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Original Research Article

Determinants of measles-rubella vaccine second dose uptake among 24 to 35 month-old children in Wajir Town, Kenya

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ABSTRACT

Background: Two vaccine doses can prevent measles and rubella (MR2); achieving ≥95% coverage is crucial for effective population immunity. Low MR2 uptake is linked to increased measles outbreaks. With only 57.1% MR2 uptake, Kenya reported 1,775 measles cases in 2021. This study evaluates MR2 uptake and its determinants among 24-35-month-old children in Wajir town.
Methods: A cross-sectional design was employed using cluster sampling in Wajir town, Wajir East sub-county, in December 2023. Parents of 399 children aged 24-35 months were interviewed using a pretested and predesigned questionnaire. Data was analyzed in SPSS V27. Socio-demographic characteristics were summarized in proportions. COR, aOR, and 95% Confidence Intervals measured association and significance. The analysis was two-tailed with a significance level set at $p<0.05$.
Results: The study included 399 children with a median age of 25 months (interquartile range 24-29). MR2 uptake was 49.6%. Statistically significant predictors of MR2 uptake were parents' or guardians' occupation (aOR 2.85, 95% CI=1.18, 6.87, p=0.020), knowledge of the number of measles vaccines (aOR 16.05, 95% CI=4.16, 62.87, $p<0.001$), and the child's gender (aOR 3.9, 95% CI=1.81, 7.86, $p<0.001$). Inadequate awareness about MR2 was the primary reason for not vaccinating children.
Conclusions: MR2 uptake was low compared to the WHO-recommended target of ≥95%. The parents' occupation, knowledge of the vaccine schedule, and the child's gender determined MR2 uptake. The Wajir County Department of Health should carry out targeted knowledge-creation for parents/guardians and gender-aligned advocacy to improve MR2 uptake.

Keywords: Measles, Rubella, Uptake, Wajir, Kenya

INTRODUCTION

Measles is highly contagious, causing fever, rash, and severe complications like blindness and encephalitis mainly in children. It spreads to 90% of susceptible people. Two combined vaccine doses prevent measles. Rubella, preventable by vaccination, risks miscarriage and congenital rubella syndrome (CRS) in pregnant women, causing birth defects like heart and vision problems.[1]

From 2000-2022, measles vaccinations prevented 57 million deaths. The COVID-19 pandemic disrupted efforts, causing an 18% rise in cases and 43% more deaths in 2022, with outbreaks in 37 countries.[2] Despite progress, inadequate commitment and resources hinder the full implementation of measles vaccination programs globally.[3]

WHO recommends two doses of measles-containing vaccine to achieve 95% global coverage for herd

immunity and elimination.[4] Despite the global efforts to control and eradicate measles, the disease continues to claim lives, resulting in over 207,500 deaths worldwide in 2019.[5] There were 205,101 measles cases globally, with 97,185 in Africa and 1,775 in Kenya. For rubella, there were 10,029 cases globally, 3,880 in Africa, and 33 in Kenya. In 2021, measles-rubella second dose coverage was 74% globally, 45% in Africa, and 57.1% in Kenya. Kenya reported no CRS cases that year.[6,7] In April 2017, WHO advised nations to include MCV2 in immunization schedules, regardless of MCV1 coverage levels, updating its measles vaccine plan.[8]

Kenya added the second measles-rubella vaccine dose to its routine immunization in 2013 and conducted mass campaigns in 2016 and 2021. Despite these efforts, measles outbreaks persist. Studies conducted in other counties in Kenya showed low MR2 uptake rates (56.2% and 51.1%) and identified various factors influencing uptake, with urban and rural areas exhibiting differing influences on vaccine uptake.[9,10]

Wajir town has faced recurrent measles outbreaks recently, with little known about MR2 uptake and its determinants. This study evaluated MR2 uptake, examining household, child, and health facility factors. Recommendations will help the Wajir County department of health address challenges, improve MR2 uptake, prevent outbreaks, and develop population immunity.

METHODS

Study design, period and area

A cross-sectional community-based study was conducted in December 2023 among children aged 24 to 35 months in Wajir town. This study would offer insight into Wajir town's MR2 uptake and associated determinants.

Wajir has 58 villages in Wajir town, with an estimated population of 96,116, including 9,341 children aged 24 to 35 months.[11] The town serves as a major trading center, hosting an international airport with connections to Somalia, a measles-endemic country.[12] Low MR2 uptake contributed to a recent measles outbreak in Wajir. The town has ten primary public health facilities and three private hospitals, but only public facilities offer immunizations.

Inclusion and exclusion criteria

The study included 9,341 eligible children aged 24-35 months, whose parents or guardians consented to provide MR2 vaccination information. Seven key informants: County EPI Coordinator, Wajir East Sub-County public health Nurse, and five facility in-charges were also interviewed to provide MR2 information.

Eligible children were excluded from the study if their parents had settled in the enumerated village within the past six months or if their parents were ill or mentally impaired.

Sample size determination

Kenya's MR2 of 57.1% in 2021 was used to determine the sample size[13]. In estimating the sample size, a 95% confidence interval, and a 57.1%, proportion of MR2 coverage in Kenya in 2021 was used, p=0.571, q=(1-p)=0.429, z=1.96, desired level of precision e=0.05 using Cochran (1977) the sample size was $n=(1.96)^2(0.571)(0.429)/0.05^2=376$, after Cochran's correction formula for population less than was less than 10, 000 and 10% withdrawal and non-respondents the sample size was 399.[13]

Sampling procedure

Cluster sampling was utilized, with villages serving as clusters. Initially, a list of 58 villages along with their eligible children was compiled. Following WHO guidelines, 30 villages were randomly selected using a random table.[14] The number of eligible children per village was determined through probability proportionate to size (Figure 1). Systematic sampling with a household interval of 38 and a bottle-spinning method for direction were used. Absent caregivers were replaced until the required sample size was achieved.

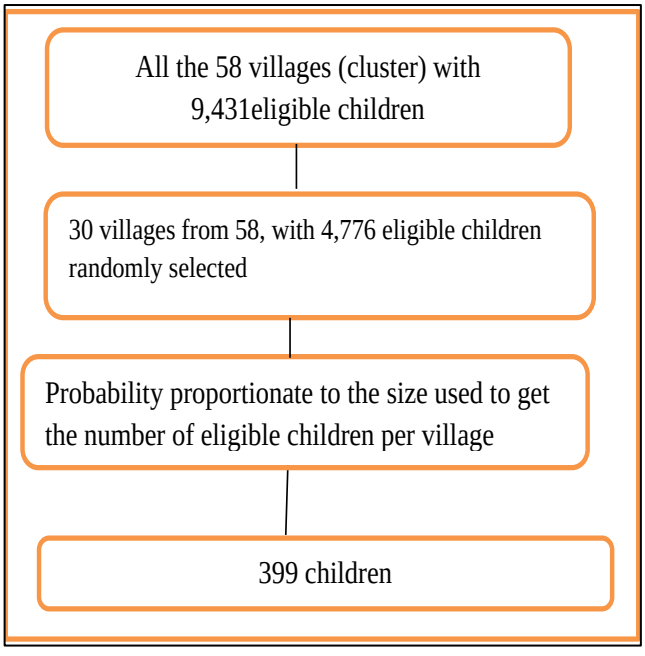

Figure 1: Schematic representation of sampling.

Data collection procedures

A structured questionnaire was designed Open data kit covering demographics, vaccination history, and vaccine accessibility. Four public health officers and a nurse collected data. A key informant guide was also developed and administered by the principal investigator.

Data quality control

Data quality was ensured through careful questionnaire design, adequate enumerator training and supervision, and pretesting, which achieved a Cronbach's score of 0.78, above the acceptable 0.7.

Data processing and analysis

Data were exported to MS excel, cleaned, coded, and then analyzed using SPSS ver 27. Variables were summarized, and logistic regression analyses were conducted to assess associations between dependent variable and predictors, using Crude odds ratio (COR) and adjusted odds ratio (aOR) with 95% CI. Significance level was set at p<0.05.

Ethical consideration

The Amref international university ethical review and scientific committee (ESRC), the national commission for science, technology, and innovation (NACOSTI), and the Wajir County research directorate granted study permission. Parents or guardians who consented to participate in the study were recruited and the key informants signed a consent form

RESULTS

Characteristics of the respondents

The study achieved a 100% response rate (n=399). The respondents' median age 30 years (IQR 25-33), indicating homogeneous distribution. Among respondents, 356 (89%) were married, 392 (98.2%) practiced Islam, and 1.8% practiced Christianity. Additionally, 243 (60.9%) were unemployed, 323 (81.6%) had >2 children, 336 (84.2%) had no formal education, and 201 (50.4%) had a monthly income above Ksh 20,000 (Table 1).

Approximately 252 (63%) of respondents received information about MR2 from health workers, and 251 (62%) were aware of the MR2 vaccination. Just over 50% knew the appropriate age for MR2 vaccination, while 233 (58.4%) knew number of doses. Additionally, 342 (85%) were informed about MR2's side effects, 293 (73%) knew diseases it prevents, and 360 (80%) were aware of complications for unimmunized children (Table 1).

A key informant said, "*A major discrepancy in adherence to the MR2 schedule, mothers typically adhere strictly to the MR1 schedule but may not be fully aware of or informed about the importance of completing the MR2 vaccination series".*

MR2 uptake among children aged 24-35 months

In the study, 49.6% (95% CI=44.6-54.4) of 399 children received the second measles-rubella vaccine dose.

Household-related factors associated with MR2 uptake

The Bivariate analysis revealed several influential factors in MR2 uptake, including parents or guardians' age (COR 1.56, 95% CI: 1.045-2.316, p<0.029), type of occupation (COR 6.0, 95% CI: 3.66-9.8, p<0.001), monthly household income (COR 2.5, 95% CI: 1.7-3.71, p<0.001), and number of children in the household (COR 2.23, 95% CI: 1.32-3.81, p<0.003). Factors such as the source of information (COR 80.0, 95% CI: 36.7-174.6, p<0.001) and MR2 awareness (COR 0.004, 95% CI: 0.001-0.016, p<0.001) also significantly influenced MR2 uptake. Moreover, knowledge of measles-rubella vaccine age eligibility, awareness of the number of doses required, understanding of vaccine side effects and measles complications, and awareness of diseases prevented by the vaccine were all associated with outcome (Table 2).

Characteristics of children involved in the study

Of 399 surveyed children, 320 (57.6 %) were male. The median age of children was 25 months (interquartile range 24 to 29 months). Those with a second or higher birth rank accounted for 273 (68.4%).

At bivariate analysis, the child's gender (COR 2.1, 95% CI=1.4, 3.15, p<0.001) predicts MR2 uptake, with male children having twice the odds of receiving MR2, as shown in Table 3.

Health facility related-characteristics

Approximately 295 respondents (74%) primarily walked to healthcare facilities. About half of the respondents, 202 people (50.6%), spent over 30 minutes traveling to these facilities. Additionally, nearly 365 respondents (91%) delivered at health facilities. Health facility-related determinants significantly influencing MR2 uptake in bivariate analysis included mode of transport (COR 3.85, 95% CI: 2.36-6.29, p<0.001), time taken to reach the facility (COR 3.35, 95% CI: 2.22-5.05, p<0.001), and place of delivery (COR 3.5, 95% CI: 1.56-8.0, p=0.003) (Table 4).

Table 1: Characteristics of respondents (n=399).

Variables	Categories	N (%)
Relationship to child	Mother	383 (96.0)
	Guardian	16 (4.0)
Mother/ guardian age (in years)	≤30	22 (55.5)
	>30	177 (44.5)

Continued.

Variables	Categories	N (%)
Marital status	Married	356 (89.2)
	Not married	43 (10.8)
Religion	Islam	392 (98.0)
	Christianity	7 (2.0)
Education level	No formal education	336 (84.2)
	Primary and above	63 (15.8)
Number of children	≤2	72 (18.4)
	>2	323 (81.6)
Occupation	Employed	156 (39.1)
	Unemployed	243 (60.9)
Household income	Ksh ≤20,000	198 (49.6)
	Ksh >20,000	201 (50.4)
Source of MR2 information	Health worker	252 (63.2)
	Never heard	147 (36.8)
MR2 awareness	Yes	251 (62.9)
	No	148 (37.1)
Knowing the age at which MR2 is given to a child	Yes	236 (59.1)
	No	163 (40.9)
Knowing the number of MR vaccines given to children	Yes	233 (58.4)
	No	166 (41.6)
Knowing the side effects of the MR2 vaccine	Yes	342 (85.7)
	No	57 (14.3)
Knowing the diseases MR2 vaccine prevent	Yes	293 (73.4)
	No	106 (26.6)
Knowing the complications of measles for unimmunized child	Yes	360 (80.2)
	No	39 (9.8)

Table 2: Household factors associated with MR2 uptake (n=399).

Variables	Categories	MR2 status (%)		COR (95% CI)	P value
		Yes	No		
Relationship to child	Mother, (n=383)	68.9	31.1	1.73 (0.62, 4.85)	0.298
	Guardian, (n=16)	37.5	62.5		
Mother/ guardian age (in years)	≤30 (n=222)	54.5	45.5	1.56 (1.045, 2.316)	0.029
	>30 (n=177)	43.5	56.5		
Marital status	Married (n=356)	50.6	49.4	1.42 (0.75, 2.67)	0.283
	Not married (n=43)	41.9	58.1		
Religion	Islam (n=392)	49.1	50.9	6 (0.075, 54.3)	0.091
	Christianity (n=7)	85.7	14.3		
Education level	No formal (n=336)	49.1	50.9	6.0 (3.83, 9.41)	0.633
	Primary and above (n=63)	52.4	47.6		
Occupation	Employed (n=156)	75.0	25.0	6.0 (3.66, 9.8)**	<0.001
	Unemployed (n=243)	33.7	66.3		
Household income (Monthly)	Ksh≤20,000 (n=198)	38.4	61.6	2.5 (1.7-3.71)**	<0.001
	Ksh>20,000 (n=201)	60.7	39.3		
No. of children	≤2 (n=73)	65.8	34.2	2.23 (1.32-3.81)	0.003
	>2 (n=326)	46.3	53.7		
Source of MR2 information	Health worker (n=252)	77.8	22.2	80.0 (36.7, 174.6)**	<0.001
	Never heard (n=147)	1.4	98.6		
MR2 awareness	Yes (n=251)	78.1	21.9	0.004 (0.001, 0.016)**	<0.001
	No (n=148)	1.3	98.7		
Knowing age MR2 is given to a child	Yes (n=236)	82.6	17.4	80.0 (24.9, 257.3**	<0.001
	No (n=163)	4.9	95.1		
Knowing no. of MR vaccines for children	Yes (n=233)	82.4	17.6	124.9 (51.7, 301.7)**	<0.001
	No (n=166)	3.6	96.4		
Knowing diseases MR2 vaccine prevent	Yes (n=293)	63.8	36.2	15.2 (7.8, 29.7)**	<0.001
	No (n=(106)	10.4	89.6		

**Statistically significant.

Table 3: Child-related characteristics associated with MR2 uptake (n=399).

Variables	Categories	N (%)	MR2 status (%)		COR (95% CI)	P value
			Yes	No		
Child's age (in months)	≤30 (n=320)	320 (80.2)	50.9	49.1	1.3 (0.78, 2.26)	0.301
	>30 (n=79)	79 (19.8)	44.3	55.7		
Child's gender	Male (n=230	230 (57.6)	57.4	42.6	2.1 (1.40, 3.15)**	<0.001
	Female (n=169)	169 (42.4)	39.1	60.9		
MR1 status	Vaccinated (n=398)	9398 (9.7)	49.7	50.3	-	-
	Unvaccinated (n=1)	1 (0.3)	0	100		
Child's birth	Birth rank ≤2 (n=126)	126 (31.6)	52.3	47.7	1.2 (0.81, 1.88)	0.336
	Birth rank >2 (n=273)	273 (68.4)	48	52		

**Statistically significant.

Table 4: Health facility-related factors associated with MR2 uptake (n=399).

Variables	Categories	N (%)	MR2 status (%)		COR (95% CI)	P value
			Yes	No		
Mode of transport to health facility	Walking n=295)	295 (73.9)	41.4	58.6	3.85 (2.36, 6.29)**	<0.001
	Other means (n=104)	104 (26.1)	73.1	26.9		
Time taken to reach health facility	<30 minutes (n=197)	197 (49.4)	64.5	35.5	3.35 (2.22, 5.05)	<0.001
	≥30 minutes (n=202)	202 (50.6)	35.2	64.8		
Place of delivery	Health facility (n=365)	365 (91.5)	48.0	52.0	3.5 (1.56, 8.0)**	0.003
	Home (n=34)	43 (8.5)	76.5	23.5		

**Statistically significant.

Determinants of MR2 uptake

The study identified parents' or guardians' occupation (aOR 2.85, 95%CI: 1.18-6.87), knowledge of the number of scheduled measles vaccines (aOR 19.35, 95%CI: 4.16-62.87), and child's gender (aOR 3.9, 95%CI: 1.81-7.86) as statistically significant determinants of MR2 uptake (Table 5).

Table 5: Determinants of MR2 uptake among children in Wajir.

Variables	AOR	95% CI	P value
Parents/guardians occupation	2.85	1.18, 6.87	0.020
Parents/guardians' knowledge of number of MR vaccines given to children	16.05	4.16, 62.87	<0.001
Child's gender	3.77	1.81, 7.86	<0.001

DISCUSSION

Study aimed to determine MR2 (measles-rubella second dose) uptake and its determinants in Wajir town, Wajir East Sub-County, Wajir County. Uptake rate was 49.6%, indicating that 50.4% of children not fully immunized. Key determinants included parents' occupation, awareness of vaccine schedules and child's gender.

The MR2 uptake was below the WHO target of 95% for measles elimination but is comparable to the regional average of 41% in Sub-Saharan Africa. This low uptake aligns with the 2022 global, regional, and national MR2 coverages of 74%, 45%, and 56%, respectively, but similar to 48.1% in Jabitehnan district, Ethiopia, and lower than 59.6% in Cherangany Sub-county, Kenya.[9,16,17] The sub-optimal MR2 coverage in Wajir may have contributed to the recent measles outbreaks, emphasizing the need for sustained immunization efforts to achieve herd immunity.

Parents' occupations significantly influenced MR2 uptake. Employed parents were more likely to vaccinate their children, with an adjusted odd ratio (AOR) of 2.85 (95% CI: 1.18, 6.87, p=0.020). This finding is consistent with other studies that linked employment to higher vaccination rates, as employed parents may have better access to information and resources. Conversely, unemployed parents prioritize daily subsistence over immunization, leading to lower uptake. Neufeind et al found that parents with low socioeconomic status are less informed about vaccines and less likely to vaccinate.[17] This contradicts Ilesanmi et al, who noted that working parents struggle to balance work and vaccination schedules, highlighting the need for flexible, accessible vaccination services.[18]

Knowledge of the vaccine schedule was another crucial determinant. Children whose parents knew the required MR2 dose were significantly more likely to vaccinate their children (AOR 16, 95% CI: 4.16-62.87). Studies acknowledged that well-informed parents are more likely to immunize their children, underscoring the importance of health education and effective communication strategies.[19-21]

Child gender also influenced MR2 uptake, with males being twice as likely vaccinated as females (AOR 3.77, 95% CI: 1.81-7.86, p<0.001). This disparity may be attributed to cultural perceptions and biases that prioritize male health over female health, reflecting broader issues of gender inequality in healthcare access. Similar findings from Nigeria and India that parents assume immunization might affect their daughters when they reach childbearing age.[22,23] However, contrary findings found in Somali immigrants in Norway that male children are less likely to get the measles vaccine for fear of autism.[24]

One limitation of our study was the potential for recall and response bias from parents or guardians, which we mitigated by using documented information in the mother-child immunization booklet, verifying the site of injection, and employing trained interviewers with a standardized questionnaire.

CONCLUSION

The study found that MR2 uptake in Wajir town is significantly below the WHO target of 95%, contributing to recent measles outbreaks and highlighting the need for sustained, targeted MR2 immunization awareness and knowledge-creation efforts to improve uptake.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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