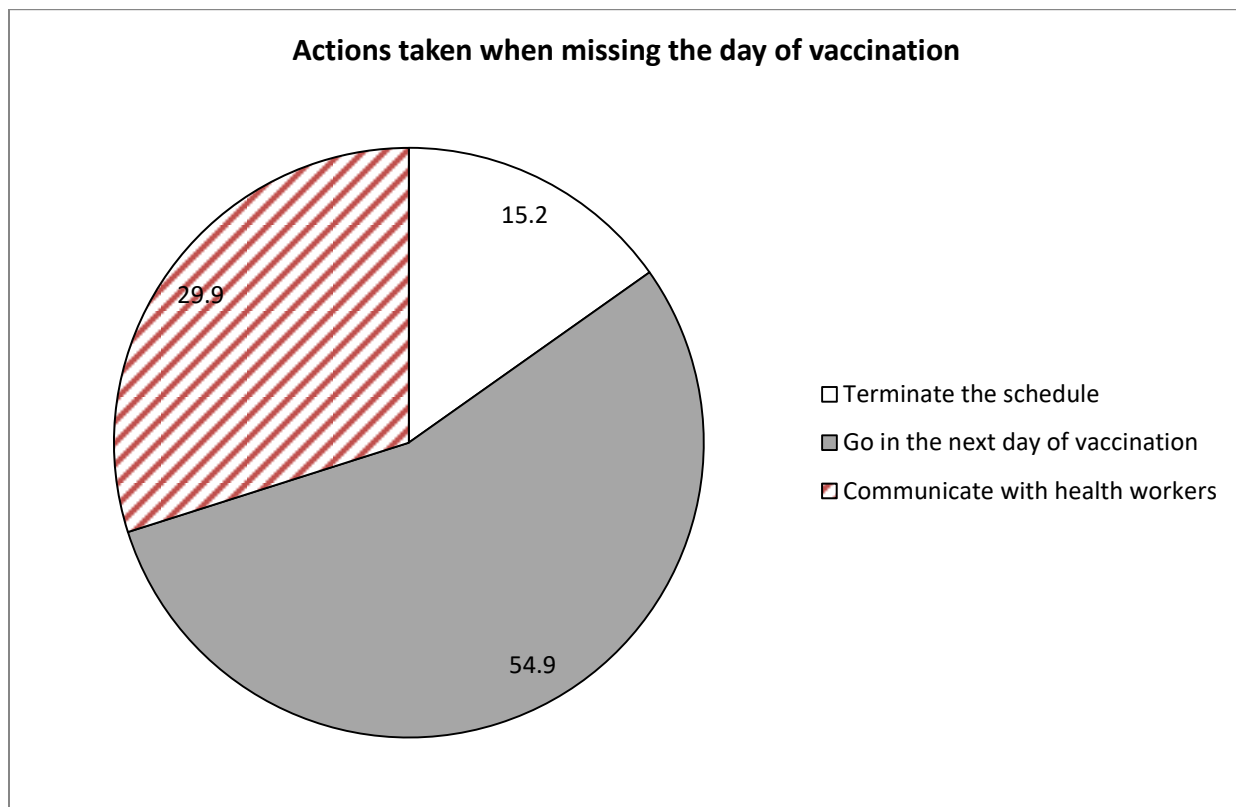


Figure1: Actions taken when missing vaccination day by caregivers of children aged 24-35 months in Dale woreda, Sidama Region, Ethiopia, 2022.

Attitude of respondents towards barriers of vaccination service utilization

Eight questions were put to them to find out how caregivers felt about the current vaccination program. More than half of the attitude questions about the current vaccination service were answered favorably by 410 (94%) of the caregivers. In comparison, 25 (5.7%) disagreed with at least three of the eight questions (Table 4).

Vaccination coverage

One hundred sixty-one (37%, 95% CI: 32, 42%) of the children between the ages of 24 and 35 months had incomplete vaccination (i.e., did not receive all of the advised vaccinations according to the vaccination card, EPI registration and the memory of the mother's or caregivers' self-report). In this study, the coverage of the third dose of OPV, PCV and Penta vaccines was 90.3%, measles-1 vaccine (MCV-1) was 81.6%, and measles 2 (MCV-2) was 61.4% (Figure 2).

Reasons for missing the recommended doses of vaccines

The study found that mothers or caregivers of children aged 24-35 months missed the recommended doses of the vaccines for different reasons. From the list of reasons 66 (41%) of caregivers mentioned not knowing date of the next appointment to go back for the next round as a reason, 40 (24.8%) of them mentioned fear of being exposed to COVID-19 at health facilities, 28 (17.4%) of them mentioned lack of awareness on vaccination, and 17 (10.6%) mentioned vaccination time to be inconvenient (Table 5).

Factors associated with incomplete childhood immunization

The multivariate logistic regression showed children from mothers having three or more ANC visits to have 77% lesser odds to have incomplete vaccination status as compared with children from mothers having less than three ANC visits (AOR:0.23; 95% CI: 0.06,0.8).

Table 4: Barriers to vaccination service utilization among caregivers of children aged 24-35 months in Dale woreda Sidama Region, Ethiopia, 2022 (n=435)

Barriers	Agree	Disagree	Unsure
The cost for transportation to vaccination site is not affect the utilization of vaccination service	360(82.8%)	73(16.7)	2(0.5%)
The time it takes to travel to vaccination site is not affecting the utilization of the service	360(82.8%)	70(16.1%)	5(1.1%)
The time of immunization services acceptable	361(83%)	59(13.6%)	15(3.4%)
Vaccination prevents from childhood diseases	406(93.3%)	19(4.4%)	10(2.3%)
Bad weather conditions affect the utilization of immunization services	329(75.6%)	45(10.3%)	61(14%)
The role of community health workers in the area enhances delivery of immunization services.	408(93.8%)	25(5.7%)	2(0.5)
Place of delivery enhances the utilization of immunization services	283(65.1%)	98(22.5%)	54(12.4%)
The use of mobile vaccinations teams enhances utilization of immunization services	424(97.5%)	8(1.8%)	3(0.7%)

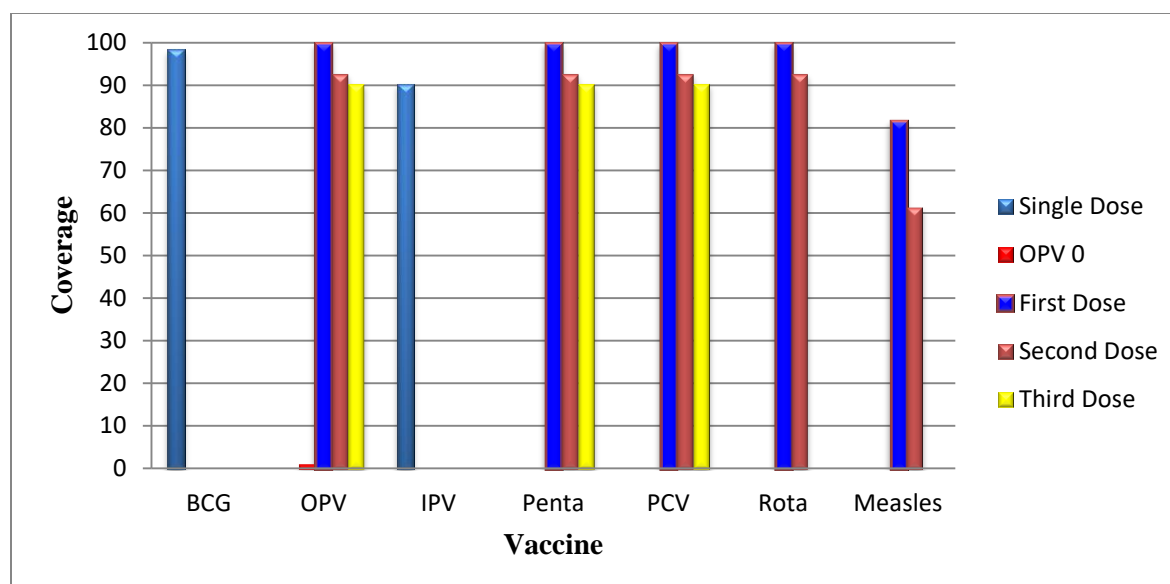


Figure 2: Vaccination coverage among children aged 24-35 months in Dale woreda, Sidama Region, Ethiopia, 2022.

Similarly, children from mothers who had PNC visits 2-3 times had 95% lesser odds to have incomplete vaccination status than children who had only one PNC visit (AOR: 0.05; 95% CI: 0.008, 0.33). Children who were delivered in health facilities had 90% lesser odds to have incomplete vaccination status than children who were delivered at home (AOR: 0.10; 95% CI: 0.013, 0.86). Mothers or caregivers who were married had 96% lesser odds to have a child with incomplete vaccination status than those with

other than married marital status (AOR: 0.04; 95% CI: 0.002, 0.715). In terms of participant satisfaction, those dissatisfied with the current level of vaccination services provided had 9 times higher odds to have children with incomplete vaccination than those satisfied (AOR: 8.8; 95% CI: 2.2, 35). Mothers or caregivers who were literate had 98% lesser odds to have a child with incomplete vaccination status than those who were illiterate (AOR: 0.02; 95% CI: 0.004, 0.13) (Table 6).

Table5: Reasons for missing the recommended doses of vaccine among caregivers of children aged 24-35 months in Dale woreda Sidama Region, Ethiopia, 2022 (n=161)

Reasons	Frequency	Percentage
Not knowing whether to come back for second and third dose	66	41
Concerned about being exposed to COVID-19 at health facilities	40	24.8
Lack of awareness on the importance of vaccination	28	17.4
Vaccination site is far-away	21	13
Fear of side effects	17	10.6
Vaccination time is inconvenient	17	10.6
Not knowing vaccination time and site	15	9.3
The child was sick	11	6.83
Absenteeism of vaccinators	5	3.1
Forgot vaccination day	9	5.6
Other	11	6.83

Table 6: Factors associated with incomplete vaccination among children aged 24-35 months in Dale woreda, Sidama region, Ethiopia, 2022

Characteristics	Categories	Vaccination status		COR (95% CI)	AOR (95% CI)
		Incomplete	Complete		
Marital status	Married	119(27.4%)	254(58.4%)	0.22(0.13,0.37)	0.04(0.002,0.7)*
	Other marital status	42(9.7%)	20(4.6%)	1	1
Employment status	House wife	102(23.4%)	171(39.4%)	1	1
	Farmer	11(2.55%)	18(4.1%)	1.05(0.046,2.25)	0.004(0.00,0.19)*
	Self employed	13(3%)	42(9.1%)	0.52(0.26,1.01)	0.5(0.018,4.44)
	Causal laborer	25(5.7%)	9(2.1%)	4.65(2.09,10.3)*	14.8(0.53,41)
Number of ANC visit	Formal employee	10(2.3%)	34(7.8%)	0.49(0.23,1.04)	5.9(0.83,42)
	<2 visit	106(25%)	72(17%)	1	1
	3 or more visit	45(10.6%)	201(47.4%)	0.15(0.09,0.23)*	0.23(0.06,0.8)*
Number of PNC Visit	One PNC visit	59(31.9%)	82(44.3%)	1	1
	2-3 PNC visit	5(2.7%)	39(21.1%)	0.17(0.06,0.48)*	0.05(0.008,0.33)*
Delivery place	Home	56(12.9)	29(6.7%)	1	1
	Health facility	105(24.1%)	245(56.3%)	0.22(0.13,0.36)*	0.1(0.013,0.86)*
Satisfaction rate	Satisfied	88(20.2%)	224(51.5%)	1	1
	Not satisfied	72(16.6%)	50(11.5%)	3.66(2.36,5.67)*	8.8(2.2,35)*
Educational status	Illiterate	76(17.5%)	69(15.9%)	1	1
	Literate	85(19.5%)	205(47.1%)	0.37(0.25,0.57)*	0.02(0.004,0.13)*

*significant at p-value<0.05; ANC, antenatal care; PNC, postnatal care

Discussion

According to the findings of this study, 37% of the children 24-35 months old did not finish the prescribed immunizations doses. The primary characteristics related with incomplete immunizations were marital status, number of ANC visits, and number of PNC visits, job status, delivery facility satisfaction, and educational status.

The data showed that 37% of children did not receive the full course of recommended vaccinations. This finding was lower than that reported in a study done in Kenya, where it was reported at 59% (16), and the finding reported in the 2019 Ethiopian Mini Demographic and Health Survey (DHS), where it was reported at 91 % (13) .The possible explanation could be selection bias, variations in sample size, period of study done (fear of being exposed to COVID-19 virus at health centers), and period of study done.

The significant dropout rate from MCV1 and MCV2 may be caused by the lengthy interval of time between the first dose given at nine months and the second dose at 15 months, which is six months apart; as a result, the caregivers might be likely to forget. Lack of knowledge of the number of MCV scheduled doses could also be a reason as seen in similar studies in Kenya and Nigeria (16, 17).

This study revealed that the coverage of MCV-2 was 61.4% among children aged 24-35 months. This finding was higher than the finding reported in the 2019 Ethiopian Mini DHS, which was 9% at the national level and 15.3% in the Southern Nations, Nationalities, and Peoples' Region (SNNPR) among children aged 24-35 months (13). The possible explanation could be that the DHS used a large sample or large area of coverage, and there may be differences in access to vaccination services and community awareness towards child immunization.

It was observed that there was a decreasing coverage between the subsequent vaccine doses, with 99.8%, 92.6%, and 90.3% for OPV 1, OPV 2, AND OPV 3 doses, respectively. A similar decreasing pattern was observed in the coverage of these vaccine doses in the 2019 Ethiopian Mini DHS (78%, 71%, and 60%) (13) and in the Senegalese DHS (94.6%, 90.7%, and 72.7%) (19), respectively.

As observed in the numeric results mentioned above, the finding of this study was higher than both the DHS data from Ethiopia and Senegal. The possible explanation could be that the DHS used a large sample or large area of coverage, and there may be differences in access to vaccination services and community awareness towards child immunization.

This study provides evidence that there is a correlation between maternal literacy and the completion rates of vaccinations in children. The research found that illiterate mothers tend to administer more incomplete vaccinations compared to literate mothers. The study's findings were consistent with similar research conducted in the Aletawondo district of Sidama region of (9), and Gindhir District, Southern Ethiopia (15). The fact that this pattern is observed in different geographical areas strengthens the validity of the results.

Additionally, the study revealed that children of mothers with higher levels of education have better completion rates for vaccinations. This result is similar to the findings of similar studies in hard-to-reach areas of Ethiopia and Aleta Wondo district (9, 20). This suggests that maternal education plays a significant role in ensuring that children receive the recommended vaccinations. This may be due to the fact that mothers and other caregivers who are literate can access and comprehend information about vaccines, their advantages, and any possible risks. Being able to read and comprehend such information is crucial in making informed

decisions and making appropriate action regarding vaccination for their children.

The immunization status of children was affected by the marital status of their caregivers. Notably, the number of incomplete vaccinations was found to be lower among married caregivers compared to single caregivers. This finding aligns with previous studies conducted in the Somali region of eastern Ethiopia, which indicated that married couples were 4.2 times more likely to have a child who had received all the recommended vaccinations (21). The probable explanation for this observation is that married couples often make decisions jointly, including those related to their children's healthcare. The shared decision-making process likely increases the likelihood of mutual agreement on ensuring proper immunization for their child.

Similarly, there was a significant correlation between the number of ANC visits and the child's immunization status. This result was similarly reported in studies carried out in hard-to-reach areas of Ethiopia (20), in data from the Senegalese DHS (21), and in a study that used 2016 Ethiopian DHS (22).

Additionally, the number of PNC visits was also found to significantly impact the completion of recommended vaccines. This finding was also observed in a study conducted in the Pawi district of Ethiopia (18). The reason for this correlation could be attributed to the opportunities it presents for healthcare workers to educate pregnant women, postnatal mothers, and their families about the importance of immunizations for both the mother and the infant.

Incomplete vaccination was found to be lower for those who were delivered at health facilities than those who were delivered at home. This finding was consistent with the findings reported in studies conducted in Aletawondo district of

Sidama region(9), Machakel Woreda (11), hard-to-reach areas of Ethiopia (20), South Region (12) and Senegal (19). Staff at health institutions may be able to provide counseling and education on the importance of immunization, addressing any myths or misconceptions associated with vaccines. This personalized interaction helps individuals make informed decisions regarding immunization and may increase vaccine uptake.

According to this study, children with working mothers were more likely to receive all recommended vaccinations compared to children with unemployed mothers. This finding is consistent with a systematic review and meta-analysis study conducted in Ethiopia, which also reported significantly higher immunization coverage among children from working families compared to those from unemployed families (23). The most plausible explanation for this trend is that working mothers have the opportunity to educate themselves about the importance of immunization and share this knowledge with other working parents. By advocating for immunization within their workplace and community, they can raise awareness and encourage other parents to prioritize their child's immunization.

The level of respondents' satisfaction is strongly correlated with the immunization status of their children. Caregivers of children with incomplete vaccinations are less likely to be satisfied. This finding has also been reported in other studies conducted in the Machakel Woreda (11) and Gambela Region (24). To alleviate concerns and enhance satisfaction, it is important to actively address any worries. This can be done by accurately explaining potential side effects, safety precautions, and the effectiveness of the vaccine. By allowing people to engage in open discussions with healthcare professionals, they can make more informed decisions.

This study has some limitations. The outcome variable and the factor variables were assessed

simultaneously, making establishing cause and effect relations impossible. The study does not include qualitative analysis of social, cultural and behavioral issues which influence the vaccination status of the children; this may hinder the development of comprehensive interventions or strategies to improve vaccination rates among children.

Conclusion

This study has shown the high burden of incomplete vaccination among children aged 24-35 months in the study area. Marital status, level of education, employment, number of ANC and PNC visits, place of delivery, and satisfaction rate were discovered to be significant predictors of the child's immunization status. The most often stated reason for not finishing the necessary doses was not knowing when to return for the next session. Therefore, strategies designed to improve childhood vaccination uptake and coverage in the study area should address determinants of incomplete vaccination in addition to the existing health facility-level programs.

Acknowledgement

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Ethical considerations

Ethical clearance was obtained from the Institutional Review Board (IRB) of College of Medicine and Health Sciences, Hawassa University. Before data collection, the ethical

clearance letter from the IRB was submitted to the Dale Woreda Health Office. Verbal consent of the respondent was taken prior to data collection. Privacy and confidentiality were maintained. Withdrawal from the study at any point if they wished was assured.

Data availability statement

The datasets analyzed during the current study are available upon reasonable request from the corresponding author. ktefera2015@gmail.com.

Conflicts of Interest

The authors declared no conflicts of interest exist.

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