





# BMJ Open Prevalence and determinants of incomplete or not at all vaccination among children aged 12–36 months in Dabat and Gondar districts, northwest of Ethiopia: findings from the primary health care project

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## ABSTRACT

**Objective** Ethiopia is one of the Africa's signatory countries for implementation of the primary healthcare strategy including immunisation. In Ethiopia, however, 16% of child death is due to vaccine-preventable disease. Thus, this study aimed to assess the prevalence and determinants of incomplete or not at all vaccination among children aged 12–36 months in Dabat and Gondar districts, Northwest Ethiopia.

**Study design** The study is community-based cross-sectional study.

**Study setting** Dabat and Gondar Zuria districts, Northwest Ethiopia.

**Participants** Mothers/caregivers with children aged 12–36 months were enrolled in the study. Participants were randomly selected through systematic sampling and a total of 603 participants were included in the analysis.

**Methods** A binary logistic regression analysis was done. In the multivariable logistic regression analysis, a *p* value of <0.05 and adjusted OR (AOR) with 95% CI were used to identify statistically associated factors with incomplete or not at all vaccination.

**Outcomes** Incomplete or not at all vaccination.

**Results** The prevalence of incomplete or not at all vaccinated children was 23.10% (95% CI 16.50 to 29.70). The multivariable analysis revealed that the odds of incomplete or not at all vaccination were higher among mothers who had no antenatal care (ANC) visit (AOR: 1.81, 95% CI 1.21 to 4.03) and no postnatal care (PNC) visit (AOR=1.52, 95% CI 1.05 to 2.25).

**Conclusions** In the study area, nearly one-fourth of children are incompletely or not at all vaccinated. Our finding suggests that ANC and PNC visits are key determinants of incomplete or not at all vaccination. Thus, in low-resource settings like Ethiopia, the health system approaches to improved ANC and PNC services should be intensified with more effective advice on child immunisation to reduce vaccine preventable disease.

## Strengths and limitations of this study

- This study showed the rate of incomplete or not at all vaccination and its determinants using a representative sample of rural areas in Northwest Ethiopia.
- However, due to the nature of the study, the possibility of recall bias with our results cannot be ignored.
- Despite this limitation, the results are useful for researchers, local communities and the country at large.

## BACKGROUND

Childhood vaccination is one of the most significant public health interventions to decrease deaths among children under 5 years old.<sup>1</sup> Hence, the WHO established the Expanded Programme on Immunization (EPI) in 1974<sup>2</sup> to control vaccine preventable diseases.<sup>3</sup> About 29% of deaths in children under 5 years are vaccine preventable.<sup>4</sup> However, globally, vaccine-preventable diseases like diphtheria, tuberculosis, tetanus, pertussis, polio and measles occurred due to incomplete and received no vaccination of children, which still accounts for 8.8 million deaths/year of deaths in children below 5 years of age.<sup>5</sup>

Ethiopia is one of the Africa's signatory countries for implementation of immunisation. However, about 60%–80% childhood morbidity and 16% of childhood mortality is associated with infectious and communicable diseases.<sup>6</sup> Ethiopia, to deliver its vaccination services, adopted and expanded

immunisation programme service both in area and number of vaccines from time to time via mobilised women development armies or volunteers, health extension workers and health facilities.<sup>7,8</sup> Ethiopia has been implementing EPI free of charge<sup>9</sup> aiming to immunise all children between the ages of 0 and 23 months against 10 vaccine-preventable diseases through BCG, measles, pentavalent, rotavirus, pneumococcus (PCV) and oral polio (OPV) vaccines.<sup>9</sup>

In spite of these efforts, the routine child vaccination coverage (39%) is still far from the expected figure by low-income and middle-income countries and realised the planned objectives of the countries.<sup>8</sup>

Limited or no vaccination mostly related to social, cultural, geographic and parental attitudes and behaviours.<sup>8,10</sup> Different studies conducted in different settings revealed that long waiting time, no personnel at the health facility, no maternal health services, no vaccines available on the day, no information about the day for vaccination, forgetting the day of vaccination, difficulties in accessing the health facility, child or mother's health status on the day of vaccination and disagreement or concern about vaccination safety are some of the reason of limited or no vaccination.<sup>11–15</sup> There are limited studies about vaccination status among children in the rural part of Ethiopia. In the rural community, primary healthcare services like immunisation are not accessible enough compared with the urban. Thus, conducting a study in rural setting where there is scarcity in literature is vital to survey information on incomplete or not at all vaccination and its determinants and contributes in filling the gap in the literature. Likewise, this study is expected to provide an important input to policymakers and programme managers about the implementation of current immunisation programme. Therefore, the aim of this study was to assess the prevalence and associated

factors of incomplete or not at all vaccination among children aged 12–36 months in Dabat and Gondar districts, Northwest Ethiopia.

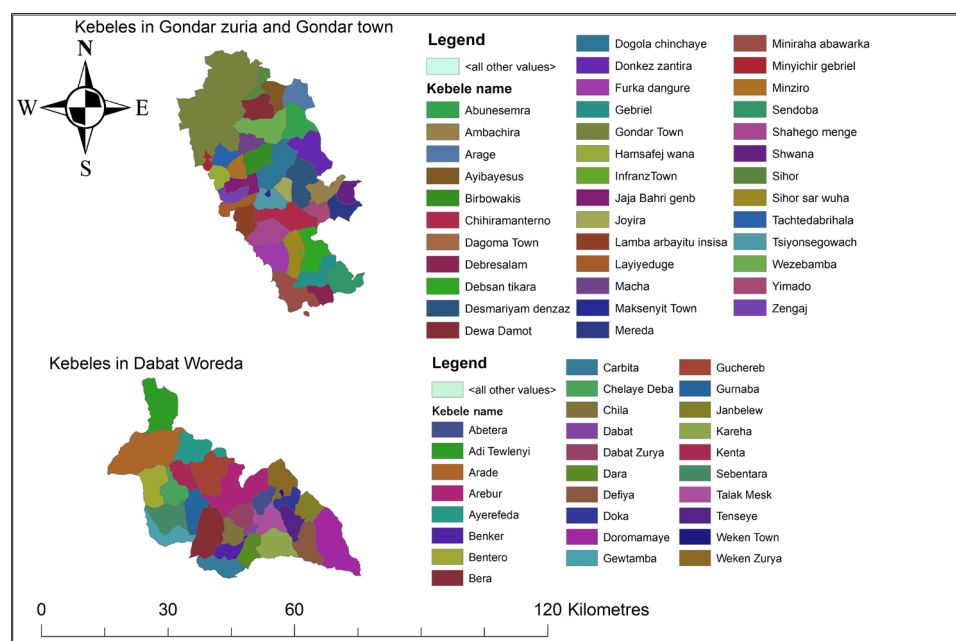
## METHODS

### Study setting and design

A community-based cross-sectional study was conducted from May 1 to 29 June 2019 in Dabat and Gondar Zuria districts, Northwest Ethiopia (figure 1). Dabat and Gondar Zuria districts, 2 of the total 23 districts in North Gondar zone of the Amhara region, consist of 30 and 38 kebeles (the smallest administrative units), respectively, located in different ecological zones (high, middle and low land). The districts have 145 509 (Dabat) and 231 324 (Gondar Zuria) inhabitants who are largely depended on agriculture. Of the total inhabitants, 3973 in Dabat and 6180 in Gondar Zuria district are children aged 12–36 months, respectively.

### Study population

Mothers/caregivers with children aged 12–36 months who lived in study area for at least 6 months were included in the study. Thus, a total of 603 children aged 12–36 months fulfilling the eligibility criteria were included. However, those who were unable to respond or very sick were excluded. Initially, the study was aimed to assess accessibility and availability of primary healthcare services at the community level, in Dabat and Gondar Zuria districts, Northwest Ethiopia. Of the total kebeles, 8 in Dabat and 10 kebeles in Gondar Zuria district were selected randomly. Systematic sampling was used to select the study participants. For households with more than one child who fulfilled the inclusion criteria, a child was selected randomly.



**Figure 1** Map of the study areas.

As part of the original survey, this particular study used the data extracted from the original survey database. Accordingly, only mothers with children aged 12–36 months were considered to investigate the magnitude of incomplete or not at all vaccination and associated factors. To this effect, sample size was calculated using Epi-info V.3.7 by considering the assumptions: 24.3% prevalence of incomplete immunisation among children aged 12–23 months in Gondar Town,<sup>16</sup> 95% level of confidence and 5% margin of error. A design effect of 1.5% and 10% non-response rate were also anticipated to obtain the final sample size of 622. Data from the mothers or caregivers of the children were collected through home-to-home visits using a structured interviewer-administered questionnaire adapted from the Ethiopian Demography and Health Survey (EDHS). The questionnaire was designed to capture sociodemographic characteristics, health service utilisation and physical access to maternal health services and visits by health extension workers. The questionnaire was prepared in English, translated to Amharic (the local language) and was administered, and the responses were translated back to English for analysis. A 2-day training on sampling procedure and data collection techniques was given to data collectors and supervisors. The acceptability and the logical structure of the questionnaire were checked on the field, during pretesting. Fifteen data collectors and three field supervisors were recruited for the study. The data collectors checked for the presence of child's immunisation card. Data on child vaccination (timing and type of vaccines received) were collected from vaccination cards and, if unavailable, by only interviewing parent's, as suggested by WHO.<sup>10</sup> Data were checked for completeness and quality, on daily basis, by the field supervisors.

### Outcome and explanatory variables

The outcome variable, incomplete vaccination or not at all vaccination, was defined as: a child aged 12–36 months who had missed at least one dose of the eight vaccines was considered to be incomplete vaccination and a child aged 12–36 months who did not receive any vaccine before this study was considered to be not at all vaccination. The prevalence of incomplete or not at all vaccination was computed as the ratio of children with incomplete or received no vaccination to the total number of children included in the study. However, fully vaccinated was defined as: a child aged 12–36 months who received the following vaccines: one dose of BCG, one dose of measles, two doses of rota, at least three doses of pentavalent, three doses of OPV and three doses of PCV. Partially vaccinated was defined as a child aged 12–36 months who received at least one dose of the above six vaccines. Antenatal care (ANC) was defined as women who received at least one maternal healthcare service during the pregnancy. Likewise, postnatal care (PNC) also defined as women who received at least one maternal health services within 48 hours after delivery by an appropriate health provider in the health facilities. Finally, formal education was also

defined as study participants at least completed grade one or attending formal learning in the school.

### Statistical analysis

Epi-data V.3.1 was used for data entry, and data were exported to SPSS V.21 for analysis. Descriptive statistics were computed. Binary logistic regression model was used to identify the relationship between dependent (incomplete vaccination or not vaccinating) and independent variables. Those independent variables with  $p$  value  $<0.2$  in the bivariable analysis in regard to the association with the dependent variable were included in the final multivariable analysis. In the binary logistic regression model, backward-stepwise multivariable analysis was used to elicit associated factors of incomplete vaccination or not vaccinating. In the final model, a significant association was declared at a  $p$  value  $<0.05$ , and finally, the results were presented in texts and tables with adjusted OR (AOR) and the corresponding 95% CI.

### Patient and public involvement

Patients were not involved in this study. We are unable to disseminate the results of the research directly to study participants.

## RESULTS

### Sociodemographic and health-related characteristics of study participants

In this study, 603 eligible children aged 12–36 months were included with a response rate of 96.95%. Most of the mothers (92.7% and 77.9%, respectively) were currently married and had no formal education. About 95.2% of the mothers had history of ANC. However, only one-third (34.2% and 30.0%, respectively) of mothers had no history of PNC and history of home delivery (table 1).

### Prevalence of incomplete vaccination or not vaccinating

The prevalence of incomplete or not at all vaccinated children was 23.10% (95% CI 16.50 to 29.70) at the time of the survey using immunisation card and mother's recall. Out of the total surveyed children, two-thirds (63.2%) of children had vaccination cards. Of the children, 505 (83.7%) and 462 (81.9%) were vaccinated for BCG and Penta 3, respectively (table 2).

### Factors associated within complete vaccination or not vaccinating

In the bivariable analysis, age of mothers, mother's occupation, maternal education, ANC visit, PNC visit and travel time to the nearest health centre were found with a  $p$  value of less than 0.2. However, the multivariable analysis revealed that only PNC and ANC were significantly associated with incomplete vaccination or not vaccinating. The odds of incomplete vaccination or not vaccinating was increased by 52% among mothers who had no PNC (AOR=1.52, 95% CI 1.05 to 2.25) compared with their counterparts. The odds of incomplete vaccination or not vaccinating was increased by 81% among mothers with

**Table 1** Sociodemographic and health-related characteristics of study participants in the rural population of Northwest Ethiopia, 2019

Characteristics	Frequency	Per cent
<b>Age of mothers (in years)</b>		
18–24	102	16.9
25–35	363	60.2
36–49	138	22.9
<b>Marital status</b>		
Currently married	559	92.7
Single	44	7.3
<b>Occupation of mothers</b>		
Housewife	571	94.7
Outdoor worker	32	5.3
<b>Maternal educational status</b>		
No formal education	470	77.9
Formal education	133	22.1
<b>Husband's educational status</b>		
No formal education	477	79.1
Formal education	126	20.9
<b>Travel time to the nearest health centre</b>		
≤30 min	146	24.2
>30 min	457	75.8
<b>Frequency of visit by health extension workers</b>		
No visit	106	17.6
Sometimes visits	461	76.5
Weekly visit	36	6.0
<b>Did you receive/attend any health education session in the last 6 months</b>		
Yes	423	70.1
No	180	29.9
<b>ANC visit (at least one)</b>		
Yes	574	95.2
No	29	4.8
<b>Place of last delivery</b>		
Home	181	30.0
Health institution	422	70.0
<b>PNC (at least one)</b>		
Yes	397	65.8
No	206	34.2

ANC, antenatal care; PNC, postnatal care.

no ANC visit (AOR=1.81, 95% CI 1.21 to 4.03) compared with their counterparts (table 3).

## DISCUSSION

In this study, the prevalence of incomplete or not at all vaccination was 23.10%; also, ANC and PNC visits were identified as independent predictors of incomplete or not at all vaccination. The finding of this study, prevalence of incomplete or not at all vaccination, was consistent

**Table 2** Prevalence of partially or unvaccinated children

Characteristics	Frequency	Per cent
<b>Availability of immunisation cards</b>		
Available	381	63.2
Not available	222	36.8
<b>BCG</b>		
Yes	505	83.7
No	98	16.3
<b>OPV1</b>		
Yes	499	82.7
No	104	17.3
<b>OPV2</b>		
Yes	496	82.3
No	107	17.7
<b>OPV3</b>		
Yes	490	81.3
No	113	18.7
<b>Penta 3</b>		
Yes	494	81.9
No	109	18.1
<b>Rotavirus vaccine 2</b>		
Yes	488	80.9
No	115	19.1
<b>PCV 3</b>		
Yes	473	78.5
No	130	21.5
<b>Measles</b>		
Yes	464	77.9
No	139	23.1
<b>Vaccination status</b>		
Fully vaccinated	464	77.9
Incompletely (partially) vaccinated	131	21.7
Not vaccinated (unvaccinated)	8	1.3

OPV, oral polio vaccine; PCV, pneumococcus vaccine.

with local studies reported from Minjar-Shenkoradistrict (24.4%),<sup>17</sup> Gondar city (24.3%)<sup>16</sup> and Addis Ababa (17.7%).<sup>18</sup> However, the current finding was higher than the reports from Debre Markos Town, Ethiopia (8.3%)<sup>19</sup> and Techiman Municipality, Ghana.<sup>20</sup> The discrepancy might be due to study setting differences, rural residence of all mothers with children in the current study compared with the latter study settings. The geographical inaccessibility of health facilities in rural residence has been found to demotivate immunisation uptake, and difficulties encountered to reach healthcare facilities are major barriers to child immunisation completion.<sup>8</sup> Similar finding was reported in Nigeria.<sup>21</sup> Mothers living in the rural areas were more likely to be affected with community belief towards poor immunisation and long walking time needed to reach the healthcare centre from the house. They also had lower access to immunisation

**Table 3** Factors associated with incomplete vaccination or not vaccinating in the rural population of northwest Ethiopia

Variables	Incomplete vaccination or not vaccinating Yes/no		Crude odds ratio (95% CI)	Adjusted Odds Ratio (95% CI)
<b>Maternal education</b>				
No formal education	113	357	1.30 (0.81 to 2.10)	1.32 (0.81 to 2.14)
Formal education	26	107	1	1
<b>Travel time to the nearest health centre</b>				
<30 min	28	118	1.35 (0.85 to 2.15)	1.41 (0.88 to 2.26)
>30 min	111	346	1	1
<b>ANC visit</b>				
Yes	128	446	1	1
No	11	18	2.13 (1.15 to 4.62)	1.81 (1.21 to 4.03)*
<b>PNC visit</b>				
Yes	82	315	1	1
No	57	149	1.47 (1.01 to 2.17)	1.52 (1.05 to 2.25)*

\*P-value <0.05

ANC, antenatal care; PNC, postnatal care.

education and counselling, and poor knowledge is associated with noncompliance towards vaccines.<sup>22</sup> For example, according to EDHS 2016, urban women (90%) are more likely to receive any ANC from a skilled provider than rural women (58%).<sup>8</sup> This suggests that poor child immunisation coverage can decline by strengthening outreach strategies in the African context.

This finding also confirmed that children whose mothers did not have ANC follow-up were found with increased odds of incomplete vaccination or not vaccinating compared with their counterparts. Similar findings were also reported by the previous local studies.<sup>23 24</sup> Obviously, information could play a crucial role in determining the health behaviour of an individual including mothers. As birth preparedness and immunisation counselling are essential components of ANC, antenatal visits can be attributed to mother's opportunity to obtain information about the benefits of immunisation from antenatal counselling sessions.<sup>25</sup> So, mothers who had no ANC care visits missed the chance of communicating with healthcare providers to hear about the benefits of vaccination and the relevance of completing it. Also, evidence from Pakistan demonstrated that mothers who had no ANC follow-up had a high probability of incomplete immunisation and non-immunisation for their children.<sup>26</sup>

The result of the multivariable analysis showed that the likelihoods of incomplete vaccination or not vaccinating among children were higher among mothers who had no history of PNC follow-up. This finding was in agreement with the report from local studies in Ethiopia.<sup>23 24</sup> In fact, the WHO guidelines for mothers and infants' PNC include guidance on preventive measures like that of immunisation.<sup>27</sup> However, the timely availability and delivery of PNC for both mothers and newborns is very low in Ethiopia.<sup>8</sup> This suggests that integration of maternal PNC and child health programme (infant immunisation

services) is vital to increase child immunisation coverage and maternal PNC.<sup>28 29</sup>

### Strengths and limitations of the study

This study showed the rate of incomplete vaccination or not vaccinating rate and its determinants using a representative sample of rural area in northwest of Ethiopia. However, in this study, for the children who did not have an immunisation card, the vaccination status was determined based on declarative data of study participants. This is prone to systematic error (recall bias) caused by differences in accuracy of immunisation information over a period up to 36 months. However, strong efforts were made to minimise this bias mainly by recruiting experienced data collectors and supervisors. Also, since vaccination status and predicting factors were assessed simultaneously, it is not possible to establish cause-effect relationship. Despite this limitation, the results are useful for researchers, communities in the districts and the country at large.

### CONCLUSIONS

In the study area, nearly one-fourth of children are incompletely vaccinated and not vaccinated. ANC and PNC follow-up are significantly associated with incomplete vaccination and no vaccination at all. Thus, healthcare services utilisation during pregnancy and after delivery should be intensified for increasing immunisation rate in the area, which can contribute for the better survival and well-being of the children.

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**Contributors** AA, TD, GA, MY and TAA conceived the study, developed the tool, coordinated data collection and carried out the statistical analysis and drafted the manuscript. AA, KA, GDD, HFW, TA, BMG, AK, DFT, TG and ED conceived the study, participated in the statistical analysis and drafted the manuscript. TD and AA conceived the study and reviewed the drafted manuscript. All authors read and approved the final manuscript.

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**Competing interests** None declared.

**Patient and public involvement** Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

**Patient consent for publication** Not required.

**Ethics approval** Ethical approval was obtained from the Institutional Review Board of University of Gondar (Ref. No. O//P/RCS/05/361/2018). Informed consent was also obtained from parents. The confidentiality of information was guaranteed by using code numbers rather than personal identifiers and by keeping the data locked. Participants were told to decline at any time if they felt uncomfortable, even after the interview was started.

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**Data availability statement** Data are available on reasonable request. We confirm that all data underlying the findings would be fully available without restriction if the manuscript is published.

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