# Factors Associated with Measles- Rubella Vaccine Second Dose Uptake among Children Aged 19-59 Months at Mwingi Central Sub County

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## Abstract

**INTRODUCTION**

**Measles has been among the many vaccine-preventable diseases, and it remains a significant public health concern in Kenya. Immunization coverage is the most common indicator used to evaluate the performance of immunization services. This study aimed to assess the factors influencing measles-rubella second dose uptake among children aged 19-59 months in Mwingi Central sub-County.**

**MATERIALS AND METHODS**

**We used a descriptive cross-sectional study design and recruited 380 mothers using stratified proportionate sampling. We later selected children who received the first dose of the Measles-rubella vaccine in 2020 by simple random sampling. We used a semi-structured questionnaire for data collection.**

**RESULTS**

**The measles-rubella uptake was 68.9% (262/380), while the different age groups of the mothers had the following uptake: 15-19 years, 20-24 years, 25-29 years, 30-34 years, 35-39 years and above 40 years were 60% (95% CI: 26.24% - 87.84%), 63.8% (95% CI 48.52% - 77.33%), 73.6% (95% CI: 65.16% - 81.01%), 70.1% (95% CI 60.93%-78.20%), 68.6% (95% CI 54.11%-80.89%) and 53.8% (95% CI 33.37%-73.41%) respectively. Client-related determinants were significantly associated with the mother's residence, employment status, religion, knowledge of the measles vaccination schedule and on the uptake of the second dose of the measles-rubella vaccine (P-value < 0.05). Facility-related determinants showed a significant association between distance from households, the facility always being open and the uptake of the second dose of the measles-rubella vaccine for children between 19 -59 months (p-value < 0.05).**

**CONCLUSION**

**The measles-rubella vaccine uptake was above average (68.9%), and uptake of the second dose was significantly associated with client-level and facility-related factors. The authors recommend that the Mwingi central sub-county health management team ensure the education of the population of its catchment area on the measles-rubella second dose vaccination schedule and that all immunizing health facilities are always open. Moreover, it should provision of outreach services for hard-to-reach communit**ies.

***Keywords****: Vaccines, Measles- Rubella Vaccine, Dose Uptake, Childhood vaccines*

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## Introduction

Though preventable by vaccination, measles and rubella remain a public health concern. Measles contributes significantly to the disease burden among children below five years (1), and rubella has severe consequences for pregnant women, like fetal death and congenital rubella syndrome (2). Measles alone resulted in 142000 deaths in 2018 globally, although this was a significant improvement from the 2.6 million deaths that occurred before the introduction of the measles vaccine in 1963 (4). Because of this vaccine, there has been a steady decrease in measles-related deaths globally over the last six decades. Sadly, this was only up to the year 2018 and late 2019, when the cases tripled in the first half of 2019 compared to the previous year, 2018 (4).

Even though the World Health Organization (WHO) included the vaccine in the list of essential health interventions, its uptake remains low, with varying levels across many countries (5). The WHO in the African region, aiming to eliminate measles, developed a strategic plan of targets to be achieved by 2020. The member countries adopted these targets and milestones and targeted to eliminate measles by 2020. Moreover, two countries of the regions also committed to eliminating rubella (5). However, progress has been slow. None of the WHO regions had met their targets by 2015 except for the Americas. The Americas eliminated the rubella virus in 2015 and the measles virus in 2016. The African region, however, has seen good progress, and the coverage of the measles-rubella vaccine increased from 56% to 85% in 2010 (4). However, the region has experienced measles outbreaks and stagnation in vaccine coverage. The outbreaks have been primarily because of armed conflicts in the region, causing disruptions in immunization activities and resistance from conservative religious groups (7).

The Kenyan government introduced the Measles-Rubella (MR) combined vaccine in 2016 to respond to the increase in rubella cases in Kenya (10). Of note is that literature has indicated that it is beneficial for children to receive two doses of the measles vaccine since it is rare for individuals vaccinated who receive the second dose to suffer from the disease (11–13). The uptake of the second dose is still low in several regions. Mwingi central sub-county has reported low measles-rubella second dose coverage of less than 50% since 2015, leading to an accumulation of susceptible children (14). Despite several combined measles-rubella vaccine campaigns in Kenya, the coverage is still low (15). Therefore, this study aimed to assess the factors influencing measles-rubella vaccine second dose uptake among children aged 19-59 months in Mwingi central sub-county.

## Materials and Methods

### *Study design and population*

The study employed a descriptive cross-sectional design. The researcher obtained client-related and facility-related factors associated with immunization uptake at Mwingi Central Sub-county. The target population was all caretakers in Mwingi central sub-county who had children aged less than five years.

The study population was all caretakers with children aged 19-59 months at Mwingi central Sub-county who received the first dose of measles-rubella in 2020. We included caretakers with children aged 19-59 at Mwingi central Sub-county who received the first dose of Measles-rubella in 2020. The excluded were caretakers with children aged 19-59 months who did not receive the first dose of measles-rubella vaccination or those who declined to participate in the study.

## *Study Area*

We conducted the study in the Mwingi Central sub-county, with an estimated population of 166,238. Children younger than five years were 19,291, and those aged 19-59 months were 13,504. It is one of eight Sub County in Kitui County.

## *Sample size*

In this study, the researchers used a 95% confidence level to balance type one and type two errors. The researcher also used a significance level of 5%. He then determined the sample size using a formula designed by Fisher (1998).

n= z^2 p (1-p)/ d^2

Z was the z value for the corresponding confidence level (1.96 for 95% confidence);

d was the significance level (i.e 0.05= or + 5%)

p was the estimated value for the proportion of a sample that has the condition of interest (45.1% as per DHIS (2020)

n = 1.96^2 p (1-p) / 0.05^2

n= 1.96^2X 0.451(1-0.451) / 0.05^2

n= 380

## *Sampling Technique*

The researcher employed different sampling methods. First, we used stratified proportionate sampling to choose all six wards:- namely Central Ward, Kivou Ward, Mui Ward, Nguni Ward, Nuu Ward, and Waita Ward, in the sub-county to ensure full representation. Two health facilities from each ward were selected depending on their population size. Hence each health facility had a different sample size proportional to its catchment population. We selected participants using simple random sampling recruiting children who received the first dose of measles-rubella in 2020 in every health facility chosen. We obtained this information from the permanent registers of each facility. We reached the participants with the help of the facility-in-charges and the Community Health Volunteers (CHVs).

## *Study Variables.*

The independent variables were the child's birth order, additional children to mother, knowledge of the measles-rubella vaccination schedule, uptake of primary vaccines, fear of vaccine side effects, distance from the health facility, experience with health workers, vaccination waiting for time and health education given to mothers. Confounding variables were the mother's age, the caretaker's education level, and the place of residence. On the other hand, the dependent variable was the uptake of measles and rubella's second dose.

## *Data Collection and management*

We used a semi-structured questionnaire with both open and closed-ended questions. It had three sections: Section one contained sociodemographic factors, section two client-related questions, and section three contained facility-related factors. A 10% (38) sample size was involved in a pretest. We conducted the pretesting in the Kyoso ward in the Mwingi North sub-county and the Migwani ward in Mwingi west sub-county. Pretesting was done to determine the validity and reliability of the data collection tool and make the necessary corrections before the actual data collection. We edited the data, coded it and entered it into SPSS. We applied bivariate analysis and logistics regression.

## *Ethical considerations*

The researcher obtained ethical approval from the University of Eastern Africa, Baraton Ethics Review Committee. The National Commission for Science, Technology and Innovation issued a license to conduct this study. We conducted this study according to the requirements of the Helsinki declaration.

## Results

### *Sociodemographic characteristics*

The mean age of mothers sampled was 30.2079 with a standard deviation of 5.89588 and an age range of 15-52 years. Mothers whose children had received the second dose had a mean age of 30.6538 years (95% CI: 29.8377 – 31.4700), while mothers whose children did not receive the second dose had a mean age of 30.7273 years (95% CI: 28.5881 – 30.4141). (Table 1.).

In terms of the education level of the mothers, the majority (46.1%, 175) were primary school drop-outs, while those who did not attend school were a minor proportion of 3.7% (14) (Table 1.2).

Most of the participants resided in Nguthe ni ward, with 40.8% (155/380) of all mothers interviewed. A minority, 5% (19), were from the Muithe ward. In terms of employment status, about 52.1% (198) of the mothers were unemployed, while 29.5% (112) were self-employed, and only 18.4% (70) were employed (Table 1.2)

Finally, about 96.3% (366) of the mothers sampled were Christians, and those with no religion formed the most negligible proportion of 0.5% (2). Muslim mothers were 3.2% (12/380). (Table 1).

***Table 1:***
***Sociodemographic profile of study population at Mwingi Central sub-county, June 2022***

| Variable | Number of mothers sampled (N=380) | proportion |
|---|---|---|
| Age of the mother | | |
| 15 – 19 years | 10 | 2.6 % |
| 20 – 24 years | 47 | 12.4 % |
| 25 – 29 years | 129 | 33.9 % |
| 30 – 34 years | 117 | 30.8 % |
| 35 – 39 years | 51 | 13.4 % |
| Above 40 years | 26 | 6.8 % |
| Education level of the mother | | |
| Primary | 175 | 46.1 % |
| Secondary | 123 | 32.4 % |
| Tertiary | 68 | 17.9% |
| None | 14 | 3.7 % |
| Residence | | |
| Central Ward | 29 | 7.6 % |
| Kivou Ward | 41 | 10.8 % |
| Mui Ward | 19 | 5.0 % |
| Nguni Ward | 155 | 40.8 % |
| Nuu Ward | 36 | 9.5 % |
| Waita Ward | 100 | 26.3 % |
| Employment status of the mother | | |
| Employed | 70 | 18.4 % |
| Self-employed | 112 | 29.5 % |
| Not employed | 198 | 52.1 % |
| Religion | | |
| Christian | 366 | 96.3 % |
| Muslim | 12 | 3.2 % |
| None | 2 | 0.5 % |

## *Measles-rubella second dose uptake*

About 68.9% (262) of participants reported that their children had received the second dose of the measles-rubella vaccination. While 31.9% (118/380) mothers indicated that their children did not receive the second dose measles-rubella vaccination.

The measles-rubella routine second dose in Mwingi central sub-county was 68.9% as of June 2022. (Table 2).

***Table 2:***
***Measles-Rubella Second Dose Uptake in Mwingi Central Sub-County***

| Variable | Received second dose | Did not receive the second dose | Total |
|---|---|---|---|
| Age | | | |
| 15 – 19 years | 6 (60.0%) | 4 (40.0%) | 10 (100.0%) |
| 20 – 24 years | 30 (63.8%) | 17 (36.2%) | 47(100.0%) |
| 25 – 29 years | 95 (73.6%) | 34 (26.4%) | 129(100.0%) |
| 30 – 34 years | 82 (70.1%) | 35 (29.9%) | 117(100.0%) |
| 35 – 39 years | 35 (68.6%) | 16 (31.45) | 51(100.0%) |
| Above 40 years | 14 (53.8%) | 12 (46.2%) | 26(100.0%) |
| Education level of the mother | | | |
| Primary | 112 (64.0%) | 63 (36.0%) | 175 100.0%) |
| Secondary | 88 (71.5%) | 35 (28.5%) | 123 (100.0%) |
| Tertiary | 54 (79.4%) | 14 (20.6%) | 68 (100.0%) |
| None | 8 (57.1%) | 6 (42.9%) | 14 (100.0%) |
| Residence | | | |
| Central Ward | 16 (55.2%) | 13 (44.8%) | 29(100.0%) |
| Kivou Ward | 31(75.6%) | 10 (24.4%) | 41(100.0%) |
| Mui Ward | 8 (42.1%) | 11 (57.9%) | 19(100.0%) |
| Nguni Ward | 100 (64.5%) | 55 (35.5%) | 155(100.0%) |
| Nuu Ward | 18 (50.0%) | 18 (50.0%) | 36(100.0%) |
| Waita Ward | 69 (69.0%) | 31(31.0%) | 100(100.0%) |
| Employment status of the mother | | | |
| Employed | 58 (82.9%) | 12 (17.1%) | 70 (100.0%) |
| Self-employed | 74 (66.1%) | 38 (33.9%) | 112 (100.0%) |
| Not employed | 130 (65.7%) | 68 (34.3%) | 198 (100.0%) |
| Religion | | | |
| Christian | 248 (67.8%) | 118 (32.2%) | 366(100.0%) |
| Muslim | 12 (100.0%) | 0 (0.0%) | 12(100.0%) |
| None | 2 (100.0%) | 0 (0.0%) | 2(100.0%) |
| Children under 5's | | | |
| One | 179 (74.6%) | 61 (25.4%) | 240(100.0%) |
| Two | 83 (59.3%) | 57 (40.7%) | 140(100.0%) |
| Birth order | | | |
| First borne | 129 (77.2%) | 38 (22.8%) | 167(100.0%) |
| Middle borne | 67 (67.7%) | 32 (32.3%) | 99(100.0%) |
| Last borne | 66 (57.9%) | 48 (42.1%) | 114(100.0%) |
| Additional children to the mother | | | |
| Yes | 75 (67.0%) | 37 (37.0%) | 112(100.0%) |
| No | 187 (69.8%) | 81 (30.2%) | 268(100.0%) |
| **Total** | 262 (68.9%) | 118 (31.1%) | 380 (00.0%) |

The vaccine uptake in different maternal age groups as 15-19 years, 20-24 years, 25-29 years, 30-34 years, 35-39 years and above 40 years were 60% (6/10), 63.8% (30/47), 73.6% (95/129), 70.1% (82/117), 68.6% (35/51) and 53.8% (14/26), respectively. Vaccine uptake about the level of education was: primary level 64.0% (112/175), secondary level 71.5% (88/123), tertiary level 79.4% (54/68) and those who did not attend any schooling 57.1% (8/14).On maternal residence, the uptake of the vaccine was as follows: Central Ward 55.2% (16/29), Kivou Ward 75.6% (31/41), Mui Ward 42.1% (8/19), Nguni Ward 64.5% (100/155), Nuu Ward 50.0% (18/36) and Waita Ward 69.0% (69/100). Finally, the measles-rubella uptake in terms of the employment status of the mother was as follows: Employed mothers 82.9% (58/70), Self-employed mothers 66.1% (74/112) and Not employed mothers 65.7% (130/198).

The measles-rubella second dose uptake concerning the birth order showed that: First borne children 77.2% (129/167), Middle borne children 67.7% (67/99) and Last borne children 57.9% (66/114).

## *Client-related factors influencing second dose uptake*

The study reviewed the client-related factors on the uptake of measles-rubella second dose among children aged 19 -59 months at Mwingi Central Sub-County, in June 2022. It revealed that the mother's age, education level, previous vaccination side effects and additional children had no statistically significant association with the uptake of the second dose of the measles-rubella vaccine (P-value >0.05).

The age of the mothers sampled ranged from 15 -52 years. We categorized their ages into six classes with a five-year class interval. The study showed that different classes of mother's age reported different coverage of the measles-rubella second dose for their children. Participants of 15-19, 20-24, 25-29, 30-34, 35-39 and above 40 years reported the following measles-rubella second dose coverage of their children 60% ,63.8%,73.6% 70,1% , 68.6% and 46.2% respectively (Table 2.1).

On mother's level of education, the primary school level reported a vaccination coverage of 64% (112); the secondary education level 71.5% (88); the tertiary education level 79.4% (54 ), and finally, those who never went to school reported a measles-rubella coverage of 57.1%. At a 95% confidence level, a chi-square value was 6.777 and a p-value of 0.079.

However, the study showed a statistically significant association between the mother's residence, employment status, religion, knowledge of measles and perception of distance on the uptake of the second dose of the measles-rubella vaccine (P-value < 0.05).

The study showed that different residences of the mother reported different measles-rubella uptake. The mother's residence was classified in administrative wards in Mwingi central sub-county. Mothers from Central ward, kivou wards, Mui ward, Nguni ward, Nuu ward and Waita ward reported the following measles-rubella second dose vaccination 55.2%, 75.6%, 42.1%, 64.5%, 50.0% and 68.9% respectively. A chi-square value at a 95% confidence level was 36.054, and a p-value of 0.0001 showed that children from some wards were more likely to be vaccinated than others. There was a statistically significant difference in various wards concerning the uptake of Measles-rubella vaccination. Hence the differences cannot be explained as due to chance.

Children whose mothers were employed (82.9 %; 58) were more likely to receive a second dose of measles-rubella compared to children whose mothers were not employed (65.7%) (130). A chi-square value was 7.760, and a P-value of 0.021 shows that the difference in employment status was statistically significant. (Table 3).

*Table 3:*
*Bivariate Analysis of the Client-Related Factors on Uptake of Measles-Rubella Second Dose*

| Variable | Received second dose | Did not receive the second dose | Chi-square (p-value at 95% confidence |
|---|---|---|---|
| Age | | | |
| 15 – 19 years | 6 (60.0%) | 4 (40.0%) | 5.120 (p=0.401) |
| 20 – 24 years | 30 (63.8%) | 17 (36.2%) | |
| 25 – 29 years | 95 (73.6%) | 34 (26.4%) | |
| 30 – 34 years | 82 (70.1%) | 35 (29.9%) | |
| 35 – 39 years | 35 (68.6%) | 16 (31.45) | |
| Above 40 years | 14 (53.8%) | 12 (46.2%) | |
| Education level of the mother | | | |
| Primary | 112 (64.0%) | 63 (36.0%) | 6.777 *(p=0.079)* |
| Secondary | 88 (71.5%) | 35 (28.5%) | |
| Tertiary | 54 (79.4%) | 14 (20.6%) | |
| None | 8 (57.1%) | 6 (42.9%) | |
| Total | 262 (68.9%) | 118 (31.1%) | |
| Residence | | | |
| Central Ward | 16 (55.2%) | 13 (44.8%) | 36.054 (*p=0.0001*) |
| Kivou Ward | 31(75.6%) | 10 (24.4%) | |
| Mui Ward | 8 (42.1%) | 11 (57.9%) | |
| Nguni Ward | 100 (64.5%) | 55 (35.5%) | |
| Nuu Ward | 18 (50.0%) | 18 (50.0%) | |
| Waita Ward | 89 (68.9%) | 11(31.1%) | |
| Employment status of the mother | | | |
| Employed | 58 (82.9%) | 12 (17.1%) | 7.760 (*p=0.021*) |
| Self-employed | 74 (66.1%) | 38 (33.9%) | |
| Not employed | 130 (65.7%) | 68 (34.3%) | |
| Religion | | | |
| Christian | 248 (67.8%) | 118 (32.2%) | 6.547 (*p=0.038*) |
| Muslim | 12 (100.0%) | 0 (0.0%) | |
| None | 2 (100.0%) | 0 (0.0%) | |
| Children under 5's | | | |
| One | 179 (74.6%) | 61 (25.4%) | 9.665 (*p=0.002*) |
| Two | 83 (59.3%) | 57 (40.7%) | |
| Birth order | | | |
| First borne | 129 (77.2%) | 38 (22.8%) | 11.950 *(p=0.003*) |
| Middle borne | 67 (67.7%) | 32 (32.3%) | |
| Last borne | 66 (57.9%) | 48 (42.1%) | |
| Additional children to the mother | | | |
| Yes | 75 (67.0%) | 37 (37.0%) | 0.292 *(p=0.589)* |
| No | 187 (69.8%) | 81 (30.2%) | |
| Knowledge of measles | | | |
| At nine months | 6 (15.4%) | 33 (84.6%) | 160.998 (*p=0.0001*) |
| At 24 months | 0 (0.0%) | 2 (100.0%) | |
| At 18 months | 246 (86.3%) | 39 (13.7%) | |
| I do not know | 10 (18.5%) | 44 (81.5%) | |
| Previous vaccination side effects | | | |
| Yes | 15 (60.0%) | 10 (40.0%) | 1.001 *(p=0.317)* |
| No | 247 (69.6%) | 108 (30.4%) | |
| Perception on distance | | | |
| Too long and inconvenient | 82 (56.2%) | 64 (43.8%) | 18.095 (*p=0.0001*) |
| Too short and convenient | 180 (76.9%) | 54 (23.1%) | |

Children born to mothers from Mwingi central ward were less likely to receive the second dose than in other wards, except for the Mui ward. Mwingi Central and Nui Ward had comparable uptake of the second dose of measles-rubella among children aged 19 – 49 months.

Regarding employment status, children of self-employed mothers were about 60.4% less likely to receive the second dose of the measles-rubella vaccine than children whose mothers were employed (OR: 0.396 (95% CI: 0.199 - 0.786). The children of unemployed and self-employed women had comparable uptake of the second dose of the measles-rubella vaccine.

Mothers with two children under five years were about 50.4% less likely to receive the second dose of the measles-rubella vaccine than mothers who had one child under five years of age, which was statistically significant (OR: 0.496 (95% CI: 0.318 – 0.774).

Middle-borne children were 59.5% less likely to receive the second measles-rubella vaccine than first-borne children (OR: 0.405 95% CI: 0.241 – 0.680).

Children of mothers who believed the distance to a health facility was short and convenient were twice as likely to receive the second vaccine dose compared to children whose mothers thought the distance was too long and inconvenient (OR: 2.602; 95% CI:1.665 – 4.066).

***Table 4:***
***Logistic Regression Analysis of the Client-Related Factors on Uptake of Measles-Rubella Second Dose***

| Variable | Received second dose | Did not receive the second dose | Logistic regression (95% CI) | P-value |
|---|---|---|---|---|
| Residence | | | | |
| Central Ward | 16 (55.2%) | 13 (44.8%) | 1.0 | |
| Kivou Ward | 31(75.6%) | 10 (24.4%) | 6.574 (2.509 – 17.226) | *0.0001* |
| Mui Ward | 8 (42.1%) | 11 (57.9%) | 2.610 (1.010 – 6.741) | 0.05 |
| Nguni Ward | 100 (64.5%) | 55 (35.5%) | 11.125 (3.683 – 33.601) | *0.0001* |
| Nuu Ward | 18 (50.0%) | 18 (50.0%) | 4.450 (2.193 – 9.029) | *0.0001* |
| Waita Ward | 89 (68.9%) | 11(31.1%) | 8.091 (3.273 – 20.002) | *0.0001* |
| Employment status of the mother | | | | |
| Employed | 58 (82.9%) | 12 (17.1%) | 1.0 | |
| Self-employed | 74 (66.1%) | 38 (33.9%) | 0.396 (0.199 -0.786) | *0.008* |
| Not employed | 130 (65.7%) | 68 (34.3%) | 0.982 (0.602 – 1.601) | 0.941 |
| Children under five years | | | | |
| One | 179 (74.6%) | 61 (25.4%) | 1.0 | |
| Two | 83 (59.3%) | 57 (40.7%) | 0.496 (0.318 – 0.774) | *0.002* |
| Birth order | | | | |
| First borne | 129 (77.2%) | 38 (22.8%) | 1.0 | |
| Middle borne | 67 (67.7%) | 32 (32.3%) | 0.405 (0.241 – 0.680) | *0.001* |
| Last borne | 66 (57.9%) | 48 (42.1%) | 0.657 (0.374 – 1.152) | *0.142* |
| Perception on distance | | | | |
| Too long and inconvenient | 82 (56.2%) | 64 (43.8%) | 1.0 | |
| Too short and convenient | 180 (76.9%) | 54 (23.1%) | 2.602 (1.665 – 4.066) | *0.001* |

### *Institution-related factors affecting vaccine second dose uptake*

There was a statistically significant association between an open health facility and the uptake of the second dose of the measles-rubella vaccine for children between 19 -49 months (p-value = 0.0001). (Table 5).

## Discussion

### *Vaccine second dose uptake*

In Mwingi central sub-county, 68.9% of caretakers indicated that their children had received the second dose of measles-rubella by the end of 2021. This level of vaccine uptake was higher compared to national coverage (57.2%) but lower compared to global coverage (71%) (WHO, 2021). The 68.9% was also lower than the WHO recommendations of ≥95% vaccine coverage for a community to achieve herd immunity.

### *Individual-level factors influencing vaccine second dose uptake*

Our findings indicate that second-dose uptake was higher in children whose mothers were more educated than low-educated mothers. This finding agrees with Naeem *et al*. (16), who found that immunization coverage was higher among educated families than less educated ones.

The vaccine second-dose uptake in the sub-county was not the same in all the wards. Kivou ward reported the highest coverage of 75.6%, and Mui ward said the lowest measles-rubella second coverage of 42.1%. This variation could be because some wards had populations which were hard to reach compared to others. In this case, Mui ward has a hard-to-reach catchment population with no outreach services. Torracinta *et al*. (17) reported that the mother's area of residence was not statistically significantly associated with complete immunization among children.

The present study also indicated that the measles-rubella second dose uptake was 82.9% in employed families and 65.7% in unemployed participants. This high uptake indicated that children from employed mothers were more likely to be immunized than children whose mothers were not employed. This study agrees with other findings (18,19), which reported that children whose mothers were employed were more likely to be immunized than children whose mothers were not employed.

Finally, the second-dose vaccine was associated with the birth order of children: first-borns 77.2%, middle-born children 67.7% and last-borns 57.9%. Thus first-born children in Mwingi central were more likely to receive the second dose than last-born children.

***Table 5:***
***Bivariate Analysis of the Facility-Related Factors on Uptake of Measles-Rubella Second Dose***

| Variable | | Received second dose | Did not receive the second dose | Chi-square (p-value at 95% confidence |
|---|---|---|---|---|
| Is the facility always open | Yes | 245 (73.1%) | 90 (26.9%) | 26.948 (p=*0.0001*) |
| | No | 15 (34.9%) | 28 (65.1%) | |
| The facility has specific days of immunization | Yes | 174 (68.0%) | 82 (32.0%) | 0.351 *(p=0.554)* |
| | No | 88 (71.0%) | 36 (29.0%) | |
| Child missed vaccination | Yes | 32 (61.5%) | 20 (38.5%) | 1.545 *(p=0.214)* |
| | No | 230 (70.1%) | 98 (29.9%) | |
| Bad experience with health workers | Yes | 8 (72.7%) | 3 (27.3%) | 0.076 *(p=0.783*) |
| | No | 254 (68.9%) | 115 (31.1%) | |
| Delays at vaccination sites | Yes | 50 (64.1%) | 28 (35.9%) | 1.076 *(p-0.300)* |
| | No | 212 (70.2%) | 90 (29.8%) | |

This finding is similar to that of Herliana & Douiri (20), who found significance in the birth order of the children and immunization coverage; hence older children were likely to be fully immunized compared to the younger children. Birth order was also a determinant of failure to be fully vaccinated. Higher birth orders had lower odds of completing the immunization schedule.

We studied maternal education and found that level of education was associated with measles-rubella vaccine second-dose uptake. Children of mothers with higher education had a higher uptake than those with lower levels of education. Other studies (16,18) have also indicated that children whose mothers were more educated were more likely to receive immunization than children from less educated mothers.

Findings from the present study indicate that different wards in the study area reported varying vaccine uptake levels. Kivou ward reported the highest percentage uptake of 75.6% and Muui's lowest uptake of 42.1%. This variation could be because some wards, like Muui, had hard-to-reach populations, and no outreach services were provided. Mothers from Mwingi central ward were less likely to receive the second dose of measles-rubella than others except for the Mui ward. Mwingi Central and Nui Ward had comparable vaccine uptake among children aged 19 – 59 months. ($P < 0.05$).

On maternal knowledge of the measles-rubella second dose schedule, mothers who correctly knew the schedule had a higher uptake (86.3%). This finding is coherent with that of (12), who revealed that knowledge of vaccination schedules contributed to vaccination uptake in a community.

### *Institutional factors affecting vaccine uptake*

Distance to the health facility was associated with vaccine uptake. This finding contradicts international health and human rights (2019), which reported that the mean distance from households to the vaccination site had no advantage regarding vaccination coverage rate. However, Aminauw *et al*. support the finding from the present study stating that 76% of children of mothers who could easily access a vaccine site from their residence were fully immunized.

An open health facility was also essential in improving second-dose vaccine uptake for children between 19 -59 months. This finding was supported by Sato R. (2020), who documented that mothers were discouraged from revisiting a health facility if it was primarily closed, limiting the uptake of health services.

## Conclusions

The uptake of the measles-rubella second dose in the Mwingi Central sub-county was low (68.9%) compared to the WHO requirement of 95% for a community to have herd immunity. Individual factors associated with the measles-rubella second dose vaccine uptake were the mother's educational level, residence, employment status, religion and knowledge of the measles-rubella vaccine schedule. Distance to the health facility and an open health facility were also essential in improving second-dose vaccine uptake for children between 19 -59 months.

## Recommendations

We recommend that the Mwingi central sub-county health management team ensure that its catchment population is educated on the measles-rubella second dose schedule. Moreover, all immunizing health facilities should stay open and provide outreach services for hard-to-reach communities. Further study should also be conducted to establish why wards in Mwingi central sub-county have varying levels of uptake of the measles-rubella second dose.

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