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Socio-demographic factors affecting the first and second dose of measles vaccination status among under-five children: Perspectives from South Asian countries

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ABSTRACT

Background: The measles vaccine is crucial in preventing fatalities and reducing widespread childhood infections worldwide, yet achieving the desired immunization rates remains a challenge in developing countries. Our study aims to identify the impact of socio-demographic factors on measles vaccination among children in South Asian countries.

Methods: Participants (89513) were taken from the most recent Demographic and Health Survey (DHS) datasets of South Asian countries between 2015 and 2021. Descriptive statistics and multivariable analyses were employed to find out the factors associated with measles vaccination among South Asian countries.

Results: Our study found that the first dose of vaccinated children was 51.7 % in Afghanistan which is the lowest among South Asian countries. The key determinants related to two doses of measles vaccination include parental characteristics, media access, and antenatal care (ANC). Mothers who had done baby postnatal checkups (AOR = 1.22, CI = 1.17–1.26) and made more than four ANC (AOR = 1.77, CI: 1.65–1.89) were more likely to fully immunize their child than mothers with no postnatal and antenatal checkups.

Conclusion: The complete dose of measles vaccination rate in South Asia is still low compared to the first dose of measles vaccination among children. The government and stakeholders should organize frequent awareness programs through media and health personnel to inform people about routine vaccinations to eliminate measles.

1. Introduction

Measles, an ancient disease in the history of infectious diseases, poses a serious concern to young infants due to its extremely transmissible nature and its possibility for severe, even life-threatening consequences (Kouadio et al., 2010; World Health Organization, 2023). The measles virus affects immune cells and interferes with their ability to fight off infection, leading to a substantial number of deaths associated with the disease. Infection with measles can significantly decrease the body's immunological memory, perhaps making a person more vulnerable to infections from other viruses. Vaccinated children do not exhibit these adverse effects on the immune system (Mina et al., 2019).

Measles represents a significant global health concern, particularly affecting children from low and middle-income countries in Asia and Africa, and over 95 % of all measles deaths occur among impoverished countries (Menezes et al., 2023). Particularly if wars or other tragedies disrupt the structure of society and healthcare, small measles outbreaks may quickly turn into lethal epidemics (DeFraites et al., 2020; Peng et al., 2020). The measles virus spreads much more quickly than other arising viruses like SARS-CoV-2. Measles shows an essential reproduction of 12–18, while the reproduction figure is only 2.5 to 3.5 for SARS-CoV-2. This number represents the average number of cases one infected person can generate throughout their infectious period within a susceptible population (Durrheim et al., 2021). During the year 2019, the global death toll from measles reached 207,500 children, with a documented total of 413,308 cases of the disease (Rana et al., 2021; WHO, 2019).

The World Health Organization (WHO) advises that children should be administered two doses of a measles-containing vaccine, which has been found to be 94.1 % effective in preventing this disease (Nic

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Lochlainn et al., 2019; Uzicanin and Zimmerman, 2011). Children should have their first dose of measles between the ages of 9 and 12 months, and their second dose between the ages of 15 and 18 months (Auzenbergs et al., 2023). Notably, immunization rates against measles differ significantly around the world. Measles has been eradicated in several nations because of high vaccination rates, although disease outbreaks are still frequent in other countries (Kauffmann et al., 2021). Since measles is highly infectious, over 95 % of the population need to be immunized to halt disease transmission and achieve herd immunity (Pandey and Galvani, 2023). Prior to the widespread implementation of measles vaccination in 1980, the virus killed approximately 2.6 million people annually. The increased efforts of immunization programs have substantially lowered these numbers. Despite these antiviral interventions, measles remains one of the leading causes of death among children. According to the WHO, over 89,780 persons perished from measles in 2016, most of whom were youngsters under five (WHO, 2023). Between 2005 and 2019, estimates of the coverage area for the measles vaccine be around 93 % to 95 % and 31 countries attained $\geq$95 % coverage with the first dose in 2019 (O'Connor et al., 2021). This has significantly decreased the number of measles cases and deaths in many countries. Yet, South Asian countries remain susceptible to measles outbreaks, as the disease is extremely contagious and can spread rapidly in areas with low vaccination rates. In addition, the country's highly populated urban centers are especially susceptible to infectious illness outbreaks such as measles.

Maternal education and wealth quintiles are crucial factors for coverage of full childhood vaccines (DPT, BCG, polio, measles vaccine) (Acharya et al., 2022). Many children who reside in conflict-affected and remote rural regions are unvaccinated against measles due to insufficient resources and difficulties reaching nearby vaccination facilities (Cutts et al., 2021; Jahan et al., 2020). The high cost of transportation and obstacles within the health system contribute to low vaccination rates in low- and middle-income countries (Jamal et al., 2020). Parental doubts regarding vaccine safety have an impact on vaccine uptake among their children (Gidengil et al., 2019; Salmon et al., 2005). Moreover, children from socioeconomically deprived backgrounds struggle to receive measles vaccinations due to inadequate access to healthcare facilities (Gao et al., 2020).

While studies have been undertaken to identify the factors influencing the first dose of measles vaccination among children, research on the determinants of complete doses of measles vaccination in South Asian countries remains limited. It is important to remember that a second dosage is advised for all children, as it plays a key role in protecting the approximately 15 % of children who may not establish protective immunity following their initial vaccine (World Health Organization, 2023). Our study aims to assess the determinants influencing the uptake of both first and second-dose of measles vaccination among children in South Asian countries. In this study, we hypothesize that (1) the measles vaccination rate among children in South Asian countries would be lower than the approximate herd immunity target (95 %), (2) the likelihood of receiving both the first and second dose of measles vaccine would significantly be associated with selected socio-demographic factors (maternal age, mother's education, mother currently working, place of residence, wealth index, father's education, father's occupation, household head, mother's age at first birth, number of children, birth order number, gender of child, permission to visit healthcare alone, distance to health facility, antenatal care visit (ANC), postnatal care visit (PNC), media exposure).

Research question: What are the significant factors of measles first and second doses of vaccination uptake among children in South Asia?

2. Materials and methods

In this study, data on the factors related to the first dose of 'Measles-containing vaccine' (MCV1) as well as the second dose of 'Measles-containing vaccine' (MCV2) uptake among under-five children was extracted from the 'Demographic and Health Survey' (DHS) datasets (http://www.dhsprogram.com). The DHS datasets from six South Asian countries (Afghanistan (2015), Bangladesh (2017–18), Nepal (2016), Pakistan (2017–18), India (2019–21), and Maldives (2016–17)) were utilized to perform the analysis. Notably, Sri Lanka and Bhutan were not included, as the latest datasets for these two countries were unavailable on the DHS website. The DHS has strict requirements for obtaining participants' informed consent and ensuring the confidentiality of their identities. The data collection was conducted in several phases between 2015 and 2021 in the selected South Asian countries. The information on under-five children's measles vaccination status focuses on the age groups 12–23 months and 24–35 months and the vaccinations advised during the first two years of life (Allen et al., 2020). A stratified two-stage sampling technique was utilized to select study participants in the DHS survey. The dataset was weighted using sample weights from the DHS dataset before data processing to produce accurate estimates. A total of 89,513 participants who received MCV1 were selected from six South Asian countries. Due to all missing cases in the "H9A" variable in the Nepal DHS dataset, we excluded the Nepal dataset for the analysis part of MCV2. For MCV2, a total of 84,827 participants were selected from five South Asian countries. When reviewing the DHS databases, vaccination cards and caregiver recall were considered as evidence of vaccination uptake. MCV1 and MCV2 were considered as dependent variables and measured as two-category dummy variables. For MCV1 and MCV2, "Yes" indicated as received the measles vaccine, and "No" indicated as not received the measles vaccine. In order to implement the results and uncover the influencing factors that could affect the MCV1 and MCV2 uptakes among under-five children, seventeen independent variables have been incorporated. The variables are described as follows: Maternal age (current), Mother's age at first birth, Mother's education, Mother currently working, Place of residence, Wealth index, Father's education, Father's occupation, Household head, Number of children, Birth order number, Gender of child, Permission to visit healthcare alone, Distance to health facility, ANC, PNC and Media exposure (Acharya et al., 2022; Gao et al., 2020; Jahan et al., 2020; Sarker et al., 2019b; Song et al., 2020).

We conducted descriptive analysis, Pearson Chi-Square test statistics, and binary logistic regression analysis for each dichotomous dependent variable to find the relationships between socio-demographic factors and immunization (Pituch and Stevens, 2015). The analysis was conducted using SPSS version 25 software, with a 95 % confidence interval, statistical significance threshold set at a p-value $\leq$0.05.

3. Results

3.1. Bivariate analysis

In order to identify the association of socio-demographic factors and vaccination status, bivariate analysis the Pearson Chi-Square test was conducted. Fig. 1, the bar diagram shows the individual percentage distribution of MCV1 coverage in six South Asian countries, where Afghanistan had the lowest vaccination rate (51.7 %).

Fig. 2, the bar diagram shows the individual percentage distribution of MCV2 coverage in five South Asian countries. We found that MCV2 coverage was low across all selected countries. Only 38.1 % of children were vaccinated in India which reported the lowest MCV2 coverage among South Asian countries. From Table 1, the variable maternal age was found statistically significant for both first and second dose of measles vaccination uptake (P-value $<$ 0.001).

Among the 15–19 years aged mothers, 1918 (56.1 %) children were found vaccinated; in the range of 20–25 years, 22797(69.5 %) were found vaccinated, and above 25 years 39592(74.3 %) old were found vaccinated for MCV1. Only 606(19.7 %) children of mothers aged 15–19 years were vaccinated for MCV2, and 7026 (22.7 %) children of mothers aged 20–25 years were vaccinated for MCV2. The variable place of residence was found statistically significant for both MCV1 and MCV2

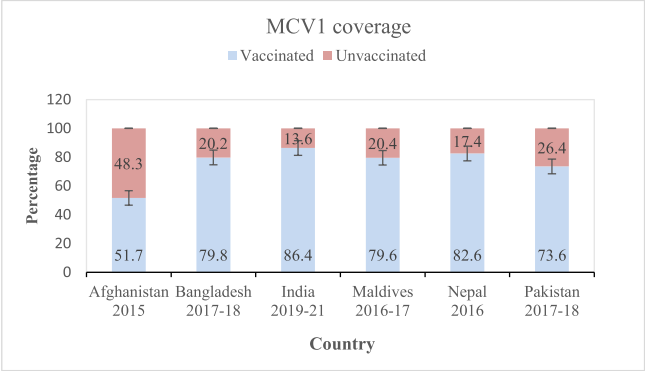

Fig. 1. Percentage of the first dose of measles-containing vaccine (MCV1) coverage among children under five within six South Asian countries from the DHS datasets (2015–2021).

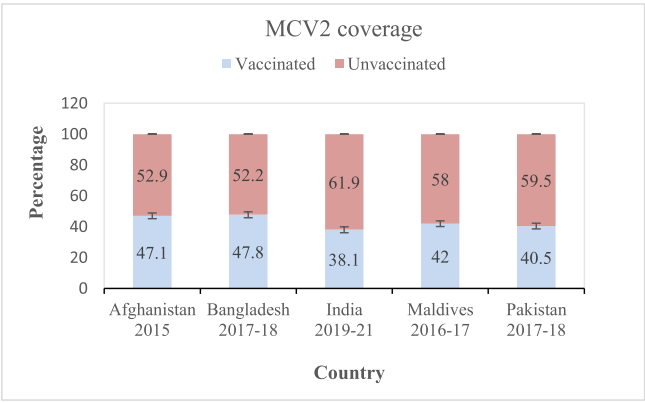

Fig. 2. Percentage of the second dose of measles-containing vaccine (MCV2) coverage among children under five within five South Asian countries from the DHS datasets (2015–2021).

(P-value < 0.001). In urban and rural areas, 18,710 (75.7 %) and 45,597 (70.4 %) children were vaccinated for MCV1, respectively. MCV1 vaccination coverage was 5 % higher for children residing in urban areas. In our study, the variable educational status for both parents was found statistically significant (P-value < 0.001). For all of our dependent variables, the sex of child variable was statistically insignificant. In our study, the variable number of children was found statistically significant only for MCV1 (P-value < 0.001). While, statistically insignificant for MCV2. The MCV1 uptake decreased with an increasing number of birth order.

3.2. Multivariable analysis

The study carried out a multivariable regression analysis to test the association of all the independent variables with measles vaccination in South Asian countries. From Table 2, We found that for MCV1, mothers aged 20–25 years were found 2.58 times more likely to immunize their child (AOR1: 2.58; 95 % C.I: 2.38–2.81), and mothers aged more than 25 years were found 5.55 times more likely to immunize their child (AOR1: 5.55; 95 % C.I: 5.06–6.09) than the 15–19 years mothers aged.

For MCV2, 20–25 years aged mothers (AOR2: 1.37; 95 % C.I: 1.24–1.51) were found 1.37 times, and mothers aged more than 25 years (AOR2: 1.41; 95 % C.I: 1.27–1.57) were found 1.41times more likely to give both MCV1 and MCV2 to their child than the mothers aged 15–19 years.

For MCV1, the mothers who completed secondary education were 1.82 times more likely to immunize their child (AOR1: 1.82; 95 % CI: 1.73–1.91), and those with primary level education were 1.63 times more prone to vaccinate their child (AOR1: 1.63; 95 % CI: 1.55–1.72) than uneducated mothers. Children of mothers from the poorer (AOR1 = 0.91, CI = 0.87–0.95), middle (AOR1 = 0.83, CI = 0.79–0.87), richer (AOR1 = 0.82, CI = 0.77–0.86), richest (AOR = 0.78, CI = 0.73–0.84) wealth quintile were less prone to give their child MCV1 than the children of mothers in the poorest wealth quintile. The odds for currently working mothers were found 1.32 times more than the odds for currently not working mothers (AOR1: 1.32; 95 % C.I: 1.26–1.38); that is, the working mothers were more likely to more prone to give MCV1 to their children than non-working mothers. The fathers who were educated at the secondary level were 29 % more prone to vaccinate their child (AOR1: 1.29; 95 % CI: 1.23–1.35), those who were educated in the higher level were 7 % more prone (AOR1: 1.07; 95 % CI: 1.003–1.14) and those who were educated at the primary level were 24 % more prone to give their child MCV1 (AOR1: 1.24; 95 % CI: 1.18–1.30) than the fathers who were uneducated.

Children whose mothers made up to four (AOR1 = 1.95, CI: 1.86–2.04) and more than four (AOR1 = 1.63, CI: 1.54–1.74) ANC were more prone to receive MCV1 compared to children whose mothers attended no ANC. Mothers who had difficulty obtaining permission to visit healthcare alone were (AOR1: 0.56; 95 % CI: 0.52–0.60) less prone to vaccinate, those who had little trouble obtaining permission to visit healthcare alone were (AOR1: 0.60; 95 % CI: 0.57–0.64) times less prone to vaccinate MCV1 to their child compared to mothers who easily got permission to visit healthcare alone. Mothers who had done baby postnatal checkups (AOR2 = 1.21, CI=1.17–1.27) were more prone to give both doses of vaccine (MCV2) to their children than mothers who had not done any postnatal checkups. For MCV1, mothers of children who had media access (AOR1 = 1.06, CI=1.02–1.10) were more likely to vaccinate their children than those with no media access. In case of MCV2, mothers of children who had media access (AOR2 = 1.07, CI=1.02–1.11) were more likely to vaccinate their children than those with no media access.

4. Discussion

In terms of measles eradication, it is noteworthy that vaccination rates vary significantly across regions and demographic populations. The WHO provided recommendations for routine immunization against measles based on disease prevalence in specific regions. It is recommended to vaccinate at 9 months for children living in measles-endemic areas and 12 months for children living in low-incidence areas (Nic Lochlainn et al., 2019). The rate of MCV1 uptake in Bangladesh, Pakistan, India, and Afghanistan were 79.8 %, 73.6 %, 86.4 %, and 51.7 % respectively. Our findings indicate that MCV1 and MCV2 coverage in South Asian countries is below the herd immunity target (95 %). The measles vaccination rate has historically been low in developing countries, particularly in districts across Pakistan and Afghanistan, where the rate remained below 50 % in 2019 (Cutts et al., 2021; World Health Organization, 2019), which is relatable to our study. Notably, the measles vaccination rate in South Asian countries is lower due to improper administration of vaccines (Kuddus et al., 2023). Previous research revealed that improper preservation, poor allocation planning, and delivery processes are the main causes of measles vaccine wastage in several regions of Bangladesh and India (Das et al., 2020; Kuddus et al., 2023).

Similar to our MCV1 study results, a prior study shows that the full vaccination rate was highest in Bangladesh (84 %) and lowest in Afghanistan (46 %) (Acharya et al., 2022). Our research shows that children from higher socio-economic and educational backgrounds, those with lower birth orders had higher odds of getting a complete dose of MCV than their counterparts, consistent with previous studies (Efendi et al., 2020; Jahan et al., 2020). Furthermore, studies carried out in South Asian countries revealed that children from urban areas exhibit higher rates of vaccination coverage in comparison to their competitors (Acharya et al., 2022; Sarker et al., 2019b).

Table 1
Descriptive characteristics and bivariate analysis of first and second doses of measles vaccination among children under five from the South Asian DHS datasets (pooled) between 2015 and 2021.

Socio-demographic factors	Received first dose of measles vaccine			Chi-square value (p-value)	Received second dose of measles vaccine			Chi-square value (p-value)
	N (%)	Yes, n (%)*	No, n (%)*		N (%)	Yes, n (%)*	No, n (%)*	
	Overall (N = 89513)				Overall (N = 84827)			
Maternal age								
15–19 Years	3416(3.8)	1918(56.1)	1498(43.9)		3074(3.6)	606(19.7)	2468(80.3)	16.709
20–25 Years	32820	22797	10023	668.796	30906	7026(22.7)	23881	(<0.001)
	(36.7)	(69.5)	(30.5)	(<0.01)	(36.4)		(77.3)	
More than 25	53277	39592	13685		50846	11641	39205	
	(59.5)	(74.3)	(25.7)		(59.9)	(22.9)	(77.1)	
Residence								
Urban	24719	18710	6009(24.3)	250.288	22184	5590(25.2)	16594	105.055
	(27.6)	(75.7)		(<0.001)	(26.2)		(74.8)	(<0.001)
Rural	64795	45597	19198		62643	13683	48960	
	(72.4)	(70.4)	(29.6)		(73.8)	(21.8)	(78.2)	
Maternal Educational level								
No education	40482	24121	16362		38849	8527(21.9)	30322	52.504
	(45.2)	(59.6)	(40.4)	5599.95	(45.8)		(78.1)	(<0.001)
Primary	11960	9361(78.3)	2600(21.7)	(<0.001)	11017(13)	2644(24.0)	8373(76.0)	
	(13.4)							
Secondary	27966	23172	4795(17.1)		26482	5969(22.5)	20513	
	(31.2)	(82.9)			(31.2)		(77.5)	
Higher	9104(10.2)	7654(84.1)	1451(15.9)		8479(10)	2133(25.2)	6347(74.8)	
Number of children								
1–2 children	65786	50000	15786	2126.95	61724	13923	47801	3.450
	(73.5)	(76.0)	(24.0)	(<0.001)	(72.8)	(22.6)	(77.4)	(0.63)
3 or more children	23728	14307	9421(39.7)		23103	5350(23.2)	17753	
	(26.5)	(60.3)			(27.2)		(76.8)	
Household head								
Male	79512	56066	23446	620.727	76186	17469	58718	18.400
	(88.8)	(70.5)	(29.5)	(<0.001)	(89.8)	(22.9)	(77.1)	(<0.001)
Female	10001	8241(82.4)	1760(17.6)		8641(10.2)	1805(20.9)	6836(79.1)	
	(11.2)							
Wealth index								
Poorest	19685(22)	13952	5733(29.1)		18669(22)	3508(18.8)	15161	
		(70.9)		150.403			(81.2)	456.625
Poorer	18730	13314	5417(28.9)	(<0.001)	17742	3813(21.5)	13929	(<0.001)
	(20.9)	(71.1)			(20.9)		(78.5)	
Middle	18268	12776	5492(30.1)		17234	3766(21.9)	13468	
	(20.4)	(69.9)			(20.3)		(78.1)	
Richer	17385	12613	4772(27.4)		16431	4057(24.7)	12374	
	(19.4)	(72.6)			(19.4)		(75.3)	
Richest	15444	11651	3793(24.6)		14752	4129(28.0)	10622	
	(17.3)	(75.4)			(17.4)		(72.0)	
Age at 1st birth (years)								
Less than 17	20197	13175	7022(34.8)	748.435	19087	4480(23.5)	14607	10.582
	(22.6)	(65.2)		(<0.001)	(22.5)		(76.5)	(0.005)
18–20	31897	22725	9171(28.8)		29981	6659(22.2)	23322	
	(35.6)	(71.2)			(35.3)		(77.8)	
21 or higher	37420	28407	9013(24.1)		35759	8134(22.7)	27625	
	(41.8)	(75.9)			(42.2)		(77.3)	
Mother currently working								
No	72432	50784	21649	560.583	70099	16092	54007	12.751
	(80.9)	(70.1)	(29.9)	(<0.001)	(82.6)	(23.0)	(77.0)	(<0.001)
Yes	17081	13523	3558(20.8)		14728	3181(21.6)	11546	
	(19.1)	(79.2)			(17.4)		(78.4)	
Father's Educational Level								
No education	28644(32)	16862	11782		27937	5999(21.5)	21938	
		(58.9)	(41.1)	3654.11	(32.9)		(78.5)	63.771
Primary	15153	11223	3930(25.9)	(<0.001)	14062	3269(23.2)	10793	(<0.001)
	(16.9)	(74.1)			(16.6)		(76.8)	
Secondary	34037(38)	26969	7068(20.8)		31939	7265(22.7)	24674	
		(79.2)			(37.7)		(77.3)	
Higher	11679(13)	9252(79.1)	2427(20.9)		10889	2739(25.2)	8149(74.8)	
					(12.8)			
Father's occupation								
Currently unemployed	517(0.6)	368(71.2)	149(28.8)		375(0.4)	69(18.4)	306(81.6)	
Manual worker	10901	5992(55.0)	4909(45.0)	5925.68	10901	3180(29.2)	7721(70.8)	300.126
	(12.2)			(<0.001)	(12.9)			(<0.001)
Agriculture/Self-employed	9207(10.3)	4212(45.7)	4995(54.3)		9207(10.9)	2047(22.2)	7160(77.8)	
Professional/Technical/ Managerial	68889(77)	53735 (78.0)	15154 (22.0)		64344 (75.9)	13977 (21.7)	50367 (78.3)	
Birth order number								

(*continued on next page*)

Table 1 (*continued*)

Socio-demographic factors	Received first dose of measles vaccine N (%)	Yes, n (%)*	No, n (%)*	Chi-square value (p-value)	Received second dose of measles vaccine N (%)	Yes, n (%)*	No, n (%)*	Chi-square value (p-value)
	Overall (N = 89513)				Overall (N = 84827)			
1	26697 (29.8)	20850 (78.1)	5847(21.9)	1690.84 (<0.001)	24908 (29.4)	5722(23.0)	19186 (77.0)	8.926 (0.012)
2–3	37705 (42.1)	27790 (73.7)	9915(26.3)		35599(42)	7911(22.2)	27687 (77.8)	
Greater than 3	25111 (28.1)	15666 (62.4)	9445(37.6)		24320 (28.7)	5639(23.2)	18681 (76.8)	
Sex of child								
Male	46203 (51.6)	33278 (72.0)	12924 (28.0)	1.642 (0.200)	43736 (51.6)	10050 (23.0)	33686 (77.0)	3.434 (0.064)
Female	43311 (48.4)	31028 (71.6)	12282 (28.4)		41091 (48.4)	9223(22.4)	31868 (77.6)	
Antenatal Visit								
No visit	10206 (11.4)	4886(47.9)	5320(52.1)	3471.07 (<0.001)	9991(11.8)	1706(17.1)	8286(82.9)	286.393 (<0.001)
Up to 4 visit	59344 (66.3)	43686 (73.6)	15658 (26.4)		56332 (66.4)	12780 (22.7)	43553 (77.3)	
More than 4 visit	19963 (22.3)	15735 (78.8)	4228(21.2)		18504 (21.8)	4788(25.9)	13716 (74.1)	
Postnatal visit								
No	65172 (72.8)	46428 (71.2)	18744 (28.8)	42.787 (<0.001)	61861 (72.9)	13484 (21.8)	48377 (78.2)	110.889 (<0.001)
Yes	24342 (27.2)	17879 (73.4)	6463(26.6)		22966 (27.1)	5789(25.2)	17177 (74.8)	
Permission to visit healthcare alone								
No problem	19912 (22.2)	17354 (87.2)	2558(12.8)	3871.36 (<0.001)	19912 (23.5)	3690(18.5)	16222 (81.5)	282.393 (<0.001)
Big problem	26362 (29.5)	16054 (60.9)	10308 (39.1)		24985 (29.5)	5752(23.0)	19233 (77.0)	
Not a big problem	43240 (48.3)	30899 (71.5)	12341 (28.5)		39930 (47.1)	9831(24.6)	30099 (75.4)	
Distance to health facility								
Near	13046 (14.6)	11384 (87.3)	1662(12.7)	2768.66 (<0.001)	13046 (15.4)	2476(19.0)	10570 (81.0)	142.420 (<0.001)
Remote	41101 (45.9)	26511 (64.5)	14590 (35.5)		38295 (45.1)	8714(22.8)	29581 (77.2)	
Not so far	35366 (39.5)	26412 (74.7)	8954(25.3)		33485 (39.5)	8083(24.1)	25402 (75.9)	
Media exposure								
No	28016 (31.3)	18743 (66.9)	9273(33.1)	491.910 (<0.001)	26876 (31.7)	5374(20.0)	21502 (80.0)	166.355 (<0.001)
Yes	61497 (68.7)	45564 (74.1)	15933 (25.9)		57951 (68.3)	13899 (24.0)	44052 (76.0)	

*Percentages (%) were calculated horizontally (row directions).

Our study revealed that maternal age, parental education, wealth index, antenatal visit, postnatal visit, mother's permission to visit healthcare alone are significantly associated with higher vaccination rates among children in South Asia; these findings are consistent with a previous study (Acharya et al., 2022; Sarker et al., 2019a). From bivariate analysis, we found that MCV1 coverage was lower among children residing in rural areas, which aligns with an earlier study conducted among children in low-middle-income countries (Sbarra et al., 2020). However, in our study, sex of child does not affect MCV1 and MCV2 uptake among South Asian children who are under 5. Parents who have 1–2 children are more careful about the first dose of measles and likely to be less concerned about measles-2 vaccination, aligning with previous findings (Atteraya et al., 2023). A study carried out in Nepal discovered that maternal education and household income were strongly associated with full vaccination coverage among children (Fenta et al., 2021). Moreover, studies in Bangladesh and Pakistan revealed that child immunization was significantly associated with higher levels of maternal education (Bugvi et al., 2014; Jahan et al., 2020). A possible explanation is that a higher level of education may enhance a mother's understanding of the importance of routine immunization for their children.

Our study showed that children who live near healthcare facilities have a higher chance of getting MCV1, which aligns with a study conducted in Ethiopia (Mihret Fetene et al., 2023). Access to nearby health facilities is particularly crucial in rural and remote areas, where reaching the distant health facility could be challenging (Jamal et al., 2020; Song et al., 2020). Moreover, the main obstacles arise in remote places due to frequent electricity shortages and issues maintaining vaccine temperature, making it difficult for impoverished people to obtain routine immunizations (Songane, 2018). Media access has a positive impact on measles vaccination uptake for both MCV1 and MCV2. Previous studies also indicated that media access plays a vital role in increasing awareness regarding vaccination among parents (Adisu et al., 2024; Sohn et al., 2018). Other studies have also shown the impact of social networks and community effects on vaccination decisions (Brunson, 2013; Rodrigues et al., 2023).

5. Strengths and limitations of the study

The study of measles vaccination uptake in South Asian countries may provide insights that are applicable to other regions with similar socio-economic and cultural characteristics. However, the limitation of this study could be the possible consequences of sampling bias. Furthermore, the data for the second dose of the measles vaccine was not

Table 2
Binary Logistic Regression to identify factors associated with the first and second doses of measles vaccination among children under five from the South Asian DHS datasets (pooled) between 2015 and 2021.

Variables	First dose of measles vaccination				Second dose of measles vaccination			
	p-value	AOR1	95 % CI		p-value	AOR2	95 % CI	
			Lower	Upper			Lower	Upper
Maternal age (years)								
15–19 (Ref)	–	–	–	–	–	–	–	–
20–25	0.000*	2.58	2.38	2.81	0.000*	1.33	1.20	1.47
More than 25	0.000*	5.55	5.06	6.09	0.000*	1.36	1.22	1.51
Residence								
Urban (Ref)	–	–	–	–	–	–	–	–
Rural	0.548	1.01	0.97	1.06	0.182	1.03	0.98	1.07
Maternal educational level								
No education (Ref)	–	–	–	–	–	–	–	–
Primary	0.000*	1.63	1.55	1.72	0.000*	1.15	1.09	1.21
Secondary	0.000*	1.82	1.73	1.91	0.000*	1.05	1.004	1.11
Higher	0.000*	1.77	1.64	1.92	0.136	1.05	0.98	1.14
Number of children								
1–2 (Ref)	–	–	–	–	–	–	–	–
3 or higher	0.000*	0.67	0.65	0.70	0.870	1.00	0.96	1.04
Household head								
Male (Ref)	–	–	–	–	–	–	–	–
Female	0.000*	1.16	1.09	1.23	0.000*	0.93	0.88	0.98
Wealth index								
Poorest (Ref)	–	–	–	–	–	–	–	–
Poorer	0.000*	0.91	0.87	0.95	0.000*	1.12	1.07	1.19
Middle	0.000*	0.83	0.79	0.87	0.000*	1.11	1.05	1.17
Richer	0.000*	0.82	0.77	0.86	0.000*	1.26	1.19	1.34
Richest	0.000*	0.78	0.73	0.84	0.000*	1.45	1.36	1.56
Age at 1st birth (years)								
Less than 17 (Ref)	–	–	–	–	–	–	–	–
18–20	0.000*	0.87	0.83	0.91	0.000*	0.92	0.88	0.96
21 or higher	0.000*	0.71	0.68	0.75	0.000*	0.89	0.85	0.94
Mother currently working								
No (Ref)	–	–	–	–	–	–	–	–
Yes	0.000*	1.32	1.26	1.38	0.000*	0.92	0.88	0.96
Father's educational level								
No education (Ref)	–	–	–	–	–	–	–	–
Primary	0.000*	1.24	1.18	1.30	0.000*	1.11	1.05	1.16
Secondary	0.000*	1.29	1.23	1.35	0.000*	1.10	1.05	1.15
Higher	0.000*	1.07	1.003	1.14	0.000*	1.15	1.07	1.23
Father's occupation								
Currently unemployed (Ref)	–	–	–	–	–	–	–	–
Manual worker	0.000*	0.77	0.63	0.95	0.000*	2.00	1.53	2.62
Agriculture/Self-employed	0.000*	0.58	0.47	0.71	0.000*	1.64	1.25	2.15
Professional/Technical/Managerial	0.206	1.13	0.93	1.39	0.056	1.29	0.99	1.68
Birth order number								
1 (Ref)	–	–	–	–	–	–	–	–
2–3	0.000*	0.65	0.62	0.68	0.000*	0.92	0.88	0.97
Greater than 3	0.000*	0.46	0.43	0.49	0.577	0.98	0.92	1.04
Sex of child								
Male (Ref)	–	–	–	–	–	–	–	–
Female	0.116	0.97	0.94	1.00	0.097	0.97	0.94	1.00
Antenatal visit								
No visit (Ref)	–	–	–	–	–	–	–	–
Up to 4 visits	0.000*	1.95	1.86	2.04	0.000*	1.50	1.41	1.59
More than 4 visits	0.000*	1.63	1.54	1.74	0.000*	1.76	1.65	1.89
Postnatal visit								
No (Ref)	–	–	–	–	–	–	–	–
Yes	0.000*	0.74	0.71	0.77	0.000*	1.21	1.17	1.26
Permission to visit healthcare alone								
No problem (Ref)	–	–	–	–	–	–	–	–
Big problem	0.000*	0.56	0.52	0.60	0.000*	1.34	1.26	1.43
Not a big problem	0.000*	0.60	0.57	0.64	0.000*	1.36	1.28	1.44
Distance to health facility								
Near (Ref)	–	–	–	–	–	–	–	–
Remote	0.000*	0.78	0.72	0.84	0.000*	1.07	1.009	1.15
Not so far	0.000*	0.84	0.78	0.90	0.000*	1.10	1.03	1.17
Media exposure								
No (Ref)	–	–	–	–	–	–	–	–
Yes	0.000*	1.06	1.02	1.10	0.000*	1.07	1.02	1.11

*Significant at <0.05; **AOR** adjusted odds ratio; **CI** confidence interval.

available in the DHS Nepal dataset. So, we excluded Nepal from the analysis of measles-2 uptake.

6. Conclusions

The completion of two doses of the measles vaccine is comparatively low; according to the findings, the majority of mothers are likely to bring their child for the first dose of measles vaccine. Maternal age, ANC visit, PNC visit, parental education and occupation, and wealth quintile as the factors influencing child's measles vaccination status. This research showed that children from deprived communities are less likely to receive the second dose. Socio-economic disparities in the uptake of the two doses of measles vaccine (MCV2) can be increased by improving maternal health facilities, enhancing education, and addressing wealth inequality. Despite being close to healthcare facilities, many mothers choose to leave their children unprotected by failing to comply with a complete dose of measles vaccination. There is a need for organized efforts to identify the gaps in the expanded program on measles vaccination coverage and to reduce the missed vaccinations in all healthcare facilities throughout the South Asian region. Overall, awareness among parents regarding the full doses of measles vaccination needs to be increased through mass media and health personnel in the South Asian region, specifically in comparatively underdeveloped countries.

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CRediT authorship contribution statement

Maliha Mahazabin: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Nazia Tabassum:** Writing – review & editing, Writing – original draft, Methodology, Data curation, Conceptualization. **S.M. Khalid Syfullah:** Writing – original draft, Methodology, Data curation, Conceptualization. **Uttam Kumar Majumder:** Writing – review & editing, Methodology, Investigation, Conceptualization. **Md Akhtarul Islam:** Writing – review & editing, Investigation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

http://www.dhsprogram.com

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Ethics declarations

The data was assessed through the DHS program (http://www.dhsprogram.com) via an online request. The website and the utilized data were openly accessible and free of any personal identifiers. The DHS has strict requirements for obtaining participants' informed consent and ensuring the confidentiality of their identities.

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