The Turkish Journal of Pediatrics 2025; 67: 304-316
https://doi.org/10.24953/turkjpediatr.2025.5886

Original Article

Association of socio-demographic factors with measles vaccination coverage among Indonesian children aged 12-23 months: a nationwide study

Asep Hermawan[1], Irlina Raswanti Irawan[1], Mirna Widiyanti[1], Rosnani Rosnani[2], Hidayat Arifin[3,4,5]

[1]*Research Center for Public Health and Nutrition, National Research and Innovation Agency, Jakarta, Indonesia;* [2]*Department of Maternity Nursing, School of Nursing, Politeknik Kesehatan Kemenkes Palembang, Palembang, Indonesia;* [3]*Department of Basic Nursing, Faculty of Nursing, Universitas Airlangga, Surabaya, Indonesia;* [4]*Research Group in Medical-Surgical Nursing, Faculty of Nursing, Universitas Airlangga, Surabaya, Indonesia;* [5]*School of Nursing, College of Nursing, Taipei Medical University, Taipei, Taiwan.*

ABSTRACT

Background. This study aimed to examine the socio-demographic factors associated with measles vaccination coverage among Indonesian children aged 12–23 months, using data from a nationally representative survey.

Methods. A cross-sectional analysis was conducted using the 2018 Indonesian Basic Health Survey (Riskesdas), including 19,425 children aged 12–23 months. Multivariate logistic regression was used to identify factors associated with measles vaccination status, and subgroup analyses were performed across three regional clusters.

Results. Of the children surveyed, 73.46% had received measles vaccination, 68.14% had at least one antenatal care visit per trimester, and 53.59% had received at least one postnatal care visit. The most significant predictors of measles vaccination were frequent postnatal care (adjusted odds ratio [AOR]: 2.36, 95% confidence interval [CI]: 1.86-2.99) and higher maternal education (AOR: 2.31, 95% CI: 1.30-4.10). Other associated factors included the age and employment status of the head of the household (as defined by the Riskesdas study), travel time to healthcare facilities, household expenditure, and urban–rural residence.

Conclusion. Utilization of postnatal care and higher maternal education were key determinants of measles vaccination coverage. Improving maternal healthcare access and promoting female education may enhance vaccination uptake among Indonesian children.

Key words: vaccination, immunization, measles, children, survey, Indonesia.

Measles remains a significant concern for healthcare professionals in low- and high-income countries, including nurses, physicians, and other medical personnel.[1,2] It is a primary cause of high morbidity and mortality in children because of its high transmissibility and potential for severe complications such as pneumonia, encephalitis, acute diarrhoea, visual impairment, central nervous system infections, and mortality due to gastroenteritis.[3,4] The risk is particularly elevated for children with compromised immune systems or malnutrition. Therefore, increased measles vaccination coverage is crucial for reducing the disease burden.[5,6] However, challenges persist, with low vaccination rates often attributed to

✉ Asep Hermawan ▪ asep058@brin.go.id

Received 7th Feb 2025, revised 24th Mar 2025, 8th Apr 2025, accepted 21st Apr 2025.

misinformation, vaccine hesitancy, and various socio-demographic factors.[7,8]

Globally, the measles vaccination program has significantly reduced the incidence of disease and mortality associated with measles. From 2000 to 2018, there was a 66% decrease in measles cases and a 73% reduction in fatalities attributable to routine vaccination with measles-containing vaccines (MCVs).[9] Despite these advancements, measles remains a substantial cause of morbidity and mortality in children, particularly in low-income countries.[10,11] In Indonesia, measles vaccination coverage, as observed in routine Indonesian Basic Health Research (Riskesdas) conducted since 2007, has shown fluctuating values. It was 81.6% in 2007, increased to 82.1% in 2013, and declined to 77% in 2018 among children aged 11-23 months.[12-14] Furthermore, owing to the coronavirus cisease 2019 (COVID-19) pandemic, a decrease in vaccination coverage has led to an increase in the number of measles cases in Indonesia.[15]

Previous studies in Indonesia employing national data sources such as the National Socioeconomic Survey, the Village Potential Survey, and the Indonesia Demographic and Health Survey, examined through multivariate analysis, have revealed that maternal education[16], skilled birth attendance[16-19], and socioeconomic status[16] significantly influenced measles vaccination coverage. In Indonesia, variables such as insurance ownership have been positively linked to vaccination coverage[16,20], child's age, postnatal visits, decision-making, partner's education[16], mother's age, parity, number of healthcare facilities (hospitals and health centers) per 1000 population[17], number of health centers, and residential areas (rural/urban).[21] These factors play a significant role in enhancing vaccination coverage and protecting children from vaccine-preventable diseases.

The measles vaccine plays a pivotal role in mitigating morbidity and mortality associated with measles. Children aged 12-13 months, who exhibit particular susceptibility to measles require specific attention and sufficient vaccine coverage. This study aimed to evaluate the prevalence of measles vaccination and to identify factors associated with vaccination among Indonesian children aged 12 to 23 months. The objective was to enhance existing knowledge and address the paucity of evidence regarding the determinants of vaccine coverage within this population.

Materials and Methods

Study design and data sources

A cross-sectional analysis was performed utilizing secondary data from the 2018 Riskesdas, a nationwide survey executed by the National Institute of Health Research and Development under the Ministry of Health of the Republic of Indonesia. The 2018 Riskesdas was integrated into the National Socioeconomic Survey, conducted by Statistics Indonesia (BPS) across 34 provinces in March 2018. Riskesdas represents a comprehensive national health survey conducted at the regency/municipal level. The extensive dataset encompasses various health-related factors, including health indicators, assessments, healthcare availability, health-related behaviors, environmental conditions, and hygiene. This study is based on the analysis of the 2018 Riskesdas, which has already received ethical approval (No. LB.02.01/KE.267/2017) from the Health Research Ethics Committee of the National Institute of Health Research and Development, Ministry of Health, Republic of Indonesia. Informed consent was obtained from all participants prior to data collection during the survey. Consequently, no additional ethical approval was obtained for this study. This study adhered to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.

Sampling

The sample selection in the 2018 Riskesdas employed a two-stage sampling design utilizing probability proportional to size (PPS) with linear systematic sampling. In the first stage, census

blocks (clusters) were selected using systematic PPS within each urban and rural stratum across all regencies and cities in Indonesia. In the second stage, from each selected census block, ten households were chosen through systematic sampling. This selection process incorporated implicit stratification based on the highest educational attainment of the head of the household to ensure representativeness, defining the head of the household as the person in the household who is responsible for acquisition of daily needs, and acts as the main decision-maker, or someone appointed or recognized in that role, regardless of gender. Overall, the Riskesdas encompassed approximately 300,000 households drawn from 30,000 clusters across 34 provinces.[14] For the present study, a total of 19,425 children aged 12–23 months from 514 regencies or cities were analyzed. Children who had already received booster measles vaccinations were excluded.

Variables

To enhance comprehension of the variables employed in this study, each variable was classified according to standard categorizations pertinent to maternal and child health research. The dependent and independent variables were operationalized in alignment with the structure of the 2018 Riskesdas dataset and extant literature. Table I delineates the grouping, definitions, and categories for each variable analyzed in this study.

Data analysis

This study delineated children's characteristics using frequency and percentage metrics. Cross-tabulation analysis was conducted to explore the association between independent variables and measles vaccination coverage. Simple logistic regression was employed for bivariate analysis, serving to identify candidate variables for inclusion in a multiple logistic regression model. Variables with a p-value below 0.25 were considered candidates for further analysis. Multiple logistic regression was utilized for multivariate analysis. Model selection for multivariate analysis employed a stepwise backward elimination strategy, commencing with the variable exhibiting the highest alpha value. Variables were retained and considered confounding if the odds ratio (OR) changed by more than 10%; otherwise, they were excluded from the analysis. This process was repeated until all candidate variables significantly influenced (alpha < 0.05) the dependent variable. The survey data necessitated weighting during the analysis to address sampling considerations.

Results

Demographic characteristics

Across all regions, most participants received the measles vaccine (73.46%), antenatal care (ANC) at least once every trimester (68.14%), and at least one postnatal care (PNC) visit (53.59%). The majority of mothers were aged 25–34 years (48.52%), had primary education (50.54%), and were unemployed (57.42%). Most heads of household were aged ≥45 years (35.44%), had primary education (57.77%), and were employed in the informal sector (76.48%). Most households had convenient access to primary health centers (PHCs, ≤15 minutes, 73.39%) and clinics/general practitioners (≤15 minutes, 81.13%), while 39.11% lived ≥31 minutes from hospitals. A significant proportion of households fell within the first quintile of monthly expenditure per capita (26.65%) and resided in rural areas (59.69%) (Table II).

In Sumatera, Java, and Bali, the majority of mothers were aged 25–34 years, had primary school education, and were unemployed. The heads of household generally fell within the 35–44 age group, had primary school education, and were employed in the informal sector. Many households had convenient access to PHCs and clinics/general practitioners within ≤15 minutes, while hospitals were within 15–30 minutes. Most households belonged to the second quintile of monthly expenditure per capita, and the majority resided in rural areas. Most participants in Sumatera, Java, and Bali had

Table I. Definition and categorization of variables used in the study.

Variable	Categories	Description
Dependent Variables		
Measles vaccination	Vaccinated Not vaccinated	Indicates whether the child aged 12–23 months received measles vaccination. The information about vaccination data was obtained from the family especially mother and verified using the child's vaccination card
Independent Variables		
Antenatal care frequency	At least once per trimester Checked by non-healthcare personnel No ANC	Assesses adequacy of ANC received during pregnancy
Postnatal care frequency	PNC per period At least one PNC visit No PNC	Measures access to care provided after childbirth
Mother's age	<25 years 25–34 years 35–44 years ≥45 years	Maternal age at the time of survey
Maternal education	No schooling Primary Secondary Higher	Formal educational attainment of the mother
Maternal employment	Unemployed Informal sector Formal sector	Employment status of the mother
Age of the head of the household	<25 years 25–34 years 35–44 years ≥45 years	Age of the primary household decision-maker
Education status of the head of the household	No schooling Primary Secondary Higher	Formal educational attainment of the head of the household
Employment status of the head of the household	Unemployed Informal sector Formal sector	Employment status of the head of the household
Time to nearest hospital	≤15 minutes 15–30 minutes >30 minutes	Self-reported time required to reach the nearest hospital

ANC, antenatal care; GP, general practitioner; PHC; public health center; PNC, postnatal care.

Table I. Continued.

Variable	Categories	Description
Time to nearest PHC	≤15 minutes	Time required to reach the nearest primary health center
	15–30 minutes	
	>30 minutes	
Time to nearest Clinic/GP	≤15 minutes	Time to reach the nearest clinic or general practitioner
	15–30 minutes	
	>30 minutes	
Monthly expenditure per capita	Quintile 1 (lowest) to Quintile 5 (highest)	Total monthly household expenditure per person, categorized into quintiles
Residential classification	Urban	Classification based on household location
	Rural	

ANC, antenatal care; GP, general practitioner; PHC; public health center; PNC, postnatal care.

Table II. Participants' characteristics across three regions in Indonesia.

Characteristics	Sumatera, Java, and Bali (n = 11,523)	Nusa Tenggara, Kalimantan, and Sulawesi (n = 6,317)	Maluku and Papua (n = 1,589)	Total (n = 19,429)
	n (%)	n (%)	n (%)	n (%)
Measles vaccination				
Not vaccinated	3,107 (26.96)	1,423 (22.53)	627 (39.46)	5,157 (26.54)
Vaccinated	8,416 (73.04)	4,894 (77.47)	962 (60.54)	14,272 (73.46)
Antenatal care frequency				
At least once every trimester	8,635 (74.94)	3,941 (62.39)	663 (41.72)	13,239 (68.14)
Checked by non-healthcare personnel	313 (2.72)	244 (3.86)	91 (5.73)	648 (3.34)
No ANC	2,575 (22.35)	2,132 (33.75)	835 (52.55)	5,542 (28.52)
Postnatal Care Frequency				
PNC per period	3,718 (34.61)	1,722 (29.97)	294 (21.84)	5,734 (32.15)
At least once in a period	5,886 (54.78)	3,056 (53.19)	615 (45.69)	9,557 (53.59)
No PNC	1,140 (10.61)	967 (16.83)	437 (32.47)	2,544 (14.26)
Mother's Age				
<25 years	2,613 (23.47)	1,630 (27.07)	385 (26.14)	4,628 (24.84)
25-34 years	5,626 (50.53)	2,775 (46.08)	637 (43.25)	9,038 (48.52)
35-44 years	2,771 (24.89)	1,521 (25.26)	405 (27.49)	4,697 (25.21)
≥45 years	124 (1.11)	96 (1.59)	46 (3.12)	266 (1.43)
Maternal Education				
No schooling	175 (1.57)	165 (2.74)	113 (7.67)	453 (2.43)
Primary	5,381 (48.33)	3,304 (54.87)	730 (49.56)	9,415 (50.54)
Secondary	3,902 (35.05)	1,752 (29.09)	458 (31.09)	6,112 (32.81)
Higher	1,675 (15.05)	801 (13.30)	172 (11.68)	2,648 (14.22)

ANC, antenatal care; GP, general practitioner; PHC; public health center; PNC, postnatal care.

Table II. Continued.

Characteristics	Sumatera, Java, and Bali (n = 11,523)	Nusa Tenggara, Kalimantan, and Sulawesi (n = 6,317)	Maluku and Papua (n = 1,589)	Total (n = 19,429)
	n (%)	n (%)	n (%)	n (%)
Maternal employment				
Unemployed	6,619 (59.45)	3,384 (56.19)	694 (47.11)	10,697 (57.42)
Informal sector	3,283 (29.49)	2,127 (35.32)	650 (44.13)	6,060 (32.53)
Formal sector	1,231 (11.06)	511 (8.49)	129 (8.76)	1,871 (10.04)
Age of the head of the household				
<25 years	435 (3.78)	296 (4.69)	79 (4.97)	810 (4.17)
25-34 years	3,202(27.79)	1,647 (26.07)	435 (27.38)	5,284 (27.20)
35-44 years	3,873 (33.61)	2,035 (32.21)	542 (34.11)	6,450 (33.20)
≥45 years	4,013 (34.83)	2,339 (37.03)	533 (33.54)	6,885 (35.44)
Education status of the head of the household				
No schooling	455 (3.95)	393 (6.22)	99 (6.23)	947 (4.87)
Primary	6,558 (56.91)	3,820 (60.47)	847 (53.3)	11,225 (57.77)
Secondary	3,417 (29.65)	1,519 (24.05)	461 (29.01)	5,397 (27.78)
Higher	1,093 (9.49)	585 (9.26)	182 (11.45)	1,860 (9.57)
Employment status of the head of the household				
Unemployed	855 (7.42)	427 (6.76)	110 (6.92)	1,392 (7.16)
Informal sector	8,731 (75.77)	4,929 (78.03)	1,200 (75.52)	14,860 (76.48)
Formal sector	1937 (16.81)	961 (15.21)	279 (17.56)	3,177 (16.35)
Time to nearest hospital				
≤5 minutes	3,955 (36.65)	1,497 (26.41)	322 (25.91)	5,774 (32.62)
15-30 minutes	3,250 (30.12)	1,487 (26.23)	268 (21.56)	5,005 (28.27)
>30 minutes	3,586 (33.23)	2,685 (47.36)	653 (52.53)	6,924 (39.11)
Time to nearest PHC				
≤5 minutes	8,721 (76.89)	4,337 (69.5)	986 (63.49)	14,044 (73.39)
15-30 minutes	2,156 (19.01)	1,418 (22.72)	351 (22.60)	3,925 (20.51)
>30 minutes	465 (4.10)	485 (7.77)	216 (13.91)	1,166 (6.09)
Time to nearest clinic/GP				
≤5 minutes	8,940 (86.54)	2,826 (70.09)	385 (62.60)	12,151 (81.13)
15-30 minutes	1,106 (10.71)	750 (18.60)	93 (15.12)	1,949 (13.01)
>30 minutes	284 (2.75)	456 (11.31)	137 (22.28)	877 (5.86)
Monthly expenditure per capita				
Quintile 1	2,669 (23.16)	1,987 (31.45)	521 (32.79)	5,177 (26.65)
Quintile 2	2,711 (23.53)	1,321 (20.91)	310 (19.51)	4,342 (22.35)
Quintile 3	2,294 (19.91)	1,152 (18.24)	287 (18.06)	3,733 (19.21)
Quintile 4	2,046 (17.76)	996 (15.77)	249 (15.67)	3,291 (16.94)
Quintile 5	1,803 (15.65)	861 (13.63)	222 (13.97)	2,886 (14.85)
Residential classification				
Urban	5,405 (46.91)	2,016 (31.91)	411 (25.87)	7,832 (40.31)
Rural	6,118 (53.09)	4,301 (68.09)	1,178 (74.13)	11,597 (59.69)

ANC, antenatal care; GP, general practitioner; PHC; public health center; PNC, postnatal care.

received measles vaccination (73.04%), received ANC at least once every trimester (74.94%), and PNC per period (34.61%) (Table II).

In Nusa Tenggara, Kalimantan, Sulawesi, Maluku and Papua, Mothers were typically aged 25–34 years, had primary school education, and were unemployed. The heads of household were usually aged 35–44 years, had primary education, and were employed in the informal sector. Hospitals were generally reachable within >31 minutes, PHCs within 15–30 minutes, and clinics/general practitioners within ≤15 minutes. The monthly expenditure per capita was in the first quintile, and most respondents lived in rural areas. Most respondents in Nusa Tenggara, Kalimantan and Sulawesi, received the measles vaccine (77.47%), had ANC at least once every trimester (62.39%), and PNC per period (53.19%). In Maluku and Papua, 60.54% of children received the measles vaccine, but 52.55% of mothers reported no ANC visits (Table II).

Multivariate analysis

In Sumatera, Java, and Bali, the final model incorporated several variables, including the frequency of ANC and PNC, maternal education,the age and employment status of the head of household, travel time to the nearest hospital, clinic/general practitioner, and PHC, monthly expenditure per capita, and residential classification. The most significant predictors in this model were PNC per period (OR = 2.36; 95% CI: 1.86–2.99), higher maternal education (OR = 2.31; 95% CI: 1.30–4.10), and employment of the head of the household in the formal sector (OR = 2.00; 95% CI: 1.38–2.90; Table III).

For the Nusa Tenggara, Kalimantan, and Sulawesi regions, the final model identified key service-related variables, particularly the regularity of ANC and PNC appointments, underscoring the importance of consistent maternal healthcare. The most influential predictors were PNC per period (OR = 2.51; 95% CI: 1.92–3.28), secondary maternal education (OR = 2.87; 95% CI: 1.81–4.55), and higher maternal education (OR = 2.47; 95% CI: 1.50–4.08; Table III).

In Maluku and Papua, the final model included ANC and PNC frequency, maternal education, characteristics of the head of household, travel time to the nearest hospital, clinic/general practitioner, and PHC, monthly expenditure per capita, and residential classification. The most impactful factors were PNC per period (OR = 2.40; 95% CI: 1.89–3.04) and higher maternal education (OR = 2.57; 95% CI: 1.47–4.49; Table III).

The final model for all regions combined identified multiple factors influencing measles vaccination coverage. These included ANC and PNC frequency, maternal education, the age and employment status of the head of household, travel time to health facilities (hospital, clinic/general practitioner, and PHC), and residential classification. Among all variables, maternal education emerged as the most influential predictor. Children of mothers with the highest education level had significantly greater odds of receiving the measles vaccine (OR = 3.01; 95% CI: 1.87–4.84) after adjusting for all other covariates (Table III).

Discussion

Socio-demographic factors play a significant role in shaping routine childhood vaccination coverage, including measles immunization, and ultimately contribute to achieving herd immunity, which is essential for reducing morbidity and mortality among children. Understanding these determinants is crucial for identifying and eliminating barriers to immunization uptake.

PNC and maternal education were the strongest predictors of measles vaccination. Mothers who attended PNC services were significantly more likely to complete their child's vaccination schedule, consistent with prior evidence showing that postnatal and adequate ANC enhance immunization uptake.[22-25] Additionally, mothers with secondary or higher education

Table III. Comparison of measles vaccination characteristics among children aged 12-23 months in Indonesia.

Characteristic	Sumatera, Java, and Bali (n = 11,523)			Nusa Tenggara, Kalimantan, and Sulawesi (n = 6,317)			Maluku and Papua (n = 1,589)			Total (19,429)		
	%	COR (95% CI)	AOR (95%CI)	%	COR (95% CI)	AOR (95%CI)	%	COR (95% CI)	AOR (95%CI)	%	COR (95% CI)	AOR (95%CI)
Antenatal care frequency												
At least once every trimester	78.27	1.96 (1.70-2.25)***	1.45 (1.21-1.75)***	81.39	1.84 (1.55-2.18)***	1.48 (1.21-1.8)***	79.31	3.31 (2.45-4.49)***	1.45 (1.2-1.75)***	78.86	1.98 (1.78-2.2)***	1.42 (1.22-1.65)***
Checked by non-healthcare personnel	62.16	0.89 (0.63-1.26)	0.73 (0.50-1.06)*	70.97	1.03 (0.69-1.52)	1.00 (0.67-1.48)	69.73	1.99 (1.06-3.74)**	0.74 (0.5-1.08)	65.21	0.99 (0.77-1.28)	0.81 (0.59-1.10)
No ANC	64.78	1.00 (Reference)	1.00 (Reference)	70.42	1.00 (Reference)	1.00 (Reference)	53.64	1.00 (Reference)	1.00 (Reference)	65.35	1.00 (Reference)	1.00 (Reference)
Postnatal care frequency												
PNC per period	81.38	2.83 (2.30-3.49)***	2.36 (1.86-2.99)***	84.68	3.04 (2.35-3.94) ***	2.51 (1.92-3.28)***	79.95	3.67 (2.33-5.78)***	2.40 (1.89-3.04)***	81.89	2.89 (2.47-3.39)***	2.17 (1.78-2.64)***
At least once in a period	74.62	1.9 (1.56-2.31)***	1.69 (1.36-2.11)***	79.04	2.07 (1.66-2.58) ***	1.83 (1.46-2.28) ***	70.36	2.18 (1.49-3.2)***	1.69 (1.35-2.12)***	75.42	1.96 (1.70-2.26)***	1.59 (1.33-1.90)***
No PNC	60.71	1.00 (Reference)	1.00 (Reference)	64.53	1.00 (Reference)	1.00 (Reference)	52.08	1.00 (Reference)	1.00 (Reference)	61.00	1.00 (Reference)	1.00 (Reference)
Mother's age												
<25 years	74.85	1.00 (Reference)	-	76.34	1.00 (Reference)	-	63.30	1.00 (Reference)	-	74.72	1.00 (Reference)	-
25-34 years	76.04	1.07 (0.91-1.24)	-	78.86	1.16 (0.95-1.41)	-	66.92	1.17 (0.80-1.72)	-	76.27	1.09 (0.96-1.23)	-
35-44 years	75.68	1.05 (0.88-1.25)**	-	79.25	1.18 (0.94-1.48)	-	68.89	1.28 (0.83-1.99)	-	76.16	1.08 (0.94-1.24)	-
≥45 years	61.85	0.54 (0.33-0.91)	-	76.56	1.01 (0.50-2.05)	-	69.24	1.31 (0.57-3.00)	-	66.70	0.68 (0.46-1)**	-
Maternal education												
No schooling	52.78	1.00 (Reference)	1.00 (Reference)	61.20	1.00 (Reference)	1.00 (Reference)	26.47	1.00 (Reference)	1.00 (Reference)	50.78	1.00 (Reference)	
Primary	72.43	2.35 (1.52-3.63)***	1.98 (1.16-3.38)**	74.06	1.81 (1.20-2.73)**	1.71 (1.11-2.62)**	62.32	4.59 (2.51-8.42)***	1.97 (1.17-3.32) **	72.43	2.55 (1.92-3.37)***	2.20 (1.42-3.43)***
Secondary	78.09	3.19 (2.05-4.95)***	2.16 (1.25-3.72)**	83.75	3.27 (2.11-5.07)***	2.87 (1.81-4.55)***	74.83	8.26 (4.31-15.81)***	2.25 (1.33-3.81)**	78.99	3.65 (2.73-4.87)***	2.71 (1.73-4.24)***
Higher	81.80	4.02 (2.54-6.36)***	2.31 (1.30-4.10)**	83.18	3.14 (1.94-5.08)***	2.47 (1.50-4.08)***	79.35	10.67 (5.07-22.45)***	2.57 (1.47-4.49)**	82.03	4.42 (3.26-6.01)***	3.01 (1.87-4.84)***
Maternal employment												
Unemployed	74.41	1.00 (Reference)		78.22	1.00 (Reference)	-	68.88	1.00 (Reference)	-	74.97	1.00 (Reference)	-
Informal sector	75.27	1.05 (0.91-1.20)	-	76.98	0.93 (0.78-1.11)	-	60.70	0.70 (0.51-0.96)**	-	74.84	-	-
Formal sector	82.13	1.58 (1.28-1.96)***	-	82.02	1.27 (0.89-1.81)	-	79.33	1.73 (0.89-3.39)	-	82.03	-	-
Age of the head of the household												
<25 years	79.80	1.00 (Reference)	1.00 (Reference)	67.80	1.00 (Reference)	1.00 (Reference)	63.30	1.00 (Reference)	-	76.40	1.00 (Reference)	-
25-34 years	74.25	0.73 (0.52-1.02)*	0.64 (0.42-0.97)**	78.38	1.72 (1.22-2.43)**	1.63 (1.15-2.32) **	66.92	0.88 (0.42-1.85)	-	74.50	0.90 (0.7-1.16)	-
35-44 years	74.91	0.76 (0.55-1.05)*	0.72 (0.48-1.07)	77.42	1.63 (1.16-2.29)**	1.60 (1.12-2.28) **	68.89	1.22 (0.59-2.50)	-	75.19	0.94 (0.74-1.19)	-
≥45 years	75.69	0.79 (0.57-1.09)	0.86 (0.57-1.29)	78.90	1.78 (1.27-2.49)**	1.79 (1.26-2.53) **	69.24	1.08 (0.52-2.24)	-	76.07	0.98 (0.77-1.25)	-
Education status of the head of the household												
No schooling	69.41	1.00 (Reference)	-	71.54	1.00 (Reference)	-	30.86	1.00 (Reference)	-	67.89	1.00 (Reference)	1.00 (Reference)
Primary	73.73	1.24 (0.93-1.64)	-	75.27	1.21 (0.91-1.62)	-	60.11	3.38 (1.80-6.34)***	-	73.60	1.32 (1.07-1.62)***	0.86 (0.63-1.17)
Secondary	77.04	1.48 (1.10-2.00)**	-	81.43	1.74 (1.25-2.43)**	-	76.15	7.15 (3.63-14.11)***	-	77.77	1.65 (1.33-2.06)***	0.77 (0.55-1.07)
Higher	79.90	1.75 (1.24-2.48)***	-	84.44	2.16 (1.42-3.29)***	-	73.71	6.28 (2.86-13.78)***	-	80.63	1.97 (1.52-2.55)***	0.75 (0.50-1.12)

ANC, antenatal care; AOR, adjusted odds ratio; CI, confidence interval; COR, crude odda ratio; GP, general practitioner; PHC; public health center; PNC, postnatal care; ***p <0.01; **p <0.05; *p < 0.1.

Table III. Continued.

Characteristic	Sumatera, Java, and Bali (n = 11,523)			Nusa Tenggara, Kalimantan, and Sulawesi (n = 6,317)			Maluku and Papua (n = 1,589)			Total (19,429)		
	%	COR (95% CI)	AOR (95%CI)	%	COR (95% CI)	AOR (95%CI)	%	COR (95% CI)	AOR (95%CI)	%	COR (95% CI)	AOR (95%CI)
Employment status of the head of the household												
Unemployed	70.13	1.00 (Reference)	1.00 (Reference)	77.90	1.00 (Reference)		71.14	1.00 (Reference)		71.74	1.00 (Reference)	1.00 (Reference)
Informal sector	73.61	1.19 (0.95-1.49)	1.26 (0.93-1.71)	76.75	0.94 (0.67-1.30)	-	62.40	0.67 (0.34-1.34)	-	73.83	1.11 (0.92-1.34)	1.10 (0.85-1.42)
Formal sector	82.49	2.01 (1.52-2.65)***	2.00 (1.38-2.90)***	81.28	1.23 (0.83-1.83)	-	75.88	1.28 (0.59-2.78)	-	82.03	1.8 (1.43-2.26)***	1.64 (1.19-2.24)***
Time to nearest hospital												
≤15 minutes	79.64	1.65 (1.41-1.93)***	1.54 (1.22-1.93)***	79.40	1.11 (0.89-1.39)	-	79.69	2.53 (1.62-3.95)***	1.57 (1.25-1.97)***	79.60	1.53 (1.35-1.74)***	1.47 (1.21-1.80)***
15-30 minutes	76.76	1.40 (1.18-1.65)***	1.29 (1.06-1.57)**	78.89	1.08 (0.87-1.33)	-	72.72	1.72 (1.11-2.66)**	1.29 (1.06-1.57)**	77.05	1.32 (1.15-1.51)***	1.26 (1.06-1.50)**
>30 minutes	70.30	1.00 (Reference)	1.00 (Reference)	77.64	1.00 (Reference)	-	60.80	1.00 (Reference)	1.00 (Reference)	71.80	1.00 (Reference)	1.00 (Reference)
Time to nearest PHC												
≤15 minutes	77.17	2.13 (1.61-2.83)***	1.51 (1.00-2.28)**	79.15	1.58 (1.21-2.07)**	-	71.48	3.02 (1.93-4.71)***	1.51 (0.99-2.29)*	77.37	2.07 (1.7-2.51)***	1.49 (1.07-2.08)**
15-30 minutes	70.91	1.54 (1.14-2.09)	1.24 (0.81-1.89)	76.65	1.37 (1.01-1.86)*	-	63.29	2.08 (1.26-3.42)**	1.24 (0.8-1.9)	71.89	1.55 (1.25-1.91)***	1.25 (0.89-1.76)
>30 minutes	61.31	1.00 (Reference)	1.00 (Reference)	70.59	1.00 (Reference)	-	45.38	1.00 (Reference)	1.00 (Reference)	62.34	1.00 (Reference)	1.00 (Reference)
Time to nearest clinic/GP												
≤15 minutes	76.91	2.35 (1.63-3.39)***	1.86 (1.21-2.86)***	79.56	1.18 (0.87-1.61)	-	79.75	2.12 (1.19-3.78)**	1.82(1.17-2.85)**	77.33	1.71 (1.36-2.17)***	1.27 (0.95-1.70)
15-30 minutes	71.77	1.79 (1.20-2.67)***	1.78 (1.12-2.84)**	79.63	1.19 (0.82-1.72)	-	79.76	2.12 (0.98-4.58)*	1.74(1.08-2.81)**	74.00	1.43 (1.10-1.86)***	1.27 (0.92-1.75)
>30 minutes	58.64	1.00 (Reference)	1.00 (Reference)	76.67	1.00 (Reference)	-	64.99	1.00 (Reference)	1.00 (Reference)	66.56	1.00 (Reference)	1.00 (Reference)
Monthly expenditure per capita												
Quintile 1	73.54	1.00 (Reference)	1.00 (Reference)	73.19	1.00 (Reference)	-	55.75	1.00 (Reference)	1.00 (Reference)	72.63	1.00 (Reference)	-
Quintile 2	73.84	1.02 (0.86-1.19)	0.94 (0.77-1.15)	78.16	1.31 (1.05-1.64)**	-	61.92	1.29 (0.86-1.93)	0.94 (0.77-1.15)	74.30	1.09 (0.96-1.24)	-
Quintile 3	72.01	0.93 (0.77-1.12)	0.76 (0.61-0.94)**	78.37	1.33 (1.06-1.67)**	-	67.21	1.63 (1.06-2.50)**	0.76 (0.61-0.95)**	73.09	1.02 (0.88-1.19)	-
Quintile 4	75.50	1.11 (0.91-1.35)	0.82 (0.65-1.04)	79.03	1.38 (1.08-1.77)**	-	72.73	2.12 (1.30-3.44)**	0.86 (0.68-1.09)	76.06	1.20 (1.02-1.4)**	-
Quintile 5	81.93	1.63 (1.32-2.02)***	1.02 (0.77-1.35)	83.00	1.79 (1.32-2.43) ***	-	75.59	2.46 (1.49-4.05)***	1.09 (0.83-1.43)	81.88	1.70 (1.43-2.02)***	-
Residential classification												
Urban	76.38	1.16 (1.03-1.32)**	0.70 (0.59-0.84)***	78.42	1.08 (0.90-1.30)	-	78.57	2.54 (1.76-3.66)***	0.72 (0.61-0.87)***	76.75	1.18 (1.06-1.31)**	0.71 (0.61-0.84)***
Rural	73.55	1.00 (Reference)	1.00 (Reference)	77.09	1.00 (Reference)	-	59.07	1.00 (Reference)	1.00 (Reference)	73.66	1.00 (Reference)	1.00 (Reference)

ANC, antenatal care; AOR, adjusted odds ratio; CI, confidence interval; COR, crude odda ratio; GP, general practitioner; PHC; public health center; PNC, postnatal care; ***p <0.01; **p <0.05; *p < 0.1.

were more likely to adhere to recommended vaccination schedules, likely due to better health literacy and access to information.[24,26,27] This underscores the importance of integrating maternal health services and education in immunization programs.

The characteristics of the heads of households, also influenced vaccination uptake. Our findings showed higher vaccination rates among children in households where the heads of household were older and employed in the formal sector. According to research conducted in Ghana, children are more likely to receive all recommended vaccinations when fathers are actively involved in the decision making process.[28,29] In line with this, our analysis indicates that additional factors also influence vaccination coverage among children. Higher vaccination rates were observed among children in households where the heads of household were aged more than twenty five years and employed in the formal sector across regions such as Sumatra, Java, Bali, Nusa Tenggara, Kalimantan, and Sulawesi. A previous study reported that parents within the younger age group of twenty to twenty nine years were less likely to vaccinate their children due to concerns about the safety and effectiveness of vaccines. This study further shows that fathers who are employed are generally less likely to refuse childhood vaccination.[30] Moreover, fathers who held negative perceptions toward child immunization were often employed in manual labor or physically demanding occupations.[31]

The Riskesdas 2018 study did not specifically collect information about the fathers of the children; instead it obtained data on the head of household and the mother. Consequently, both the original dataset and the present analysis derived from it carry an inherent gender bias, as they operate under the assumption that heads of household are rarely the mother. Given the observed differences in the demographic profiles of the heads of household and of the mothers, it can be reasonably inferred that mothers were generally not considered heads of household. However, the absence of paternal data limits the ability to examine theinfluence of the fathers on child health outcomes, including vaccination behaviors.

Access to healthcare services, particularly shorter travel times to hospitals, clinics, or health centers, significantly increased the likelihood of timely vaccination. This is supported by previous findings that even small increases in travel distance can reduce vaccine uptake.[24,32] Furthermore, an additional one kilometer in travel distance to the nearest health facility has been shown to reduce the likelihood of vaccination by five percent. Although no direct correlation was found between the nearest health facility and dropout rates in vaccination, long distances may contribute to delayed immunization, especially during the final stages of the vaccination schedule.[33] In Maluku and Papua, lower measles vaccination coverage may be attributed to several interrelated factors beyond individual socio-demographic characteristics. These regions face systemic challenges, including limited healthcare infrastructure, geographic isolation, and difficult terrain, which hinder access to routine immunization services. Additionally, there is a chronic shortage of health professionals and inadequate distribution of vaccines in remote areas. Sociopolitical dynamics, such as historical marginalization and underinvestment in public health, further exacerbate these disparities. Addressing these challenges requires region-specific strategies that prioritize infrastructure development, community outreach, and equitable allocation of healthcare resources.

Socioeconomic status and area of residence significantly influenced vaccination rates. Families experiencing economic hardship are often less likely to complete childhood vaccinations, resulting in lower immunization coverage.[34] In contrast, vaccination rates tend to be higher among families with better financial conditions and usually improve as the family's economic situation becomes more stable.[35] Children from wealthier families and urban areas were more likely to be vaccinated, consistent with findings from both sub-Saharan Africa

and Indonesia.[26,36] This finding underscores the persistent disparity in immunization coverage between urban and rural populations. It also highlights the increased risk faced by children in rural areas, who are more likely to experience missed or delayed vaccinations.[37]

This study presents several notable strengths that enhance the significance and impact of its findings. Firstly, the utilization of nationally representative data facilitates a high degree of generalizability, rendering the conclusions applicable not only at the local or regional level but also across the entire population. Such a comprehensive data source ensures that the findings accurately reflect the true dynamics of the population, which is particularly crucial for informing evidence-based public health planning and policymaking. By employing large-scale population data, this study offers a comprehensive depiction of vaccination coverage and the social factors influencing it in Indonesia. The insights derived are valuable not only for national stakeholders but also contribute to the global understanding of how social determinants shape vaccination outcomes. This evidence can assist policymakers and public health professionals in making strategic decisions aimed at designing inclusive and effective immunization programs.

Despite its strengths, the study has certain limitations. A primary limitation is the absence of specific behavioral and attitudinal variables, such as trust in vaccines, parental beliefs, and the impact of misinformation. These elements are increasingly recognized as critical in understanding vaccine acceptance and behavior, and their absence limits the ability to fully explain variations in vaccine uptake. Additionally, the study may be affected by unmeasured confounding factors, including cultural beliefs, community-level influences, the quality of healthcare services, or gender inequality, which could bias the results. Furthermore, the analysis did not assess potential interaction effects between variables due to constraints in the available dataset. Including such analyses in future research could provide deeper insights into the complex relationships affecting vaccination coverage.

This study provides meaningful evidence for policymakers and public health professionals, particularly in Indonesia. It contributes to the global understanding of how social determinants shape vaccination coverage and supports the integration of maternal healthcare with immunization programs. The identification of PNC and maternal education as strong determinants of vaccination uptake has clear implications for policy. These findings may guide targeted interventions in maternal and child health services. Future research should expand the current analysis by exploring behavioral and psychological drivers of vaccine uptake, such as health beliefs, perceived barriers, and trust in healthcare systems. Additionally, mixed-methods studies that incorporate qualitative data from caregivers and healthcare providers may offer deeper insights into contextual challenges and facilitate the development of culturally sensitive interventions. Strengthening maternal education and expanding access to PNC services, particularly in underserved and remote areas, should also be prioritized as part of policy efforts aimed at improving routine childhood immunization.

Conclusion

This study revealed that measles vaccination coverage among children aged 12–23 months in Indonesia is influenced by maternal healthcare utilization, maternal education, and access to health services. Specifically, frequent PNC visits and higher maternal education significantly increased the likelihood of vaccination. Household characteristics, travel time to healthcare facilities, and socioeconomic factors also played important roles. Regional disparities in coverage emphasize the need for targeted interventions, especially in underserved areas like Maluku and Papua. Strengthening maternal and child health services, improving accessibility, and promoting health education are critical steps toward achieving higher

vaccination coverage and reducing preventable childhood illnesses.

Ethical approval

The study was approved by Health Research Ethics Committee of the National Institute of Health Research and Development, Ministry of Health, Republic of Indonesia (date: July 28, 2017, number: LB.02.01/KE.267/2017).

Author contribution

The authors confirm contribution to the paper as follows: Study conception and design: AH, IRI, MW; data collection: AH; analysis and interpretation of results: AH, IRI, MW, HA; draft manuscript preparation: AH, HA, RR. All authors reviewed the results and approved the final version of the manuscript.

Source of funding

The authors declare the study received no funding.

Conflict of interest

The authors declare that there is no conflict of interest.

REFERENCES

1. Patterson MC. Neurological complications of measles (rubeola). Curr Neurol Neurosci Rep 2020; 20: 2. https://doi.org/10.1007/s11910-020-1023-y
2. Wendorf KA, Winter K, Zipprich J, et al. Subacute Sclerosing Panencephalitis: The devastating measles complication that might be more common than previously estimated. Clin Infect Dis 2017; 65: 226-232. https://doi.org/10.1093/cid/cix302
3. Ben-Chetrit E, Oster Y, Jarjou'i A, et al. Measles-related hospitalizations and associated complications in Jerusalem, 2018-2019. Clin Microbiol Infect 2020; 26: 637-642. https://doi.org/10.1016/j.cmi.2019.08.022
4. Buchanan R, Bonthius DJ. Measles virus and associated central nervous system sequelae. Semin Pediatr Neurol 2012; 19: 107-114. https://doi.org/10.1016/j.spen.2012.02.003
5. Bidari S, Yang W. Global resurgence of measles in the vaccination era and influencing factors. Int J Infect Dis 2024; 147: 107189. https://doi.org/10.1016/j.ijid.2024.107189
6. Jusril H, Rachmi CN, Amin MR, et al. Factors affecting vaccination demand in Indonesia: a secondary analysis and multimethods national assessment. BMJ Open 2022; 12: e058570. https://doi.org/10.1136/bmjopen-2021-058570
7. Novilla ML, Goates MC, Redelfs AH, et al. Why parents say no to having their children vaccinated against measles: a systematic review of the social determinants of parental perceptions on MMR Vaccine Hesitancy. Vaccines (Basel) 2023; 11: 926. https://doi.org/10.3390/vaccines11050926
8. Sabahelzain MM, Moukhyer M, Bosma H, van den Borne B. Determinants of measles vaccine hesitancy among sudanese parents in khartoum state, sudan: a cross-sectional study. Vaccines (Basel) 2021; 10: 6. https://doi.org/10.3390/vaccines10010006
9. Gastañaduy PA, Goodson JL, Panagiotakopoulos L, et al. Measles in the 21st century: progress toward achieving and sustaining elimination. J Infect Dis 2021; 224: S420-S428. https://doi.org/10.1093/infdis/jiaa793
10. Doshi RH, Eckhoff P, Cheng A, et al. Assessing the cost-effectiveness of different measles vaccination strategies for children in the Democratic Republic of Congo. Vaccine 2017; 35: 6187-6194. https://doi.org/10.1016/j.vaccine.2017.09.038
11. Wang R, Jing W, Liu M, Liu J. Trends of the global, regional, and national incidence of measles, vaccine coverage, and risk factors in 204 countries from 1990 to 2019. Front Med (Lausanne) 2022; 8: 798031. https://doi.org/10.3389/fmed.2021.798031
12. NIHRD Ministry of Health. National report on basic health research-RISKESDAS, 2007. 2008. Available at: https://labmandat.litbang.kemkes.go.id/images/download/laporan/RKD/2007/lap_rkd07.pdf
13. NIHRD Ministry of Health. National report on basic health research-RISKESDAS, 2013. 2013. Available at: https://repository.badankebijakan.kemkes.go.id/id/eprint/4519/1/Basic_Health_Research_Riskesdas.pdf
14. NIHRD Ministry of Health. National report on basic health research-RISKESDAS, 2018. 2019. Available at: https://repository.badankebijakan.kemkes.go.id/id/eprint/3514/1/Laporan%20Riskesdas%202018%20Nasional.pdf
15. Ramadhani FH, Azizah R, Jalaludin J, Martini S, Sulistyorini L. Meta-analysis and systematic review: risk factors of measles incidence in Indonesia (2012-2021). Jurnal Kesehatan Masyarakat 2023; 19: 138-148. https://doi.org/10.15294/kemas.v19i1.43060

16. Herliana P, Douiri A. Determinants of immunisation coverage of children aged 12-59 months in Indonesia: a cross-sectional study. BMJ Open 2017; 7: e015790. https://doi.org/10.1136/bmjopen-2016-015790

17. Holipah H, Maharani A, Kuroda Y. Determinants of immunization status among 12- to 23-month-old children in Indonesia (2008-2013): a multilevel analysis. BMC Public Health 2018; 18: 288. https://doi.org/10.1186/s12889-018-5193-3

18. Holipah H, Maharani A, Sujarwoto S, Hinoura T, Kuroda Y. Trends, spatial disparities, and social determinants of DTP3 immunization status in Indonesia 2004-2016. Vaccines (Basel) 2020; 8: 518. https://doi.org/10.3390/vaccines8030518

19. Efendi F, Pradiptasiwi DR, Krisnana I, et al. Factors associated with complete immunizations coverage among Indonesian children aged 12-23 months. Children and Youth Services Review 2020; 108. doi:10.1016/j.childyouth.2019.104651 https://doi.org/10.1016/j.childyouth.2019.104651

20. Hardhantyo M, Chuang YC. Urban-rural differences in factors associated with incomplete basic immunization among children in Indonesia: a nationwide multilevel study. Pediatr Neonatol 2021; 62: 80-89. https://doi.org/10.1016/j.pedneo.2020.09.004

21. Siramaneerat I, Agushybana F. Inequalities in immunization coverage in Indonesia: a multilevel analysis. Rural Remote Health 2021; 21: 6348. https://doi.org/10.22605/RRH6348

22. Mathew JL, Singhi S, Ray P, et al. Etiology of community acquired pneumonia among children in India: prospective, cohort study. J Glob Health 2015; 5: 050418. https://doi.org/10.7189/jogh.05.020418

23. Rahman M, Obaida-Nasrin S. Factors affecting acceptance of complete immunization coverage of children under five years in rural Bangladesh. Salud Publica Mex 2010; 52: 134-140. https://doi.org/10.1590/s0036-36342010000200005

24. Fenta SM, Biresaw HB, Fentaw KD, Gebremichael SG. Determinants of full childhood immunization among children aged 12-23 months in sub-Saharan Africa: a multilevel analysis using demographic and health survey data. Trop Med Health 2021; 49: 29. https://doi.org/10.1186/s41182-021-00319-x

25. Khan J, Shil A, Mohanty SK. Hepatitis B vaccination coverage across India: exploring the spatial heterogeneity and contextual determinants. BMC Public Health 2019; 19: 1263. https://doi.org/10.1186/s12889-019-7534-2

26. Oktaviana KE, Ernawati E. Hubungan tingkat pendidikan formal ibu terhadap kepatuhan dalam pemberian imunisasi dasar di bawah usia 1 tahun di Puskesmas Pancoran Jakarta Selatan. Tarumanagara Medical Journal 2019; 2: 92-98.

27. Brugha RF, Kevany JP, Swan AV. An investigation of the role of fathers in immunization uptake. Int J Epidemiol 1996; 25: 840-845. https://doi.org/10.1093/ije/25.4.840

28. Prastyo JI. The influence of father and mother's joint decision making on children's basic immunization: empirical research on Indonesia's Demographic and Health Survey 2017. The Journal of Indonesia Sustainable Development Planning 2021; 2: 234-256. https://doi.org/10.46456/jisdep.v2i3.175

29. Khattak FA, Rehman K, Shahzad M, et al. prevalence of parental refusal rate and its associated factors in routine immunization by using who vaccine hesitancy tool: a cross sectional study at district Bannu, KP, Pakistan. Int J Infect Dis 2021; 104: 117-124. https://doi.org/10.1016/j.ijid.2020.12.029

30. Jose SE, Joseph NC, Sheela S, Joshy VM. Knowledge, attitude and practice of fathers about childhood immunization: a tertiary care hospital based cross sectional study. International Journal of Community Medicine and Public Health 2020; 7: 1932-1935. https://doi.org/10.18203/2394-6040.ijcmph20202008

31. Dimitrova A, Carrasco-Escobar G, Richardson R, Benmarhnia T. Essential childhood immunization in 43 low- and middle-income countries: analysis of spatial trends and socioeconomic inequalities in vaccine coverage. PLoS Med 2023; 20: e1004166. https://doi.org/10.1371/journal.pmed.1004166

32. Danish, Muhammad A. Relationship between child immunization and household socio-demographic characteristic in Pakistan. Research on Humanities and Social Sciences 2014; 4: 82-89.

33. Ameyaw EK, Kareem YO, Ahinkorah BO, Seidu AA, Yaya S. Decomposing the rural-urban gap in factors associated with childhood immunisation in sub-Saharan Africa: evidence from surveys in 23 countries. BMJ Glob Health 2021; 6: e003773. https://doi.org/10.1136/bmjgh-2020-003773

34. Ijarotimi IT, Fatiregun AA, Adebiyi OA, Ilesanmi OS, Ajumobi O. Urban-rural differences in immunisation status and associated demographic factors among children 12-59 months in a southwestern state, Nigeria. PLoS One 2018; 13: e0206086. https://doi.org/10.1371/journal.pone.0206086