

Epidemiological Characteristics, Vaccination Coverage And Complication In Pediatric Cases Of Measles In Zhob, Pakistan

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Abstract—

Objective: To assess the epidemiological characteristics, immunization coverage, identify causes of inadequate vaccination, complications and mortality among pediatric cases of measles at Zhob.

Study design, place and duration: Observational study, District Headquarter Hospital Zhob, from November 2020 to April 2021.

Methodology: All the pediatric (<15 years) cases of measles reported at the District Headquarter hospital during the research period were enrolled. Measles was diagnosed clinically in cases with fever (101F or more), maculopapular rash over the body, cough, coryza and conjunctivitis. Cases with complications of measles were admitted and were referred to tertiary care hospital if the condition was serious. According to the Expanded Program of Immunization (EPI), the child was declared unvaccinated if he had not received any of the recommended two doses of measles vaccine and incompletely vaccinated if only one dose was administered. Measles cases were divided and compared into two groups; measles cases associated with complications and uncomplicated cases. Chi-square was used for analyzing qualitative variables. An Independent T-test was used for the quantitative variables. A Multinomial regression model was used to identify the predictors for complete vaccination.

Results: A total of 298 measles cases were reported at DHQ hospital, Zhob, from November 2020 to April 2021. The mean age of measles cases was 52.12±37.98 months with a mean weight of 19.01 ± 9.95 kgs. There were 157(52.7%) males compared to 141 (47.3%) females. Around 21 (7%) children younger than 12 months, 196 (65.8%) cases were between 12 months and 60 months, and 81 (27.2%) children were older than 60 months, i.e. five years. Out of 298 measles cases, only 44 (14.8%) had received both doses of measles vaccination. Rest 57 (19.1%) were partially vaccinated, i.e. had received one dose only, and 197(66.1%) did not receive any dose. Lack

of knowledge about vaccination(41.7%) and difficulty in access to the health centre(41.3%) were identified as the two significant barriers to vaccination. Regression analysis identified nutritional status, settled families and urban population as the strongest predictors for complete vaccination. Measles associated complications were reported in 33 (11.1%) cases. Among these, pneumonia and diarrhea with dehydration were the most frequent complications, affecting 15 (5%) and 11 (3.7%) cases, respectively. Four(1.4%) children developed encephalitis, and three cases (1%) had laryngotracheitis. Around 32 (10.7%) children had severe malnutrition. Out of the total, seven died of measles complication, four died of pneumonia, and three died of encephalitis.

Conclusion: Measles is still a significant problem in far-flung under-developed areas of Pakistan with low vaccination coverage, especially in rural and nomadic populations. Inadequate measles vaccination and malnutrition increase the risk of complication (morbidity and mortality) in patients with measles.

Keywords—Complications, Epidemiology, Measles, Pediatric, Vaccination,

Introduction

Measles is a preventable infectious disease. It is a major cause of mortality in children under five years of age (1). Measles resulted in more than two million deaths per year before its vaccination was introduced in the 1960s (2). Measles virus is a Morbillivirus, belonging to the Paramyxoviridae family of viruses. Structurally, it is single-stranded, enveloped and non-segmented (3). Measles is prevalent throughout the world, and human beings are the only known hosts, but monkeys can also be infected (4). In the absence of measles vaccination, the epidemics of measles would occur after 2 to 5 years and can last for 3 to 4 months, resulting in various grave complications (5). An outbreak of measles usually occurs in late winters and the start of the spring season (6). Epidemics of measles in winters have been attributed to risk factors like over-crowding in closed spaces during winters (5).

The measles virus is highly contagious. The measles virus can be detected for a long time (even months) in the nasopharynx, blood and urine of infected children (7). The mode of transmission of this virus is via droplets and small particle aerosols, which can remain suspended in the air for hours (7). Incubation of measles is 10-14 days, i.e. 4 to 5 days before the appearance of rash and 4 to 5 days after its disappearance (6). After the incubation period, the patients develop fever, cough, coryza and conjunctivitis. Koplik spots are pathognomonic for this illness. Koplik spots are bluish-white lesions that appear before the onset of a rash over the body and persist for 2 to 3 days (8). Koplik spots appear on buccal mucosa at the upper first molar tooth level and are 2-3 mm raised (8). The rash appears over the body, which persists for 3 to 7 days and can also involve palms of hands. The rash first appears on the face and then gradually moves down towards the body. The patients can also have headaches, pain abdomen, mild lymphadenopathy,odynophagia etc. (6). The complications of measles occur in children under five years of age or those older than 20 years (9). Malnutrition, non-vaccination, vitamin A deficiency, and immunocompromised conditions, e.g. HIV, increase the risk of measles (9,10). The risk of death in measles cases is 0.2% increasing to 10 % in the presence of risk factors especially immunocompromised patients (9,10). Measles is associated with many complications, which can lead to death if not treated promptly. These complications include pneumonia, encephalitis, diarrhea with or without blood (causing dehydration), seizures/fits (encephalitis), laryngotracheitis, myocarditis etc. (11).

Around 85% of children are currently vaccinated globally (9). In Karachi (the biggest city of Pakistan), Sheikh S et al. has reported 90 % coverage of measles vaccination (12). Baluchistan is a province where approximately 10% of the population lives in urban areas, and the rest 90% lives in rural areas (13). In Baluchistan rural population follows two patterns of living, i.e. settled and nomadic. Nomadic population migrates each year from colder climatic areas to relatively hotter areas to migrate back after the weather changes. The settled rural population remains at the same place throughout the year.

We have carried out this study in Zhob district (Baluchistan) to find out the epidemiological characteristics, immunization coverage of measles, causes of inadequate vaccination, complications and mortality among pediatric cases of measles.

Methods

The study was carried out at District Headquarter Hospital (DHQ) Zhob from November 2020 to June 2021. Ethical approval committee permission was obtained for subject research from the research committee of the hospital. All the pediatric (<15 years) cases of measles reported at the hospital during the research period were enrolled. Consent of parents of

these children was obtained for inclusion in the study. A qualified pediatrician diagnosed measles after detailed history and examination of the cases. Measles was diagnosed clinically in cases with fever (101F or more), maculopapular rash over the body, along with cough, coryza and conjunctivitis (11,13). Cases with complications of measles were admitted and were referred to tertiary care hospital if the condition was serious. Pneumonia was diagnosed according to the World Health Organization (WHO) guidelines and radiological evidence of pulmonary involvement. The central nervous system was said to be involved if the child was irritable, lethargic, had decreased consciousness level, fits or any neurological deficit (11,13). Laryngotracheitis is a respiratory tract infection with difficulty breathing and/or stridor in the absence of lung parenchymal involvement (14). According to National Centre for Health Statistics (NCHS) charts, nutrition was assessed and categorized as mild, moderate and severely malnourished (11).

All the data including, age, gender, vaccination status for measles, causes of non-vaccination or incomplete vaccination, the complication of measles, residence (whether urban or rural), nomad living or settled living, nutritional status, mortality and season/month wise presentation was recorded and analyzed using IBM SPSS Statistics for Windows, version 21.0 (IBM Corp., Armonk, NY, USA). The child was declared unvaccinated if he had not received any of the usual 02 doses of measles vaccine and incomplete vaccinated if only one dose was administered according to the EPI recommendations. Vaccination status was confirmed by checking the vaccination cards issued upon vaccination. The cases were divided into 02 groups. The cases of measles with associated complications were labeled Group A, and uncomplicated cases were labeled Group B. Both the groups were compared in terms of age, gender, mortality, vaccination status, nutritional status, residence (urban or rural) and accommodation style (nomadic or settled). Chi-square was used for analyzing qualitative variables like gender, age group, vaccination status, nutritional status etc. An Independent T-test was used for the quantitative variables like age and weight. Multinomial logistic regression analysis was used to assess and compare the effect of different variables on vaccination status. The statistical significance level was set at $p < 0.05$.

Results

A total of 298 measles cases were reported at the DHQ hospital, Zhob, from November 2020 to April 2021. The mean age of measles cases was 52.12 ± 37.98 months, with an age range from 5 to 177 months. The average weight of cases was 19.01 ± 9.95 kgs with a range of 06 to 56 kgs. There were 157 (52.7%) males compared to 141 (47.3%) females. There were 21 (7%) children younger than 12 months (<12 months), 196 (65.8%) cases were between 12 months and 60 months, and 81 (27.2%) children were older than 60 months, i.e. five years. Out of 298 cases

of measles, only 44 (14.8%) had received both doses of measles vaccination. Rest 57 (19.1%) were partially vaccinated, i.e. had received one dose, and 197(66.1%) did not receive any dose of measles vaccine. Out of 298 cases of measles, 33 (11.1%) cases had measles associated complications. Among these, pneumonia and diarrhea with dehydration were the most frequent complications, affecting 15 (5%) and 11 (3.7%) cases, respectively. Around four (1.4%) children developed encephalitis, and three cases (1%) had laryngotracheitis. According to the WHO guidelines, malnutrition was reported in 32 (10.7%) cases that had severe malnutrition. Out of the total, 07 (2.3%) cases died of measles complication, 04 died of pneumonia, and 03 died of encephalitis.

The measles cases reported to the hospital from both urban and rural areas. 194 (65.1%) cases belonged to rural areas of the district, and 104 (34.9%) cases hailed in the urban areas. In the Zhob district, people inhabit two types of living accommodations; settled houses/accommodation and nomadic (living in temporary tents called nomads). Total 168 (56.4%) cases of measles reported from nomads compared to 130 (43.6%) lived in settled housing/accommodations.

Table 1. Characteristics of measles cases

Characteristic	Cases (N=298)	Percentage
Age group		
< 12months	21	7%
12months – 60 months	196	65.8%
Above 60mths	81	27.2%
Gender		
Male	157	52.7%
Females	141	47.3%
Vaccination status		
None (unvaccinated)	197	66.1%
One dose (partial vaccinated)	57	19.1%
Two doses (Vaccinated)	44	14.8%
Main Complications		
Pneumonia	15	5%
Diarrhea with dehydration	11	3.7%
Encephalitis	4	1.4%
Laryngotracheitis	3	1%
Nutritional status		
Healthy	111	37.2%
Mild undernourished	93	31.2%
Moderate undernourished	62	20.8%
Severe undernourished	32	10.7%
Mortality	7	(2.3%)
Residence		
Urban	104	34.9%
Rural	194	65.1%
Housing/Accommodation		
Settled accommodation	130	43.6%
Nomads	168	56.4%

Only 44 (14.8%) cases had complete vaccination (02 doses). The remaining 254 cases were asked about the reason for incomplete or non-vaccination. The parents/guardians were interviewed to find the reason for not vaccinating, and their responses were recorded and displayed in table 2. Around 12 (4.7%) parents mentioned other reasons as the cause of non-vaccination, and the commonest reply was the absence of father/guardians.

Table 2. Causes of not vaccination among partially or completely unvaccinated cases

S/Number	Cause of not vaccinating	Frequency	%age
1	Lack of knowledge/awareness about vaccination	106	41.7%
2	Lack of access	105	41.3%
3	Vaccination is harmful	31	12.2%
4	Any other	12	4.7%
Total		254	100%

The measles cases were divided into two groups; cases with complications and cases without complications. Both the groups were compared in terms of age, weight, gender, vaccination status, mortality, severe malnutrition, residence (urban or rural) and housing/accommodation style, i.e. nomad or settled. Complications of measles were more in inadequately vaccinated ($p=0.039$) and malnourished ($p=0.046$), as shown in table 3. The children who had complete vaccination of measles did not have any complication. Similarly, the complicated cases had significantly less weight as compared to uncomplicated cases (46.24 ± 33.04 versus 19.55 ± 10.18 kgs); p -value less than 0.007. In contrast, age, residence (urban or rural) and accommodation style (settled and nomads) had no significant association with complications of this sinister disease, as shown in table 3.

Table 3. Comparison of characteristics between complicated versus uncomplicated cases

Characteristic	Total (N=298)	Complications (N=33)	Uncomplicated Group (N=265)	P value
Age (months) mean \pm SD	52.12 \pm 37.98	46.24 \pm 33.04	52.85 \pm 38.54	0.347
Weight (kilograms) mean \pm SD	19.01 + 9.95	14.63 \pm 6.46	19.55 \pm 10.18	0.007
Age group < 12months 12months – 60 months Above 60mnths Total	21(7%) 189(63.4%) 88(29.5%) 298(100%)	3(9.1%) 19(57.6%) 11(33.3%) 33(11.1%)	18(6.8%) 170(64.2%) 77(29.1%) 265(88.9%)	0.740
Gender Male Females Total	157(52.7%)141(47.3%) 298(100%)	25(75.8%) 8(24.2%) 33(11.1%)	132(49.8%) 133(50.2%) 265(88.9%)	0.005
Vaccination status Vaccinated Partial Vaccinated Complete Unvaccinated Total	44(14.8%) 57(19.1%) 197(66.1%) 298(100%)	0 7(21.2%) 26(78.8%) 33(11.1%)	44(16.6%) 50(18.9%) 171(64.5) 265(88.9%)	0.039
Mortality	07(2.3%)	07(100%)	0	0.000
Nutritional status Healthy Mild undernourished Moderate undernourished Severe undernourished Total	111(37.2%) 93(31.2%) 62(20.8%) 32(10.7%) 298 (100%)	08(24.2%) 10(30.3%) 07(21.2%) 08(24.2%) 33(11.1%)	103(38.9%) 83(31.3%) 55(20.8%) 24(9.1%) 265(88.9%)	0.046
Residence Urban Rural Total	194(65.1%) 104(34.9%) 298(100%)	19(57.6%) 14(42.4%) 33(11.1%)	175(66%) 90(34%) 265(88.9%)	0.336
Accommodation Settled Nomads Total	130(43.6%) 168(56.4%) 298(100%)	11(33.3%) 22(66.7%) 33(11.1%)	119(44.9%) 146(55.1%) 265(88.9%)	0.206

The monthly distribution of cases from November 2020 to April 2021 is shown below in figure 1. Majority of cases reported in February (54%), as there was a small outbreak in nomads living in the outskirts of the district, as shown in the figure below.

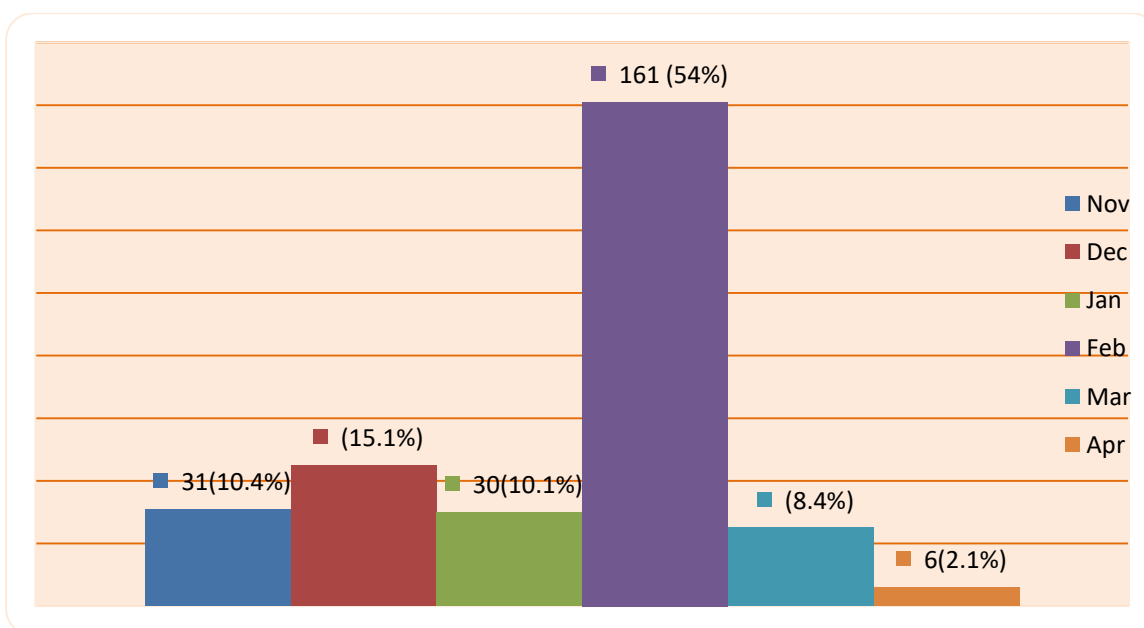


Figure 1. Month-wise distribution of measles cases

We assessed the vaccination status of measles cases according to their residence, i.e. urban or rural, and living style, i.e. settled and nomadic. We saw a significant association between residence and type of living. The majority of measles cases from rural areas were unvaccinated (83.5%), as shown in Table 4. Only 5.2% of measles cases from rural areas were completely vaccinated. In urban areas, 32.7% of cases were completely vaccinated, and 33.7% had received one shot (partially vaccinated), and 33.7% were unvaccinated. In the nomadic population, only 4.8% were completely vaccinated, and 89.9% were unvaccinated. However, 27.7% were completely vaccinated among cases from settled accommodation, and 35.4% were unvaccinated, as shown in Table 4. The measles cases from rural areas and nomadic population were significantly less vaccinated ($p < 0.001$) than urban and settled population.

	Vaccination status			Total	P-value
	Vaccinated	Partially vaccinated	Unvaccinated		
Residence					
Urban	34(32.7%)	35(33.7%)	35(33.7%)	104 (34.9%)	P<0.001
Rural	10(5.2%)	22(11.3%)	162(83.5%)	194 (65.1%)	
Total	44(14.8%)	57(19.1%)	197(66.1%)	298 (100%)	
Living/Accommodation					
Nomad	8(4.8%)	9(5.4%)	151(89.9%)	168(56.4%)	P<0.001
settled	36(27.7%)	48(36.9%)	46(35.4%)	130(43.6%)	
Total	44(14.8%)	57(19.1%)	197(66.1%)	298(100%)	

Table 4. Association of vaccination with residence (Rural & Urban) and Living style (settled & Nomadic)

Compared to unvaccinated, multinomial logistic regression analysis showed that nutritional status, settled families and urban population were the strongest predictors for vaccination after controlling for age and gender (Table 5).

Table 5. Multinomial regression model assessing predictors for vaccination (n=298)

Variables		Vaccinated		Partially vaccinated	
		RR (95% CI)	p-value	RR (95% CI)	p-value
Area of residence	Rural	.107 (.042-.273)	<0.001	.227 (.098-.524)	=0.001
	Urban	Reference		Reference	
Nomad or settled population	Settled	12.89 (4.64-35.74)	<0.001	18.32 (6.95-48.28)	<0.001
	Nomad	Reference		Reference	
Nutritional status	Mild undernourished	.273 (.095-.782)	=0.016	.337 (.124-.911)	=0.032
	Moderately undernourished	.420 (.126-1.39)	=0.156	.594 (.195-1.80)	=0.359
	Severely malnourished	.112 (.024-.572)	=0.014	.174 (.039-.772)	=0.022
	Healthy	Reference		Reference	

Referent category: Unvaccinated group

Discussion

Measles is a highly contagious infection with morbidity and mortality. Although the incidence of measles has decreased worldwide, outbreaks still occur in many parts of the world (15). Wesolowski et al. had reported that vaccination coverage in urban Baluchistan was 77.4% compared to 47.8% in rural areas, where 90% of the population of the province resides (15). This immunization coverage is much less than in other parts of the country. In our study, 32.7% of measles cases reporting from rural areas had complete vaccination.

We saw that only 14.8% of pediatric measles cases had complete vaccination (received 02 doses). This is almost similar to the finding by Khan et al., who studied measles cases in Bannu and surroundings

(Khyber Pakhtunkhwa, Pakistan) and found out that out of 578 measles cases, only 11.59% were vaccinated (16). In contrast, Khan et al. showed that 93.7% of children in and around Peshawar had received one dose of measles vaccine, and 49.8% had received both doses of measles vaccine, which is much higher than that seen in our study (17).

Our research showed that the majority of cases that had complications were males, which is similar to the results of a study carried out by Rehman, who showed that 60.3% of cases with complications were males (11). Pneumonia is the most frequent complication of measles reported in 16-77% of measles cases (18). Rehman and colleagues showed pneumonia and diarrhea as commonest complications, coinciding with our finding (11). Avial-Figueroa and colleagues also showed pneumonia as

the commonest complication encountered, followed by diarrhea and laryngotracheitis (14).

Malnutrition decreases the immunity of the individual and enhances mortality (19). In our study, 14.4% of children had severe malnutrition, which is slightly less than that shown by Rehman and Zahidie et al. (11, 19). Several studies show a significant association between malnutrition and morbidity/mortality of measles, similar to our research (20,21). The mortality has been reported 1% to 2% in endemic situations and 3-3.7% in epidemic situations (11). In our study, we saw a 2.3% mortality of measles. It is less than mortality reported by Rehamna, Avial-Figueroa and Aurangzeb et al. (11,14,18).

In our research majority of cases belonged to the rural areas (65.1%). This finding is consistent with the results of previous research in similar areas of our country (16,17). People live in scattered, far-flung areas with poor access to health care leading to inadequate vaccination. We also identified the nomadic population at major risk as the majority of measles cases (56.4%) reported from nomadic areas compared to the settled areas (43.6%). The measles cases from rural areas and nomadic population were significantly less vaccinated ($p < 0.001$) than urban and settled population. In 2018, Zubair and colleagues reported a measles outbreak in the Nasirabad district of Baluchistan among nomadic populations and found a significant association between measles outbreak and lack of routine measles vaccination/vaccination coverage nomads (22). This nomadic population presents a gap in vaccination coverage and poses a permanent threat to small recurrent outbreaks. Health care providers should carry out frequent vaccination in such areas. Awareness of people needs to be enhanced through social media, awareness campaigns, and local influencers' active role to achieve maximum vaccination and prevent this sinister disease. Large-scale surveys should be performed in all nomadic populations of Baluchistan to ascertain the exact prevalence of measles and efforts to enhance awareness against measles. There are few limitations when conducting a study in such a remote area. First, due to limited resources (human, financial, administrative), a large scale survey of nomadic and rural populations was not possible. Secondly, nomadic and rural populations live in scattered, hard-to-reach areas that are not accessible by road or transport, making the vaccination difficult.

Conclusion

Measles is still a significant problem in far-flung areas with inadequate vaccination, especially in rural and nomadic population. Poor measles vaccination and malnutrition increase the risk of complication (morbidity and mortality) in measles patients.

Conflict of interest

There is no conflict of interest.

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