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FREQUENCY OF MEASLES AMONG VACCINATED CHILDREN AT CIVIL HOSPITAL SUKKUR

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Abstract

Objective: *To determine the frequency of measles among vaccinated children at GMC Sukkur.*

Methods: *A cross-sectional descriptive study was conducted at the Department of Pediatric Medicine, GMC Sukkur, from 1st March to 31st August 2024, using non-probability consecutive sampling. The study included vaccinated children aged 1 to 7 years presenting with maculopapular rashes in the emergency or ward. Children were excluded if their parents failed to provide an immunization card, or if they had diseases like viral exanthema or hand-foot-mouth disease, or were immunocompromised. A detailed history and physical examination were performed. Blood samples were taken to assess infection severity, and the diagnosis of measles was made based on predefined criteria. Supportive management, including antipyretics and vitamin A, was provided to all children. A pre-designed proforma ensured data accuracy. The analysis was conducted using SPSS, with statistical significance set at $p \leq 0.05$.*

Results: *In our study of 146 vaccinated children, 23.3% (34/146) were diagnosed with measles. The data consisted of 62% males (91 children) and 38% females (55 children), with a mean age of 4.53 ± 1.79 years. The mean weight and height were 16.91 ± 3.37 kg and 101.64 ± 11.16 cm, respectively. Among the common symptoms of measles, fever was observed in 17.8% (26 children), cough in 20.5% (30 children), and conjunctivitis in 18.5% (27 children). Statistically significant associations were found between measles and gender ($p = 0.036$), with more females (18) diagnosed than males (16). Fever also showed a significant relationship with measles ($p = 0.043$), as 10 out of 26 children with fever were diagnosed with measles. Cough had a highly significant association ($p = 0.001$), with 14 out of 30 children presenting with a cough being diagnosed with measles. Similarly, conjunctivitis showed a significant correlation ($p = 0.017$), with 11 out of 27 children with conjunctivitis diagnosed with measles. Socioeconomic status also revealed a significant relationship ($p = 0.010$), with children from lower socio-economic backgrounds having a higher likelihood of contracting measles. Parental education levels were significantly associated with measles incidence ($p = 0.002$).*

Conclusion: *The study establishes crucial elements which push up measles cases among vaccinated children including gender, symptoms and social position and*

educational levels of the parents. The results demonstrate an urgent requirement for improved public health measures that aim to enhance vaccination coverage and manage socio-economic determinants. Future research must explicitly evaluate MMR vaccine effectiveness and investigate booster doses while developing maternal health education to decrease measles infections.

INTRODUCTION

Measles represents a serious viral infection that commonly affects children and leads to severe conditions, which include pneumonia alongside encephalitis and blindness and mortality. The development of an effective vaccine has not eliminated measles as a threatening public health issue throughout numerous worldwide regions, including Pakistan (1). The persistence of measles among vaccinated children, along with weakened vaccination programs and vaccine-resistant strain development, creates significant concerns about vaccination program performance. Healthcare systems in Sindh face added strain due to high measles rates, which leads to unnecessary, preventable sickness and deaths among patients. Understanding the speed at which measles spreads among vaccinated children enables better assessment of vaccination program effectiveness and helps identify potential improvement measures for protecting vulnerable groups (2).

Pakistan enhanced its vaccination program during recent years and established its routine vaccination schedule to protect against diseases including polio, tuberculosis, and measles. The authorities in Pakistan have intensified vaccination efforts despite the fact that measles continues to rank as the foremost preventable cause of fatalities in the nation (3). The World Health Organization (WHO) and United Nations Children's Fund (UNICEF) report that Pakistan stands as one of the nations that carries the world's largest measles disease burden, responsible for nearly 10% of all global cases (4). The health system in Pakistan treated 15,000 measles cases during 2020, with most of these occurrences affecting children under five years old. The high incidence of measles outbreaks remains alarming since vaccination under the Expanded Program on Immunization (EPI) prevents this sickness among children under one year old (5).

Measles outbreaks continue to affect Sindh province regularly, even after implementing vaccination programs. The Sindh Health Department recorded data showing that measles vaccine coverage reached only 25% of total reported cases throughout the entire country in 2021, according to their published report (6). The number of measles cases in Sindh has grown substantially in recent times, with specific districts reporting yearly increases of 10-15 %. Moreover, various factors such as low immunization coverage, poor health infrastructure, socioeconomics, and rural access to health services contribute to increasing the burden of measles in Sindh (7). As per the Pakistan Demographic and Health Survey (PDHS) 2018-2019, the coverage of measles immunization in Sindh was about 77 %, which is below the 95% coverage required in order to develop herd immunity. The continued circulation of measles within communities through this gap in vaccination rates even affected people who had been vaccinated (8).

Although Pakistan's states of vaccination coverage are improving, it's important to ensure that each child receives the complete dose of measles vaccine. Although rare, the fact that measles occurs among vaccinated children has raised questions as to whether the vaccine works or, if it does, if immunity wanes. The measles vaccine, which is an ingredient in the measles, mumps, and rubella (MMR) vaccine, is very effective in preventing infection (9). There is no vaccine, however, that is going to have a 100% efficacy, and there is that possibility of a breakthrough infection in the vaccinated,' she added. The measles vaccine is 97% effective after two doses, studies have shown, but it leaves a small proportion of children unprotected after vaccination. Vaccine failure is also seen and can result in outbreaks among the vaccinated population; this can occur as a result of such factors as delayed or missed doses, improper vaccine storage, and weak immunization systems (10).

The fact that measles has been seen in vaccinated children, specifically in Pakistan, is worrying because it implies that some of the children who received the vaccine are still exposed to the disease. There are

several factors that have contributed to this phenomenon – not just problematic vaccine coverage in some regions, not following all procedures that such a process entails, or vaccine resistance, among other reasons (3). Moreover, ongoing conflict and movement of the population in some sectors of the country have disrupted immunization programs, making children more vulnerable to measles and other vaccine-preventable diseases. However, there are additional factors that contribute to the risk of measles in vaccinated children; poor nutrition, weak immune systems, and co-infections with other diseases are also known contributors (11).

Measles in vaccinated children serves as a wake-up call to the public health authorities in Pakistan to reassess our immunization policies and to reinforce the efforts of our vaccination campaigns. Therefore, it is important to identify the reasons for vaccine failure against Polio and ensure its uptake in areas with a higher risk of vaccine failure, like Sindh. Every child must get every shot that he or she is due on time, and that the vaccine is stored and given properly. Improving immunization coverage also necessitates greater public education on public vaccination and the reasons and results of not doing so (3).

This urgent attention is needed to improve vaccination programs and reduce the incidence of such a preventable disease in Sindh and Pakistan as a whole. With increased coverage in vaccination, strengthening of immunization system and timely vaccination of all children, Pakistan can make rapid strides in doing away with measles. Therefore, increasing vaccination rates and making sure that each child receives all recommended vaccines against measles will decrease the disease's level of burden and avoid these needless deaths and complications. The fact that even vaccinated children can get measles shows that vigilance and action in protecting vulnerable people from this deadly disease is still needed (12).

Methods:

A cross-sectional study was carried out in the Department of Pediatric Medicine, GMC Sukkur, from 1st March 2024 to 31st August 2024, and a non-probability consecutive sampling technique was applied for the selection of participants. The target participants for the study were vaccinated children from one to seven years of age who developed maculopapular rash either in the emergency or the ward. Parents who failed to show immunization cards even they were claimed to be vaccinated as per parents were excluded. Also, those children who have other diseases that put them in the immunocompromised category, for instance, malnutrition, malignancy, nephrotic syndrome, and HIV-AIDS, were excluded. As a part of the assessment, history and general examination including skin assessment were performed for each child presenting with skin rashes. On the proforma, the patient's identification number, sex, age, weight, place of residence, and the number of days stayed were documented. Some clinical signs and symptoms like fever, cough, conjunctivitis, and which resembles measles were observed. Weight was taken by Camry analog weighing scale and length and FOC by a stadiometer. Treatment procedure The blood sample was collected under a strict aseptic method to determine the level of infection, white blood cell, C-reactive protein, blood culture, and Chest X-ray for chest infection. For developing the diagnosis of measles, a criterion was used. Additionally, appropriate analgesic treatment, enough fluids, proper nutrition, and vitamin A were also offered to all children.

RESULTS

Of the 146 vaccinated children enrolled in the study, 91 were males and 55 were females, which constitute approximately 62% and 38%, respectively.

The mean age of the children was 4.53 ± 1.79 years, while the mean weight and height were found to be 16.91 ± 3.37 kg and 101.64 ± 11.16 cm (Table 1).

In our study, the frequency of measles among vaccinated children was found to be 23.3% (34/146 children). Moreover, the study also examined common symptoms associated with measles in the vaccinated children. Regarding fever, 17.8% (26 children) presented with this symptom, while 20.5% (30 children) exhibited a cough. Similarly, 18.5% (27 children) showed signs of conjunctivitis, which is another common symptom associated with measles (Table-1).

Characteristic	Mean ± SD, n (%) (Total=146)
Gender	
Males	91 (62%)
Females	55 (38%)
Age (in years)	4.53 ± 1.79
Weight (in kg)	16.91 ± 3.37
Height (in cm)	101.64 ± 11.16
Frequency of measles	34 (23.3%)
Common Symptoms	
Fever	26 (17.8%)
Cough	30 (20.5%)
Conjunctivitis	27 (18.5%)

Table-1

Furthermore, in our study, the analysis of the relationship between measles and various socio-demographic, clinical symptoms, and educational factors revealed several significant associations.

Characteristics	Category	Frequency of measles (n, %)	P-value
Gender	Males	16 (17.6%)	0.036*
	Females	18 (32.7%)	
Fever	Present	10 (38.5%)	0.043*
	Absent	24 (20%)	
Cough	Present	14 (46.7%)	0.001*
	Absent	20 (17.2%)	
Conjunctivitis	Present	11 (40.7%)	0.017*
	Absent	23 (19.3%)	
Socioeconomic Status	Upper	11 (45.8%)	0.010*
	Middle	5 (27.8%)	
	Lower	18 (17.3%)	
Parental Education Level	Primary	17 (45.9%)	0.002*
	Matriculation	6 (13.0%)	
	Intermediate	6 (14.6%)	
	Graduate	5 (22.7%)	

Table-2

Relationship between gender and the occurrence of measles showed a statistically significant relationship ($p = 0.036$). Females had a higher incidence of measles compared to males, with 18 females and 16 males diagnosed with the disease. This suggests a gender difference in the frequency of measles among vaccinated children.

Similarly, a significant relationship was observed between fever and measles ($p = 0.043$). Of the children who presented with fever, a notable number (10 out of 26) were diagnosed with measles, while a larger proportion (24 out of 120) of children without fever had measles. This highlights fever as a potential symptom associated with the presence of measles. The presence of a cough also showed a highly significant association with measles ($p = 0.001$). Among children who presented with a cough, 14 out of 30 were diagnosed with measles, compared to 20 out of 116 children without a cough. This supports the importance of a cough as a common clinical symptom in measles cases.

Conjunctivitis was another symptom found to have a significant relationship with measles ($p = 0.017$). Children who exhibited conjunctivitis had a higher likelihood of being diagnosed with measles, with 11 out of 27 children with conjunctivitis having measles, compared to 23 out of 119 without conjunctivitis. This further emphasizes conjunctivitis as a typical symptom in children with measles.

Research demonstrated that socioeconomic status creates a significant relationship with measles infection rates ($p = 0.010$). Children of lower socio-economic status exhibited a higher incidence of measles since they received this diagnosis 18 times out of 104 cases, whereas upper socio-economic status children were diagnosed with measles only 11 times out of 24 cases. Children from lower socioeconomic backgrounds demonstrate higher measles infection rates because these groups perhaps experience limited healthcare service access and variable vaccination coverage.

Parental education levels proved to be significantly related to measles incidence based on statistical analysis ($p = 0.002$). The children whose parents had primary education levels experienced a higher measles infection rate of 17 out of 37 students when compared to the students whose parents had higher education levels. Children experienced less measles infection when parents possessed higher educational attainment because educated parents demonstrated greater measles prevention capabilities.

Discussion

This study aims to explore the frequency and factors associated with measles in vaccinated children. We found that 23.3% of the vaccinated children in the cohort developed measles, which is worrying because measles, which is prevented by vaccination, makes up this many in the group. Moreover, in our study, a number of significant associations have been observed on gender, clinical symptoms, socioeconomic status, and parental education. These findings can be compared and analyzed to and with other studies across the world that find similar trends and underlying factors determining the prevalence of measles in vaccinated populations.

In terms of gender differences in measles, one of our key findings was that females presented a higher frequency of measles than males. This result is in agreement with prior studies indicating that vaccine response or susceptibility to infections may also differ between male and female individuals (13). For information purposes, Aldakak L et al. (2021) found that females have a higher risk of contracting vaccine-preventable diseases than males because there are differences in immune system functioning between males and females (14). Though, importantly, there is some regional and population characteristic variation in gender based differences in vaccine efficacy and disease frequency. Hormonal and genetic factors may be possible reasons for these variations, but researchers are still trying to determine why these patterns occur.

Furthermore, the study also established a substantial relationship existing between measles frequency and characteristic measles symptoms like fever, cough, and conjunctivitis. Our findings demonstrated that these symptoms show direct associations with measles, which can serve as significant indicators for measles in vaccinated children. The development of these symptoms signifies a measles infection; thus, clinicians need to remain alert for early diagnosis among vaccinated populations where protection against measles is incomplete. Our study indicates that 47% of the children with cough received a measles diagnosis, confirming it as an excellent indicator of infection. Leung AK et al. (2018) reported alongside previous research that cough frequently appears as one of the main symptoms during measles outbreaks within vaccinated individuals (15).

Additionally, studies have revealed that children from lower socioeconomic status households experience higher risks for contracting measles. Moreover, multiple studies also confirm that vaccine-preventable diseases occur mainly because of socioeconomic factors such as health service access and vaccine delivery quality and parental educational status (16). Measles events primarily occur in lower-income areas because people in these communities experience inferior healthcare services alongside reduced vaccine coverage and delayed medical treatments. According to Ekezie W et al. (2021), medically protected children from low income families showed increased measles infection risks after vaccination because they faced primary healthcare accessibility limitations as well as vaccine booster service barriers (11). Thus, the combination of high household population density

and inadequate sanitary standards creates greater opportunity for children to contract measles.

Besides that, our study results also discovered a connection between parental education levels and frequency of measles cases. The study shows significant measles cases in children with less educated parents indicating parental educational background creates an impact on vaccine acceptance and disease prevention behavior. The study results match findings from earlier research which showed that parental educational level determines whether parents will get their children vaccinated and achieve successful disease prevention outcomes (17). The research by Cagnotta C et al. (2025) shows that parents with less education tend to have fewer vaccinations and experience more vaccine-preventable diseases (18). A lack of adequate parental education may influence why parents choose specific vaccines and prevents early disease recognition thereby delaying necessary medical treatment. Healthier education programs targeting parents with low education levels could help lower measles transmission rates among vaccinated groups of patients.

The effectiveness of vaccination plays a role in this study together with clinical and socio-economic variables. High vaccination rates among the population do not explain the widespread cases of measles among children because it challenges the enduring protective value of vaccinations toward specific subgroups. Several studies have been similarly reported cases of breakthrough in areas where the immunization rate is suboptimal or where the immunity progressively decreases over time (19). Bianchi FP et al. (2021), in a study, have also observed that vaccine efficacy may decline over time in populations that do not receive recommended booster doses (20). Though highly effective, the MMR vaccine fails occasionally, which serves as a reminder that surveillance needs to continue and booster campaigns need to happen to keep herd immunity maintained and prevent the spread of measles.

Conclusion: We found multiple key elements that affect vaccine effectiveness in children through our study, which shows how gender type, clinical symptoms, household income, and parent education impact measles development. The research results support similar past findings and show that public health protocols need to help both healthcare and social development. Researchers should test the MMR vaccine's performance for all social groups and measure both booster sessions and parent education to prevent measles return in children who are already protected.

CONFLICT OF INTEREST: - The authors declare no conflict of interest.

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