Measles second dose vaccine uptake and associated factors among children aged 24-35 months in Nedjo District, Oromia Regional State, Ethiopia

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ABSTRACT

Background: The World Health Organization (WHO) has recommended incorporating the second dose of measles-containing vaccines into routine immunization program. Ethiopia has also introduced the second dose of the measles vaccine into its routine immunization program in 2019. However, there is limited evidence on the uptake of the second dose and its associated factors in Ethiopia. Thus, this study aimed to assess second-dose vaccine uptake and its associated factors among children aged 24-35 months in Nedjo District, West Wollega Zone, Oromia Regional State of Ethiopia.

Methods: A community-based cross-sectional study was conducted among 620 children aged 24-35 months in Nedjo District from June to July 2023. A systematic sampling technique was used to select the participants. Data was collected using pretested and structured questionnaires. Three midwives and three nurses were collected the data. Descriptive statistics were employed to summarize the characteristics of the participants. A logistic regression model was used to assess factors associated with second-dose of measles vaccine uptake. The statistical significance was set at p-value < 0.05.

Results: The uptake of the second dose of measles vaccine among children in Nedjo District was 61.4% [95% CI (57–65)]. Living in urban area (AOR = 3.5, 95% CI: 1.1–11.5), college and above maternal education level (AOR = 13.1, 95% CI: 3.1–55.7), having postnatal care follow-up (AOR = 9.6, 95% CI: 3.1–30.1), waiting time less than 30 minutes to access vaccination service (AOR = 3.4, 95% CI: (1.8–6.4), and having knowledge on the recommended age for the second dose of measles vaccination (AOR = 8.0, 95% CI: 4.4–14.7) were significantly associated with second-dose measles vaccination uptake.

Conclusion: Second dose measles vaccine uptake in Nedjo District is below the global recommended coverage. Targeted interventions are required to address issues such as rural residence, lower maternal education levels, lack of postnatal care follow-up, long waiting times for vaccination services, and limited awareness of the recommended age for the second dose.

Keywords: Measles, Vaccine, Children health, Viral diseases

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BACKGROUND

Measles is a severe respiratory disease caused by the morbillivirus, which naturally infects only humans, particularly in the absence of vaccination. About 95% of individuals who are not vaccinated could infected with the measles virus (1,2). Measles vaccine provides protection against infection by the morbillivirus (3). The effectiveness of the measles vaccine in preventing measles is approximately 97% after two doses and about 93% after one dose (4). The WHO recommends two doses of the measles vaccine for children, administered at 9 to 12 months and again at 15 to 18 months (2).

Estimates indicate that approximately 11 million measles cases occurred among children under five years old worldwide in 2019 (5). The highest proportion is reported from low socio-demographic index (SDI) countries, as well as in nations and territories with low age-standardized rates (ASRs) (5).

Despite the availability of a safe and effective vaccine since the early 1960s, measles remains a major cause of illness and mortality among young children worldwide (6). Globally, 207,500 people died from measles in 2019, with the majority being children under the age of five (6). Moreover, nearly 17,338 measles cases were reported worldwide in January and February 2022, compared to 9,665 during the same period in 2021 (7). This increase in measles cases has raised alarms for WHO and United Nation international children's fund (UNICEF) (7).

Measles is a potentially fatal disease that can cause brain damage, deafness, and blindness (8). Approximately one

in 1,000 children infected with measles may develop encephalitis (brain swelling), which can lead to convulsions and may result in the child becoming deaf or intellectually disabled (8). It can also lead to death in one or two children infected with the virus (8).

In addition, measles compromises the immune system, increasing children's susceptibility to other infectious illnesses, such as pneumonia and diarrhea, even months after the initial infection (8).

Ethiopia has been experiencing an active measles outbreak since January 2022, with the most affected regions being the Southern Nations, Nationalities, and Peoples' Region (SNNPR), Oromia Regional State, and the Somali Regional state. As of February 9, 2022, a total of 1,590 cases and 13 deaths related to measles outbreak have been reported to the national database. The SNNPR has reported the highest number of infections, with 1,005 (63.2%) cases, followed by the Somali Region with 495 (31.1%) cases, and Oromia with 90 (5.7%) cases. A recurrent conflict that hinders routine immunization campaigns, along with a high rate of malnutrition and low immunization coverage, are major risk factors for a measles outbreak in the area (9).

Despite being recognized as one of the essential health interventions by the WHO, vaccination uptake remains low, with varying levels across different countries (10). By the end of 2021, global immunization coverage indicated that 71% of children had received two doses of the measles vaccine in accordance with national immunization schedules (11). The combined prevalence of the second dose of the measles-containing vaccine (MCV2) usage in children across eight sub-Saharan African nations was 44.8% in 2021 (12). The coverage of the routine MCV2 in many sub-Saharan African countries remains significantly below target levels (12). According to the 2019 Ethiopia Mini-Demographic and Health Survey (EMDHS), 9% of children aged 24 to 35 months received the MCV2 in Ethiopia. In Oromia, only 5.2% of children in the same age group received MCV2 (13). This indicates that the uptake of the routine MCV2 remains significantly below the targeted level in Ethiopia.

Evidence indicates that the uptake of the MCV2 among children in some urban areas is low (14). Factors associated with low uptake of the second dose of the MCV2 include maternal age, the average time taken to vaccinate, poor awareness of vaccine-preventable diseases, the recommended age for the last vaccination, and the number of doses received (14).

The WHO recommends achieving 95% or higher coverage of the measles-containing vaccine (MCV) at both the district and national levels to eliminate measles (2). Moreover, the strategy for 2012–2020 outlines that one of the key strategic plans is to achieve and maintain high coverage with two doses of the MCV as a foundational measure to ensure high population immunity against measles (15). However, measles has not been eradicated and continues to be the leading cause of childhood mortality in developing countries (16).

The Federal Ministry of Health of Ethiopia officially launched a nationwide integrated measles vaccination campaign on December 22, 2022, in response to measles continuing to be a major health issue in the country, with multiple outbreaks occurring in various regions (17). However, measles outbreaks continue to be reported from multiple locations across the country.

Although MCV2 uptake is low worldwide, there is limited evidence from various sociocultural contexts to identify the factors associated with low uptake of the second dose. To the knowledge of the authors, there is no study reporting on MCV2 coverage after the new vaccines were introduced into the Expanded Program on Immunization (EPI) program. There is limited evidence on MCV2 coverage across various contexts and the factors associated with low MCV2 uptake in Ethiopia. Thus, this study aimed to determine the prevalence of routine MCV2 uptake and the factors associated with it among children aged 24 to 35 months in the Nedjo District, Oromia Regional State of Ethiopia.

METHODS

Study area and period

This study was conducted in Nedjo District, West Wollega Zone, Oromia Regional State of Ethiopia from 17 June 2023 to 13 July 2023. Nedjo is a District in West Wollewga Zone, Oromia Regional State of Ethiopia. It is located 523 km to the West of Addis Ababa on the way to Asosa Town (18). According to the 2007 Census conducted by the Central Statistical Agency of Ethiopia (CSA), the district has a total population of 130,909 residents, comprising 64,654 men and 66,255 women (19).

Study design and population

A community-based cross-sectional study was conducted to determine the prevalence of MCV2. All children aged 24 to 35 months, along with their mothers or caregivers living in the selected kebeles of Nedjo District were considered as the study population.

Inclusion and exclusion criteria

All children aged 24–35 months along with their mothers or caregivers and who have vaccination cards with written vaccination dates and lived at least 6 months in the study area were included to this study. However, children whose mothers or caregivers were sick and unable to respond to the study questions were excluded from the study.

Sample size calculation

The sample size was estimated using a single population proportion formula, assuming 95% confidence level, 5%

margin of error, 42.5% true population proportion of MCV2 uptake (14), and 10% non-response rate. Consequently, the determined final sample size was 413. However, since a multistage sampling method was employed, a design effect of 1.5 was considered, which was resulted in a final sample size of 620 mother/caregiver with child pairs.

Sampling method

Nedjo District has 35 rural kebeles and four urban kebeles. One kebele from the urban area and ten from the rural areas were selected using a simple random sampling technique. A systematic sampling technique was employed to select the participants using family folder or immunization registration as sampling frame. To select individual participants, the value of K (the interval) was determined. The first participant was selected using a lottery method, and the remaining participants were selected at every K interval until the required sample size was achieved.

Data collection

Data was collected through face-to-face interviews using a structured questionnaire. The questionnaire was developed based on a literature review and adapted to align with the objectives of this study. The questionnaire first was prepared in English, and then translated to the local language, Afaan Oromoo. Data was collected by three nurses, three midwives, and one supervisor after obtaining a two days training on objective and procedure of the study, ethical issue and methods of data collection before the actual data collection. To ensure the quality of the data, the questionnaire was pre-tested on 5% of the total sample size, and amendments were made based on the results of the pre-test.

Data analysis

The collected data was coded, entered into Epi-data version 3.1 and exported to IBM Statistical Package for Social Science (SPSS) version 25 for analysis. Descriptive statistics were used to summarize the characteristics of the participants. Logistic regression model was employed to identify factors associated with MCV2 uptake. The variables with p-value ≤0.25 during bivariate analysis were included to multivariable logistic regression model by forwarded model building method. In multivariable logistic regression model, the variable with p-value ≤ 0.05 was considered as factors significantly associated with the outcome variable. Multicollinearity between the independent variables was checked, and the goodness-of-fit of the model was assessed by Hosmer–Lemeshow statistic.

RESULTS

Socio-demographic characteristics of study participants

A total of 601 participants took in this study with the response rate of 96.9%. The majority (93.2%) of the caregivers were biological mothers of the children. Most (70%) of the children were in the age range of 25–34 months. Approximately 38.1% of mothers or caregivers had primary education, and 93.2% were married. Few (5.8%) of the participants were urban dwellers, while (94.2%) were rural residents (Table 1).

Table 1: Socio-demographic characteristics of the participants in Nedjo District, West Wollega Zone, Oromia Regional State, Ethiopia, 2023

Variables	Categories	Frequency	Percentage
Occupation	Unemployed	407	67.7
	Government employee	99	16.5
	Merchant	95	15.8
Parity	One	134	22.3
	Two	162	27.0
	Three	164	27.3
	Four and above	141	23.5
Number of alive children	One	137	22.8
	Two	195	32.4
	Three	152	25.3
	More than three	117	19.5
Numbers of under-five children	One	381	63.4
	Two	151	25.1
	More than two	69	11.5
Birth order index child	First borne	148	24.6
	Middle borne	156	26.0
	Last borne	297	49.4
Sex of index child	Male	290	48.3
	Female	311	51.7
A twin or single birth	Single	578	96.2
	Twin	23	3.8

Health facility and service-related factors

Most of the mothers (92.2%) reported having antenatal care (ANC) follow-up for their indexed child (Table 2). Among those, 33.8% had more than four ANC visits, 32.6% had 2 or 3 visits, and 26% had only one ANC visit. The majority of participants (91.3%) delivered their indexed child in health institutions, and 91.8% of the mothers of indexed children had postnatal care (PNC) follow-up (Table 2).

Table 2: Health facility and service-related factors in Nedjo District, West Wollega Zone, Oromia Regional State, Ethiopia, 2023

Variables	Categories	Frequency	Percentage
ANC follow up for the index child	Yes	554	92.2
	No	47	7.8
Number of ANC follow up	1 time	156	26.0
	2-3 times	196	32.6
	>=4 times	203	33.8
Place of delivery	Health facility	549	91.3
	Home	52	8.7
PNC follow up for the index child	Yes	552	91.8
	No	49	8.2
Being vaccinated for penta	Yes	568	94.5
	No	33	5.5
Time to arrive on foot at the nearest vaccination center	<15 min	245	40.8
	15 - 30 min	210	34.9
	30 - 60 min	88	14.6
	>one hour	58	9.7
Go to a health facility for child's vaccination for MCV2	Yes	371	61.7
	No	230	38.3
Immunized for MCV2	Yes	369	61.4
	No	232	38.6
Waiting time to get vaccination	≤ 30 min	258	42.9
	>30 min	343	57.1
Returned home without being Vaccinated for MCV2	Yes	77	12.8
	No	524	87.2
Reason for returned home without being vaccinated	Vaccinator absent	23	3.8
	Vaccine not available	56	9.3
	*Other	1	.2
Facility always open for vaccine	Yes	0	
	No	601	100

**Other-mothers too busy & child ill; ANC-antenatal care; PNC-postnatal care; MCV2-Meseals combined vaccine second dose*

Vaccination uptake

Out of a total of 601 children, 61.4% (95% CI: 57-65) were vaccinated for MCV2, as confirmed by their immunization cards (Fig 1)

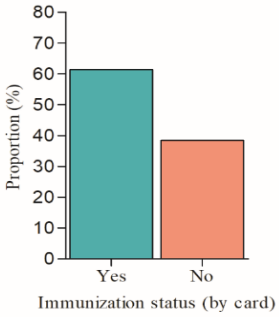

Figure 1: Prevalence of MCV2 uptake among children aged 24-35 months in Nedjo District, West Wollega Zone, Oromia Regional State, Ethiopia, 2023

Factors associated with MCV2 vaccination

In the bivariable logistic regression analysis, the following factors reached a p-value of less than or equal to 0.25 and were included in the multivariable logistic regression model: residence, maternal educational level, birth order of the child, place of delivery, PNC follow-up, vaccination status for penta, time taken to reach the health facility on foot, waiting time at the health facility for vaccination, and the recommended age for the last MCV vaccination (Table 3).

Being urban resident (AOR=3.5, 95% CI: 1.1–11.5), having college and above educational status of mother (AOR=13.1, 95% CI: 3.1–55.7), having PNC follow-up (AOR = 9.6, 95% CI: 3.1–30.1), less than 30 min waiting time to access vaccination at health facility (AOR = 3.4, 95% CI: 1.8–6.4), and having knowledge about recommended age for last vaccination (AOR = 8.0, 95% CI: 4.4–14.7) were significantly associated with MCV2 vaccination in multivariable logistic regression model (Table 3)

Table 3: Factors Associated with MCV2 uptake in Nedjo District, West Wollega Zone, Oromia Regional State, Ethiopia, 2023

Variables		MCV 2 – Status		COR (95% CI)	AOR (95% CI)	P-value
		Yes, n (%)	No, n (%)			
Residence	Urban	27(77.1)	8(22.9)	2.2 (1.0–5.0)	3.5 (1.1–11.5)	0.044
	Rural	342(60.4)	224(39.6)	1.0	1.0	
Education status	Illiterate	27(27.0)	73(73.0)	1.0	1.0	
	Primary	92(40.2)	137(59.8)	1.1 (0.34, 3.38)	2.2(0.56–8.6)	0.260
	Secondary	156(91.8)	14(8.2)	17.8 (5.1–61.9)	13.1(3.1–55.7)	<0.001
	College and above	94(92.2)	8(7.8)	18.8 (5.0–71.1)	8.7(1.9–39.8)	0.005
Birth order of index child	First borne	108(73)	40(27)	1.9(1.3–3.0)		
	Middle borne	88(56.4)	68(43.6)	0.92(0.63 –1.4)		
	Last borne	173(58.2)	124(41.8)	1.0		
Place of elivery	Health facility	350(94.9)	199(85.8)	3.15 (1.7–25.5)		
	Home	19(5.1)	33(14.2)	1.0		
PNC follow up	Yes	354(95.9)	198(85.3)	4.1(2.2– 7.6)	9.6(3.1–30.1)	<0.001
	No	15(4.1)	34(14.7)	1.0		
Being vaccinated for penta	Yes	362(98.1)	206(88.8)	6.5(2.8 –15.3)		
	No	7(1.9)	26(11.2)	1.0		
Time to arrive vaccination center	> 30 min	65(44)	81(56)	1.0		
	<= 30 min	304(66.9)	151(33.1)	2.7(1.5–4.9)		
Waiting time to get vaccine	>30min	158(42.8)	185(79.7)	1.0	1.0	
	<30min	211(57.2)	47(20.3)	5.3(3.6–7.7)	3.4(1.8–6.4)	<0.001
Knowledge on age at MCV2 given	Not know	285(83.1)	58(16.9)	1.0	1.0	
	Know the age	55(44)	70(56)	6.3 (4.0–9.8)	8.0(4.4–14.7)	<0.001

COR-Crude odds ratio; AOR-Adjusted odds ratio; CI-Confidence interval

DISCUSSION

This study found that 61.4% of children received MCV2 in Nedjo District. This finding is higher compared to the results reported from North Shewa Zone (42.5%) and the Mtwara District Council, Tanzania (44.2%) (14,20). The difference between the current study and previous studies might be attributed to the variation in study years, which could provide an opportunity for increased awareness about MCV2. In contrast, the finding of the present study is slightly lower than the results reported from Mwingi Central Sub-County, where 68.9% of children received MCV2 (21,22). Moreover, the findings of the current study indicated that MCV2 coverage is below the recommended herd immunity threshold of 95% in the study area. This situation suggests that children are at risk of measles outbreaks.

Residence, maternal educational level, PNC follow-up, waiting time at the health facility for vaccination, and knowledge of the recommended age for MCV2 were associated with MCV2 uptake. This study revealed that children born to women residing in urban areas were 3.5 times more likely to have received MCV2 than children of women living in rural areas. These findings are supported by a community-based cross-sectional study from Kenya, which indicated that MCV2 vaccination coverage was higher in urban areas compared to rural areas (23). A possible explanation for the discrepancy is that urban areas typically have better access to healthcare facilities and services. Residents in urban areas may also have a higher level of education and awareness regarding the importance of vaccinations, contributing to a higher uptake of MCV2.

The present study also indicated a significant association between PNC follow-up and MCV2 uptake. The odds of receiving MCV2 vaccination were 9.6 times higher in children born to mothers who had PNC follow-up compared to those whose mothers did not receive PNC follow-up. This finding aligns with previous studies that reported a positive impact of PNC follow-up on vaccination rates (24–26). A possible explanation is that attending PNC visits may enhance health-seeking behavior, enabling women who consult healthcare professionals for check-ups to access care for their children. Furthermore, additional information regarding the importance and schedule of vaccinations may be provided during PNC visits, which can further enhance vaccine uptake (25).

Children born to mothers with a college education or higher had greater odds of being vaccinated with MCV2. This finding is in agreement with previous studies that indicated children born to mothers with higher levels of education are more likely to be vaccinated correctly compared to those born to mothers with lower educational attainment (20,26). A possible explanation for the association between maternal education level and child vaccination is that mothers with higher education have a better understanding of the benefits of vaccination. This can also be attributed to education fostering changes in attitudes, traditions, and beliefs, as well as increasing autonomy and decision-making abilities, which enhance the health-seeking behavior of the mothers.

Waiting times of less than 30 minutes to access vaccinations at health facilities were significantly associated with MCV2 uptake. The odds of receiving MCV2 were 3.4 times higher in children born to mothers who waited less than 30 minutes compared to those who waited for more than 30 minutes. This finding is supported by results from North Shewa Zone, where children whose mothers had an average waiting time of 30 minutes or less to access vaccinations showed higher uptake of MCV2. Additionally, a study from Tanzania reported similar findings, indicating that longer waiting times to access vaccination service is significantly associated with lower rates of MCV2 uptake (20). This similarity might be attributed to a lack of community involvement in scheduling vaccination service times at health facilities (14,20).

Children born to mothers who knew the recommended age for MCV2 vaccination were 8.0 times more likely to receive the vaccine compared to those born to mothers who did not know the vaccination age. This finding is consistent with results reported from North Shewa Zone (14). A possible explanation for the similarity between previously reported results and the present study is that mothers who are aware of the recommended age for MCV2 vaccination are more likely to access service within the recommended schedules. Furthermore, mothers who understand the vaccination schedule may have comprehensive information about the guidelines, which help them to vaccinate their children at the appropriate times.

The main strength of the current study is its coverage of both rural and urban areas, which helped to generate comprehensive evidence on the level of and factors influencing MCV2 uptake. However, this study has limitations. The primary limitation is its cross-sectional design, which cannot establish causal associations between the influencing factors and the dependent variable.

CONCLUSION

In the present study, the uptake of MCV2 among children in Nedjo District was considerably low (61.4%). Interventions targeting mothers living in rural areas, those with low educational levels, mothers who do not have postnatal care follow-up, long waiting times to access vaccination services, and a lack of awareness regarding the recommended age for vaccination are essential to improve MCV2 uptake in the district.

List of abbreviations

ANC-Antenatal Care; ASRs-Age Standardized Rates; MCV2-Measles Containing Vaccine dose2; PNC-Postnatal Care; SDI-Socio-Demographic Index; SPSS-Statistical Package for Social Sciences

Declarations

Ethical consideration

Ethical clearance was obtained from the institutional review board (IREB) of Salale University (approval No/1731/2015 EC)**.** A written informed consent was obtained from each mothers/caregiver after full information was provided prior to data collection. The confidentiality of study participants was assured and maintained through limiting access to database. The study was conducted in accordance with the guidelines and regulations of the Helsinki declaration.

Consent for publication: Not applicable

Availability of data and materials

Data will be available upon request from the corresponding author.

Authors' contribution

TY- conception, designed study, acquisition and analysis of data, and interpreted results, drafted the manuscript; MF-designed study, interpreted the results and critically revised

the manuscript; HZ and MD-data acquisition, and critically revised the manuscript. All authors approved the submission of the manuscript to this journal.

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