

Investigating the Frequency and Contributing Factors of Measles Vaccine Dropout in Super High Risk Union Councils (SHRUCS) District Peshawar, KPK, Pakistan

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Abstract

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Received on 22 Feb, 2026

Accepted on 25 March, 2026

Published on 28 March, 2026

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Introduction: Measles is a highly contagious viral disease and remains a major public health concern, particularly in low- and middle-income countries like Pakistan. Despite the availability of an effective vaccine under the Expanded Programme on Immunization (EPI), gaps still exist between the first dose of measles-containing vaccine (MCV1) and the second dose (MCV2), leading to incomplete vaccination and increased risk of outbreaks. This study aimed to assess the prevalence of measles vaccine dropout and identify

associated factors among children in Super High-Risk Union Councils (SHRUCs) of District Peshawar. **Methodology:** A descriptive cross-sectional study was conducted over a period of four months, including a sample of 345 children aged 9–59 months who had received MCV1. Data were collected through a structured questionnaire and analyzed using (SPSS) version 27. **Results:** The findings showed that coverage of MCV1 was 100%,

while 83.2% of children received MCV2, resulting in a dropout rate of 16.8%. Awareness regarding measles and the need for two doses was 100%. However, factors such as forgetfulness, lack of effective reminder systems, and confusion during administration of multiple vaccines contributed to missed vaccinations. Community-level concerns, including poor sanitation and demand for additional free healthcare services, were also identified. **Conclusion:** Although awareness and access to vaccination services are high, a gap remains between knowledge and practice. The main reason of dropout was fear of AEFI, multiple vaccination at 9 months which leads to confusion, low importance of 2nd dose (means 1st dose is enough perception). The persistence of MCV2 dropout highlights the need for system-based interventions such as digital reminder systems by healthcare workers, and integration of immunization services with broader community support to improve vaccination completion rates.

Key Words: Measles, Vaccine Dropout, MCV1, MCV2, Immunization Coverage, Expanded Programme on Immunization (EPI)

INTRODUCTION

Measles is a contagious acute viral disease that is primarily transmitted by respiratory droplets and aerosol. It is caused by a strain of the Paramyxoviridae virus. Measles is a highly infectious vaccine-preventable disease that has high second attack rate among the vulnerable populations. (1) Clinically, it presents with a prodrome of fever, cough, coryza, and conjunctivitis and a generalized maculopapular rash. Although solutions to measles have been developed in the form of a proven vaccine, the disease has remained a big health risk in nearly all parts of the world, especially in children below age five in low- and middle-income nations. (2)(3)

In the world, measles has in the past been one of the major causes of childhood morbidity and mortality. Prior to the mass introduction of vaccination campaigns, millions of people died each year due to the measles. Much has been achieved in the last 20 years in terms of decreasing measles incidence and death rates through improved immunization. (4) The death rates caused by measles, according to world estimations, dropped to an estimate of 95,000 in recent world records as compared to 780,000 in 2000 due to the immunization program success worldwide. Moreover, millions of death cases have been averted by vaccinating individuals which shows that measles vaccines are good as a public health intervention. Nonetheless, even with these successes, measles elimination is still a challenging task as there are still gaps in immunity and overcoming disparate vaccine coverage in different areas. (4) The World Health Organization (WHO) has recommended that two doses of measles-containing vaccine (MCV1 and MCV2) should be against every target population to reach an

elimination goal of measles. The initial dose is usually at the age of 9 months and the second dose is usually at the second year of age, between the ages of 15-18 months. The reason behind second dose is to provide immunity to children who do not develop sufficient immunity following the first dose and hence seal immunity gaps and enhance the effect of herd immunity. (5) To interrupt measles transmission and prevent outbreaks the covering of both doses is necessary. In most countries, however, the coverage of the first dose is quite good, although the coverage of the second dose is less than optimum, leaving a substantial gap between MCV1 and MCV2 coverage. (2)

The concept of vaccination dropout, or the percentage of children who have been vaccinated against measles on their first dose (MCV1) but have not received the second dose (MCV2) is one of the greatest issues of the measles control. This disenfranchisement generates a weak group of half immunized children who are still vulnerable to infection. Consequently, the problem of vaccine dropout helps to sustain and re-emerge measles outbreaks even in initially highly vaccinated areas. Not only will the existence of drop out compromise individual immunity, it will also compromise herd immunity and, as such, pose a greater threat to spreading of diseases among communities.

The report on vaccination dropout in different geographic areas demonstrates that the problem is still quite significant. In Sub-Saharan Africa, a systematic review and meta-analysis study identified a combined prevalence of 26% of vaccination dropouts, indicating the size of the issue in resource-constrained locations. Cases, as in other countries reported, revealed a big gap between MCV1 and MCV2, indicating that specific efforts are needed to raise the rate of compresence of the vaccination series. The findings indicate that increasing access to the second dose of measles is important to gain effective disease control. (6)

Measles vaccine dropout determinants are multifactorial and comprise a complex relationship between socio-demographic and health system, and behavioral factors. Low maternal education, high number of children in family, low household income, and rural living have been noted to be consistent with increased dropout rates. Indicatively, research has indicated that children whose mothers are poorly educated, or in disadvantaged families, are more prone to skip the second dose of immunization. Also, the related family issues, including the number of children in a family, can decrease the chances of a successful complement of the vaccination schedule as there are competing priorities and limited available resources. (7)

Factors that could be related to the health system are also crucial in vaccine dropout. Lack of access to health care facilities, wait time, lack of adequate dose of vaccine, and

poor delivery of services may demoralize caregivers to resume with their doses. Besides, lack of reminder systems, including follow-up visits, along with communication of healthcare providers, is another cause of missed vaccinations. There is also an evidence that lack of follow-ups in postnatal care, the absence of adequate prenatal care visits and very long waiting time at the vaccination centers are also important predictors of measles vaccine dropout. These data stress the need to strengthen health systems to achieve full and timely immunization. (8)

Factors that relate to behavior and awareness are also significant determinants of vaccination uptake. The knowledge and perceptions that caregivers have towards the significance of the second dose of measles vaccine are critical determinants of whether children will go through to finish vaccination. Non-compliance with immunization schedules may be caused by lack of awareness, the misperception about vaccination, and low perceptions of risk of disease. Research has shown that the likelihood of caregivers not knowing the significance of MCV2 having children which ultimately drop out of the vaccination program is much higher. Thus, to decrease the number of vaccine dropouts, enhancing health education and community awareness is needed. (8)

Besides personal, as well as family-level reasons, there are systemic issues that lead to poor immunization coverage. Poor health infrastructure, insufficient allocation of resources and poor management of programs are some of the challenges that affect the immunization programs in most developing countries including Pakistan. Expanded Programme on Immunization (EPI) in Pakistan has done a lot of work in terms of vaccination coverage but the country still has a lot of difficulty in terms of attaining the optimal immunization targets. The barriers that have been identified to be the major hindrances towards high coverage include limited access to healthcare services, parental lack of awareness, and inefficiencies in service delivery systems. (9)

Pakistan is one of the states that the measles still remains an important public health issue. The lack of immunization coverage and surveillance systems has become evident in the increasing number of reported measles cases in recent years. The most vulnerable groups as regards to incomplete vaccination and subsequent outbreaks include populations at high risk as those in urban slums, peri-urban regions, and underserved population compared to other regions. Such groups are usually struggling with various impediments such as poverty, high population, restricted access to healthcare centers, and lack of awareness levels, which all lead to the increased vaccination dropout rates.

In Pakistan, District Peshawar is a problematic location to investigate the issue of vaccination dropout of measles, especially of Super High-Risk Union Councils (SHRUCs).

These regions have been typified as having been more vulnerable because of population density issues, migration, socio-economic issues, and lack of education. When such conditions are present, there is an atmosphere in which spread of infectious diseases such as measles is favorable. Although the problem of high vaccination coverage is recognized, there is scant evidence on how frequently and the determinants of the measles vaccine dropout are observed in such high-risk environments.

Despite the variety of papers conducted on measles vaccination reception rates and dropout whether globally or regionally, there is still a massive gap in site-specific data on SHRUCs in District Peshawar. To design specific intervention and to improve the results of immunization, it is important to understand the scale of vaccine dropout and the determinants of it in these settings. In the absence of such evidence, it is hard to design effective measures to decrease the dropout rates and to increase vaccine coverage.

Thus, the purpose of the research is to test the prevalence of measles vaccine dropout (MCV1 to MCV2) as well as find out the factors related with the dropout among the children living in the Super High-Risk Union Councils (SHRUCs) of District Peshawar, Khyber Pakhtunkhwa, Pakistan. In order to create evidence-based strategies that would reduce vaccine dropout, increase immunization rates, and ultimately result in the eradication of measles in the region, this study will give policymakers and medical professionals vital information.

Study Design

The study design was Descriptive cross-sectional study.

Study Settings

The study conducted in selected super high-risk union councils of district Peshawar, KPK, Pakistan.

Study Duration

From data collection to report writing the study duration was 4 months.

Sample Size

The sample size is calculated by using OpenEpi calculator. 345 participants sample size was calculated using OpenEpi while taking a confident level =95%, margin of error =5% with expected dropout =15%. (6)

The Sample size for our study was 345. The sampling Technique Convenient sampling technique.

Sample Selection

Inclusion Criteria

- Children aged 9–59 months (eligible for measles vaccination under EPI)

- Children resided in Super High-Risk Union Councils (SHRUCs) of District Peshawar for at least 6 months.
- Children whose records are available at Vaccination Center (Health care centers) (EPI card, register, or verified caregiver recall).
- Children who have received only 1st dose of (MCV1) vaccine.

Exclusion Criteria

- Child having age greater than 5 years.
- Children not resident of selected SHRUCs.
- The children who have no vaccination record available.

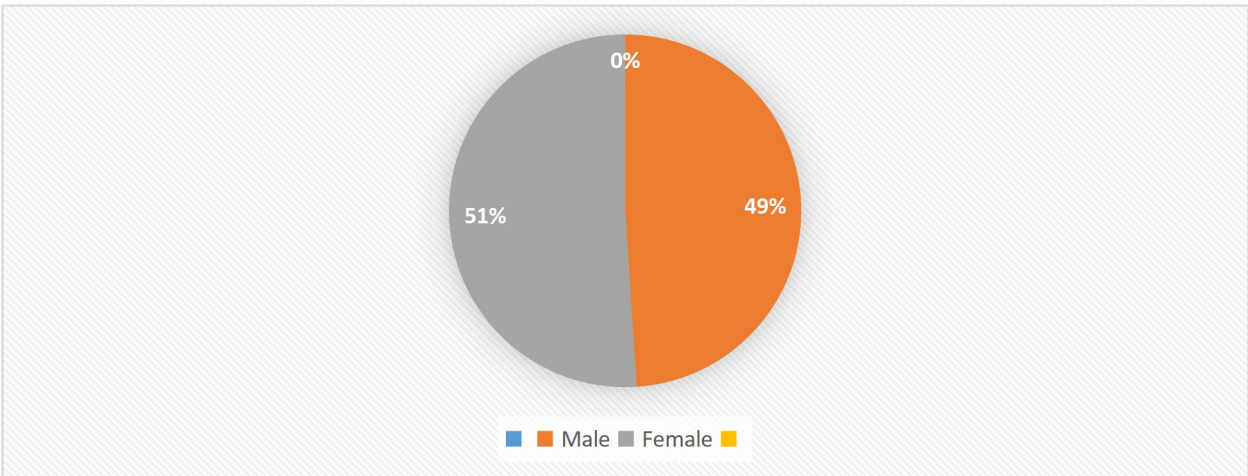
Data Collection Procedure

This cross-sectional study was conducted over a period of 3–4 months at the Super High-Risk Union Councils (SHRUCs) of District Peshawar. Data were collected using a structured, administered questionnaire. Ethical considerations were strictly observed in accordance with the university’s guidelines. Participants were informed that their involvement was entirely voluntary and that they could withdraw from the study at any time without any penalty. Anonymity and confidentiality were ensured by not collecting any personal identifiers. All collected data were used solely for academic and research purposes.

Data Analysis

Procedure Data was analyzed by SPSS software (Statistical Packaging for The Social Sciences)), Version 27.

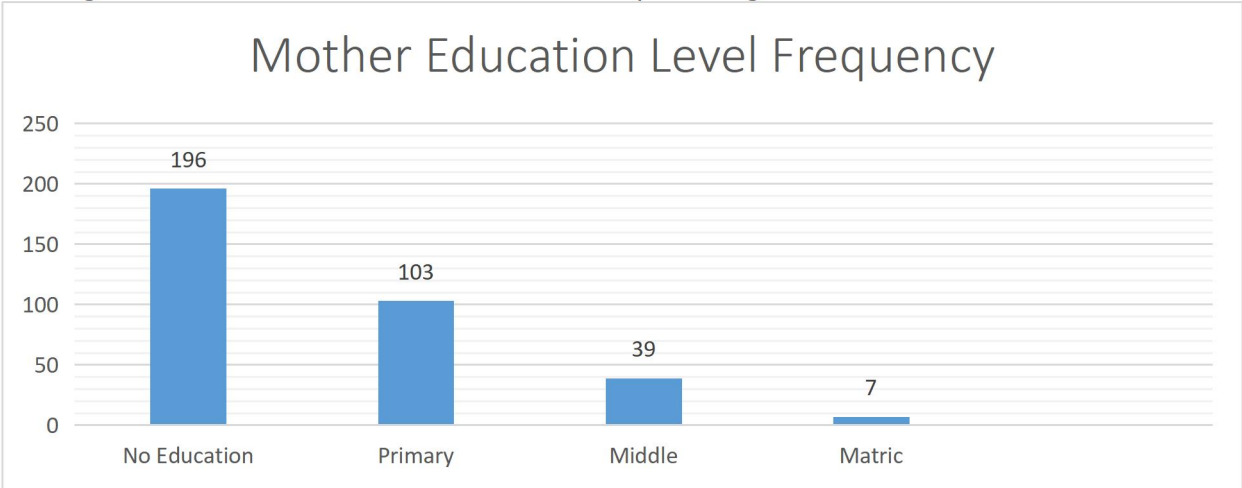
RESULTS:



Gender of Child

The gender distribution of the children included in the study shows that out of a total of 345 participants, 176 (51.1%) were female, while 169 (48.9%) were male. This indicates a

slightly higher proportion of female participants compared to male participants; however, the difference between the two groups is minimal. Overall, the sample demonstrates a nearly equal representation of both genders, suggesting that the study findings can be considered balanced with respect to gender distribution.



Mother Education Level

The education level of mothers in the study shows that most of the mothers were not educated as 196 (56.8) mothers had no formal education. This was succeeded by 103 (29.8) mothers with primary level education. Fewer mothers, 39 (11.3%), had an education level up to middle and only 7 (2.0%), had matriculation level. On the whole, the results show that the majority of mothers included in the study population were poorly educated, and very few of them had secondary or higher education.

Did the child receive second dose of measles MCV 2 vaccine (15 Month)?

Did the child receive second dose of measles MCV 2 vaccine (15 Month)

	Frequency	Percent
Yes	287	83.2
No	58	16.8
Total	345	100

Did the child receive second dose of measles MCV 2 vaccine (15 Month)?

The results of our study indicated that 287 (83.2%) children had received the second dose of the measles vaccine (MCV2) at 15 months, while 58 (16.8%) had not received it. Although the majority of children were vaccinated, a considerable proportion remained unvaccinated, highlighting a gap in full Vaccination coverage.

Main Reason not taking MCV-2 Dose on Time

	Frequency	Percent
Forgot the date	0	0
vaccination center far	0	0
vaccinated	287	83.2
others	58	16.8
Total	345	100

Main reason not taking MCV-2 dose on time

The results concerning the reasons why they did not get the MCV2 dose on time show that none of the participants cited such frequent barriers as forgetting about the date or distance to the vaccination center. Rather, a significant number of 58 (16.8) participants were classified as other reasons and it is significant to show the existence of less traditional yet significant underlying factors in the dropout of vaccines. This implies that the traditional constraints such as access and awareness are no longer the main problems in this population. Instead, the category of others is probably a composite of behavioral, social and perceptual issues, such as fear of adverse events after immunization (AEFI), absence of male accompaniment, low priority given to the second dose, and concerns about multiple vaccinations simultaneously, as indicated by community responses.

This 16.8% gap that cannot be explained or addressed by multiple factors suggests that vaccine hesitancy in this scenario is more nuanced and context-dependent, as opposed to the impact of apparent logistical obstacles. It also implies that some reasons might not be reported openly by the caregivers on structured options and thus the classification under others. This points to the weakness of close-ended questioning and the necessity of taking deeper look into community perceptions. Thus vaccine dropout in this context needs to be tackled with context-specific interventions that go beyond increasing access and awareness and instead address the concerns of the caregiver, building trust and providing personalized follow up.

Association Between Mother Education and MCV-2 Dropout

Mother Education	Vaccinated n (%)	Dropout n (%)
No Education	148	48
Primary	95	8
Middle	37	2
Matric	7	0

$\chi^2 = 18.64, df = 3, p = 0.001$

A statistically significant association was observed between maternal education and MCV-2 vaccination status ($p=0.001$). Children of mothers with lower educational attainment were more likely to experience MCV-2 dropout compared with children of educated mothers.

Association Between Father Education and MCV-2 Dropout

Father Education	Vaccinated	Dropout
No Education	22	11
Primary	114	29
Middle	100	14
Matric	51	4

$\chi^2 = 9.82, df = 3, p = 0.020$

A statistically significant association was found between paternal education and MCV-2 vaccination status ($p=0.020$).

Association Between SMS Reminder and MCV-2 Dropout

SMS Reminder	Vaccinated	Dropout
Yes	175	13
No	112	45

$\chi^2 = 27.51, df = 1, p < 0.001$

Receipt of SMS reminders was significantly associated with completion of MCV-2 vaccination. Children whose caregivers received reminders were significantly less likely to drop out.

Association Between LHW Visit and MCV-2 Dropout

LHW Visit	Vaccinated	Dropout
Yes	272	42
No	15	16

$\chi^2 = 18.37, df = 1, p < 0.001$

LHW home visits were significantly associated with MCV-2 uptake. Households receiving LHW visits demonstrated higher vaccination completion rates.

Association Between Negative Beliefs and MCV-2 Dropout

Negative Beliefs	Vaccinated	Dropout
Yes	4	2

Negative Beliefs	Vaccinated	Dropout
No	283	56

$\chi^2 = 0.72, df = 1, p = 0.396$

Non-significant

Association Between Community Encouragement and MCV-2 Dropout

$\chi^2 = 0.84, p = 0.359$

Non-significant

Association Between Anti-Vaccination Influence and MCV-2 Dropout

$\chi^2 = 1.11, p = 0.291$

Non-significant

DISCUSSION

The current research evaluated awareness and determinants of the second dose of vaccines against measles (MCV2). The results show that despite the fact that there was unanimity with regard to the need to take two doses (100%), 16 percent of the participants failed to take the second dose, which shows that there is a significant difference between understanding and practical action. The resulting gap indicates that there is a critical issue of public health because incomplete vaccination weakens the efficacy of the immunization initiatives and makes people vulnerable to measles outbreaks. The awareness among the population is high in this study because of the success of national immunization programs, especially the Expanded Programme on Immunization (EPI) in Pakistan. This could have been caused by increased exposure to health education campaigns and neighborhood based intervention. Nonetheless, the fact that the non-compliance rate is 16% despite complete knowledge implies that knowledge is not enough to guarantee compliance with vaccination schedules. The same results have been observed in earlier studies, with enhanced awareness not always leading to full Vaccination coverage. (15) (16) Additionally, there are organizational issues in the immunization program in Pakistan, such as service delivery gaps and follow-up systems, which still impede the optimal vaccine coverage. (2). (17) Of particular interest is the fact that 16 % of the subjects missed the second dose, which is pertinent as far as control of measles is concerned. To stop the transmission of measles, both doses should be covered so that the herd immunity is reached. Even small deficiencies in coverage will continue to propagate the virus within communities. (17) (18) Therefore, this proportion of missed second doses represents a meaningful barrier to measles elimination efforts.

Among the most important causes detected in this research as the cause of incomplete vaccination was forgetfulness, which means that the problem is rather behavioral than informational. This is consistent with the available literature, which notes that factors related to caregivers, such as absence of reminder system and inadequate follow-up, are among the key causes of missed vaccinations. Moreover, insufficient immune delivery systems, including irregular tracking and inaccessibility, have been cited as factors in Pakistan. (17) The fact that the default rate remains 16 per cent even with sufficient levels of awareness supports the necessity of system-wide interventions, including sms or call reminder, vaccination tracking systems, and active follow-ups on the part of the healthcare workers.

In comparison with previous studies, the findings of the present study reveal both progress and persistent challenges. Earlier research conducted in Pakistan reported significantly lower levels of awareness and even poor uptake of MCV2, with only a small proportion of caregivers completing the second dose. Although the current study shows significant awareness improvement, the fact that there is still a 16% gap in vaccine uptake speaks to the fact that behavior and logistical obstacles are yet to be addressed. This is further justified by evidences that there are still no global standards of immunization programs in Pakistan as there are still challenges in systems and operations of the programs. (17)

The other significant finding of this study is that negative beliefs, such as religious misconceptions or social misconceptions, have a very small impact, as only 1.7% of the participants reported that. This indicates that there is a favorable change on community attitude to vaccination. Yet, even with this improvement, the fact that the gaps in vaccination coverage remain, especially those who are 16 percent behind the second dose, shows that removing misinformation is inadequate to produce the best results.

In terms of public health, the results of this research indicate that it is necessary to get past awareness-based solutions and consider practical measures to enhance compliance. Enhancing record-keeping and the reinforcement of reminder systems together with the implementation of digital health solutions can contribute to a considerable decrease in missed vaccinations. The effectiveness of such interventions has been proven in terms of increasing immunization coverage previously. (19) Despite its strengths, this study has certain limitations. There can be a bias in the use of self-reported data, and the results obtained might not capture the populations in remote or underserved areas in full. However, the detection of the non-uptake rate of the second dose was 16 percent which is a valuable indicator of the current situation in terms of the immunization practice and the critical field of action.

In conclusion, while awareness regarding MCV2 is high, a significant proportion (16%) of individuals still fail to receive the second dose, primarily due to behavioral and system-related factors. Knowledge-practice disparity has challenged efforts of measles elimination efforts and has highlighted the necessity of system-based interventions to enhance vaccine coverage and immunization coverage. Findings of this research show that the relationship between understanding, behavior and uptake of a vaccine is manifest. Although there was universal awareness (100%), there was a significant portion (16%), who did not get the second vaccine, which implies that knowledge itself is not sufficient in ensuring compliance. The postulation of forgetfulness as the main cause of not catching up on vaccination implies that this lapse is more a behavioral and systemic issue as opposed to information insufficiencies. Moreover, the fact that negative beliefs play an insignificant role (1.7%) helps to underpin that vaccine hesitancy is not an important obstacle in this group of people. Collectively, these observations indicate a transition of knowledge-based obstacles to feasible and behavioral obstacles in immunization coverage.

Inferential Analysis

Pearson's Chi-square test was used to compare the relationship between independent variables and MCV-2 dropouts. The associations of maternal education status, paternal education status, receipt of SMS reminders, and visits by Lady Health Workers with MCV-2 vaccination status were statistically significant. Other factors including negative beliefs ($p=0.396$), community encouragement ($p=0.359$), anti-vaccination influence ($p=0.291$) and gender ($p>0.05$) were not significantly associated with MCV-2 dropout.

The inferential analysis showed which factors were significant contributors in the uptake of MCV-2: parental education, SMS reminder and LHW home visits. Parental education was also associated with vaccine dropout with children of parents with less education being more likely to drop out. Likewise, caregivers who received the SMS reminders and frequent LHW visits were highly likely to take the second dose of measles vaccination. Negative religious beliefs, anti-vaccination influence and community encouragement, however, were not significantly associated with MCV-2 dropout, meaning that behavioral follow up mechanisms and caregiver education have a greater impact than social resistance within the study population.

CONCLUSION

This study has evaluated measles vaccine dropout (MCV1-MCV2) and its predictors in children in Super High-Risk Union Councils of District Peshawar. The findings indicated that although the initial dose of vaccination against measles (MCV1) and having enough information on vaccination were high, a large proportion of children (16.8) never

received the second dose of vaccine (MCV2) which indicated the gap in full vaccination. It is worthwhile to note that the causes of non-adoption of MCV2 were not necessarily due to the lack of awareness, but a combination of behavioral, social and systemic factors. Responses to questions in the community demonstrated a pre-immunization fear of negative outcome (AEFI) without an escort by a male, concern about getting multiple vaccines simultaneously, and low perceived value of the second dose. Moreover, some of the respondents mentioned even more prevalent needs, such as poor hygiene and free-drugs necessity, which indicates that the adoption of vaccines is pre-determined by overall confidence and expectations towards the health care system and in it.

Also, there was a community response focus on improvement in the services offered in conjunction with rather than mere awareness to reduce vaccine dropout. These were suggested to supplement LHW home visits, to conduct more of the awareness sessions, to hire more health workers and to reduce the simplest community needs such as sanitation and access to available free health care services. It is worth noting that although many of them considered vaccination alone, general welfare services received higher ratings, which shows that conceived more community-based and integrated health services need to be implemented.

In conclusion, the general awareness and access to vaccination services is sufficient, yet more needs to be done to ensure that MCV2 dropout (16.8) is decreased because of complex socio-cultural images, service problems, and unmet expectations within the community. These considerations then bring about the need to respond to these considerations in a concerted effort alongside community responsive and trust provoking activities which would optimize the rate of the high risk communities taking up the vaccination and eradicate measles in the high risk communities.

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