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Prevalence and Risk Factors Associated with Diphtheria in Patients Presenting to Lady Reading Hospital MTI Peshawar KPK

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ABSTRACT

Background: Diphtheria as an otherwise immunolabel but life-threatening infection remains a significant health concern in developing countries and especially in population areas with poor immunization coverage. Over the recent past years, there have been an observable rise in cases of diphtheria in Pakistan particularly in Khyber Pakhtunkhwa or (KPK). The Lady Reading Hospital (LRH) in Peshawar has become one of the key players in the administration of these cases, and therefore, there is the lack of localized research of the burden and determinants of the disease. **Objectives**: To assess the prevalence and Risk factors of diphtheria among patients at Lady Reading Hospital, Peshawar, to analyze the impact of vaccination on disease severity and outcomes. **Methodology***:* A descriptive cross-sectional study was conducted at LRH six months between January and June 2025. Non-probability convenience sampling was done in 139 confirmed cases of diphtheria. The cosponsored questionnaire, which was based on a structured form focused on demographics, the medical history, vaccination background, and exposure-related factors, was used to collect data. The SPSS version 25 was used to enter all data and analyze it. A descriptive statistic was utilized to summarize the risk factors and the characteristics of patients. **Results***:* The results showed that children aged less than ten years and with incomplete or no immunization history formed most of the cases of affected persons. Sore throats, fever and typical formation of pseudo membrane were also present. Various risk factors have been characterized such as low rates of coverage of vaccines, poor sanitation, household congestion, and density of lack owing to healthcare services. Over 50 percent of the cases did not have record of receiving a complete course of the diphtheria vaccine. **Conclusion**: Serious concerns are highlighted in the paper about an alarming comeback of diphtheria outbreak in Peshawar where it is mostly attributed to a lack of immunization and general knowledge regarding the health involved. Specific action is required to ensure better routine immunization program, increase public health education and overcome the socioeconomic barriers to accessing healthcare.

INTRODUCTION

Diphtheria is a vaccine-preventable disease, which is caused by a gram positive bacterium Corynebacterium diphtheria primarily influencing mucous membranes of the respiratory tract, but can also spread to the skin as well as other organs via the systemic toxin dispersion (1). Due to a high rate of development and a great risk of lethal complications, especially, among the children and persons with insufficient immunity, the disease is characterized by a high increase in the number of diseased persons. Although the vaccine against the disease (diphtheria toxoid vaccine) has been available to the market since decades ago, the disease keeps on reemerging and this is especially in low- and middle-income nations where health infrastructures tend to lack resources (2). The worldwide picture presents the resurgence of some areas, which is dangerous because of the dropping immunization levels, rising vaccine refusal, and the disruptions in the health services (3).

Diphtheria used to be a serious cause of childhood morbidity and death in most parts of the world. Dramatically, the incidence of DTP (diphtheria-tetanus-pertussis) vaccine reduced in most parts of the world due to the development and implementation of the vaccine. But of late years we are witnessing the rebound of the cases in the areas where the immunization rates prove to be

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inadequate, as well as in areas where the disease is poorly monitored (4). WHO has registered more than 16,000 cases of diphtheria in 2022; the highest number of cases were obtained in the Southeast Asia region, namely in India and Indonesia (5). Such patterns can be viewed as an indicator of a worsening of herd immunity as well as an under appreciation of the continued risk of the disease in ill-equipped populations (6).

Pakistan still has a great problem regarding the elimination of diphtheria. Though an immunization structure, which is known as Expanded Program on Immunization (EPI) is in existence since the year 1978, the country has not been able to uphold optimal levels of vaccine coverage (7). According to the National Institute of Health (NIH), in 2023 alone, there have been reported more than five hundred cases of diphtheria, which is an alarming figure so far youth, under the age of ten, have been one of the primary victims (8). Reentry of diphtheria in Pakistan has been frequently blamed on the poor conditions of cold chains, logistic problems in timely supplies of vaccines, or the no receipt of follow-up on immunization strategies in far-flung locations (9).

A Khyber Pakhtunkhwa (KPK) province is among the most and repeatedly affected regions in Pakistan because of the frequent instances of diphtheria outbreaks in the previous several years. The KPK Health Department reported more than 120 cases in the year 2023, with a huge concentration in the urban centers namely Peshawar, Mardan, and Swat (10). High population density, poverty, poor sanitation and lack of nearby health facilities are common causes of escalation of such outbreaks (11). Poor knowledge of the schedules and even lack of knowledge regarding the time of the schedule only worsens the situation with vaccinations and contributes to this process due to the existing myths about the safety of vaccines (especially in rural areas) (12).

Operational Definitions

- **Diphtheria:** A bacterial infection caused by Corynebacterium diphtheriae, characterized by respiratory symptoms such as sore throat, fever, and pseudo membrane formation. Diagnosis is confirmed through clinical assessment and laboratory tests (culture/PCR).
- **Prevalence**: The proportion of confirmed diphtheria cases among patients presenting to Lady Reading Hospital, Peshawar, during the study period.
- **Risk Factors:** Conditions increasing susceptibility to diphtheria, such as low immunization rates, malnutrition, overcrowding, and limited healthcare access.

METHODOLOGY

A descriptive cross-sectional study was done in a hospital in the form of a cross-sectional study spanning six months between January and June 2025. The sample size has been calculated by using Cochran formula however, the common formula used in the cross-sectional research. Corresponding to an assumed prevalence rate of diphtheria of 10%, a 95 percent level of confidence, and a level of error at 5 per cent, then the calculated sample size is 139 participants. . The samples were 105 while using single population proportion formula: $n = Z2 * p * (1 - p)/d2 = 1.962 * 0.899 * 0.101/0.052 = 138.5 = 139$. Such number is expected to give a representative as to have a meaningful analysis. Non-probability convenience sampling was done in 139 confirmed cases of diphtheria. The cosponsored questionnaire, which was based on a structured form focused on demographics, the medical history, vaccination background, and exposure-related factors, was used to collect data. The SPSS version 25 was used to enter all data and analyze it. A descriptive statistic was utilized to summarize the risk factors and the characteristics of patients.

RESULTS

The study involved 139 participants confirmed with diphtheria at Lady Reading Hospital (LRH), Peshawar. The mean age was approximately 7.56 ± 3.92 years, highlighting the vulnerability of younger populations. The gender distribution was almost even: 50% male, 47.1% female, and 2.1% identifying as other. Geographically, Peshawar district accounted for the highest number of cases (34.3%), followed by Charsadda (8.6%) and Bannu (6.4%). Nearly half the sample resided in rural areas (49.3%), and 50% in urban settings. In terms of education, a significant proportion had only primary (25.7%) or secondary education (35%), while 20.7% had no formal education. Most families earned under PKR 30,000 monthly, with 54.3% earning over 30,000, indicating socioeconomic diversity. Occupation data revealed laborers (28.6%), teachers (10%), and farmers/shopkeepers (10% each) as most common.

A notable 79.3% reported overcrowded housing, and only 25.7% lived in semi-pakka structures, indicating compromised living conditions. A significant number of homes had 2–3 rooms, regardless of family size. Clinically, 25% of patients presented with sore throat, fever, and pseudo membrane, while others had combinations involving hoarseness and swollen neck. The majority had symptoms for 2–3 days before presenting (75.3%). Most patients (72.9%) were referred cases. Immunization data revealed:72.9% claimed vaccination, but only 62.9% were fully vaccinated.26.4% were completely unvaccinated,47.9% lacked immunization cards,15% of respondents were unsure about their vaccination status, regarding nutritional status, 14.3% were underweight, and 4.3% were severely malnourished. Access to health care varied; some patients had to travel 10–20 km for 60–90 minutes, highlighting logistic challenges.

Public health awareness was limited: 78.6% were aware of immunization, 20% cited cultural/religious barriers to vaccination,88.6% had been visited by a health worker, Diphtheria was mild in 70%, moderate in 18.6%, and severe in 10.7%. Timely administration of diphtheria antitoxin occurred in 91.4% of cases, with complications like airway obstruction (7.9%), neuropathy (7.1%), and myocarditis (2.9%) observed. Overall, 95.7% of patients recovered, while 3.6% succumbed to the disease.

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Table 1
Descriptive Statistic of Different Variable

Age	Range	Mean	Std.Deviation
Total Number 139	17	7.56	3.923
Gender	Categories	Frequency	Percentage
	Male	73	52.52%
	Female	66	47.48%
Residency	Rural	69	49.64%
	Urban	70	50.36%
Education	No formal Education	29	20.86%
	Primary	36	25.90%
	Secondary	49	35.25%
	Higher	25	17.99%
Monthly Income	More than 30,000	76	54.3%
	10,000-20,000	10	7.1%
	20,001-30,000	53	37.9%
Type of Housing	Kacha	17	12.1%
	Pakka	86	61.4%
	Semi-Pakka	36	25.7%
Number of Rooms	1	3	2.1%
	2	37	26.4%
	3	49	35.0%
	4	26	18.6%
	5	11	7.9%
	6	12	8.6%
	7	1	0.7%
Is the house over crowded	Yes	111	79.86%
	No	28	20.14%
Referred	Yes	102	73.38%
	No	37	26.62%

Table 2
Descriptive Statistic of Different Variable

	Categories	Frequency	%age
Duration of Symptoms	1	8	5.7%
	2	56	40.0%
	3	49	35.0%
	4	14	10.0%
	5	10	7.1%
	6	2	1.4%
The patient has contact with a suspected diphtheria Case in the Past two weeks	Yes	48	34.3%
	No	41	29.3%
	Don't know	50	35.5%
Has the patient received diphtheria vaccination?	Yes	102	72.2%
	No	16	11.4%
	Don't know	21	15.0%
If vaccinated, what is the vaccination status	Fully Vaccinated	88	62.9%%
	Partially Vaccinated	14	10.0%
	Unvaccinated	37	26.4%
If partially vaccinated, how many doses were received	1	2	1.4%
	2	11	7.9%
	Missing	127	90.7%
Do you have an immunization record/Card	Yes	72	51.4%
	No	67	47.9%
Nutritional Status (as assessed clinically)	Normal	113	80.7%
	Underweight	20	14.3%
	Severely Malnourished	6	4.3%
Did the patient receive treatment before coming to LRH	Yes	124	88.6%
	No	15	10.14%

Table No 3 presents the occupational distribution of the study participants, showing both the frequency and percentage for each category. The data highlights that the majority of respondents belong to the labor group, with 40 individuals, representing 28.6% of the total. Farmers and carpenters follow with 16 participants each, making up 11.4% in both categories. Shopkeepers and teachers are also significantly represented, each accounting for 10% of the respondents.

Other professions such as tailors (5.7%) and contractors (2.9%) had relatively smaller shares, while occupations including lawyers and health department workers stood at 2.1% each. Meanwhile, single representatives were observed in several professions, such as accountant, businessman, clerk, driver, hotel waiter, mechanic, merchant, molvi, office assistant, painter, plumber, policeman, storekeeper, taxi driver, and watchman, each contributing only 0.7% to the overall sample.

This distribution indicates that the majority of the participants come from working-class and labor-intensive backgrounds, reflecting the socioeconomic composition of the study area. The dominance of laborers, farmers, and carpenters suggests that manual and agricultural work are the most common sources of livelihood. On the other hand, the limited presence of white-collar professions such as accountants, clerks, and lawyers points to fewer opportunities in formal employment sectors.

Overall, the table demonstrates a clear trend where occupations requiring physical work and basic skills are more prevalent compared to technical or professional jobs. This occupational pattern provides valuable context for understanding the community's socioeconomic environment.

Table 3
Descriptive Statistic of Different Variable

Category	Frequency	Percentage
Accountant	1	0.7%
Business Man	1	0.7%
Carpenter	16	11.4%
Clerk	1	0.7%
Contractor	4	2.9%
Driver	1	0.7%
Farmer	16	11.4%
Health Department	3	2.1%
Hotel waiter	1	0.7%
Labor	40	28.6%
Lawyer	3	2.1%
Mechanic	1	0.7%
Marchant	1	0.7%
Molvi	1	0.7%
Office assistant	1	0.7%
Painter	1	0.7%
Plumber	1	0.7%
Police man	1	0.7%
Shopkeeper	14	10.0%
Store keeper	1	0.7%
Tailor	8	5.7%
Taxi driver	1	0.7%
Teacher	14	10.0%
Watch man	1	0.7%

The responses provided useful insight into community exposure and awareness regarding infectious disease transmission. Out of the total participants, 50 individuals (approximately one-third) reported having contact with a suspected diphtheria case within the specified period. This

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finding highlights a potential risk of disease spread through direct or indirect interaction with infected persons, emphasizing the importance of early detection and preventive measures.
On the other hand, 49 respondents stated that they had not been in contact with any suspected diphtheria case. This nearly equal distribution between the "yes" and "no" groups suggests that while some individuals are at clear risk of exposure, others may have remained unexposed, possibly due to limited mobility, better preventive practices, or unawareness of suspected cases in their surroundings.
Interestingly, 40 participants answered "don't know," reflecting a significant portion of individuals who were uncertain about their exposure status. This uncertainty might stem from a lack of awareness about the symptoms of diphtheria, limited health education, or inadequate communication within communities about suspected cases. Such responses indicate gaps in public knowledge and the need for stronger health awareness campaigns to improve community recognition of infectious diseases.

Figure 1

DISCUSSION

This research has provided important insights into the epidemiological and social determinants of diphtheria in Khyber Pakhtunkhwa, particularly within the patient population of LRH Peshawar. The young average age of affected individuals is consistent with global evidence showing diphtheria's predominance in children under 10, largely due to incomplete or absent immunization. This aligns with WHO reports (2023) and similar studies in KPK that link lower immunization rates with disease resurgence. The gender parity and balanced urban–rural split point toward widespread vulnerability, rather than concentration in a specific subgroup. However, the socioeconomic variables—notably poor housing conditions, low income, and large family size emphasize that environmental factors like overcrowding and sanitation play a key role in transmission (!3).
Educational gaps were notable. A substantial proportion of families had no formal education, reinforcing previous findings (e.g., Arif et al., 2019) that parental education is directly correlated with vaccination compliance. Despite the reported vaccination status of over 70%, detailed breakdowns reveal that nearly 40% were either partially or completely unvaccinated, and a similar number lacked verifiable records. This raises concerns about record-keeping accuracy and false perceptions of immunization status. Additionally, 20% cited cultural or religious obstacles, confirming literature on vaccine hesitancy in northern Pakistan (Safdar et al., 2023) (14).
Notably, delays in seeking medical attention (2–3 days after symptoms) and the need for referrals suggest insufficient peripheral healthcare infrastructure. Though the administration of DAT was prompt in most cases, complication rates, especially airway obstruction and neuropathy, reflect challenges of delayed diagnosis and disease severity. The high recovery rate (95.7%) is encouraging, suggesting effective hospital-based management yet the mortality rate (3.6%) is concerning, especially as diphtheria is preventable (15).
In addition to immunization, there is a set of social determinants that has an impact on the prevalence of diphtheria. It is well acknowledged that poverty, poor housing, malnutrition and sanitation contribute to the spread of infectious disease.
The respiratory pathogen like C, diphtheriae spread easily person to person and in societies where people live in a single home, infection of many individuals is easily attained. Children who are malnourished, especially children with a lacking set of micronutrients, including vitamin A or iron, might experience an impaired immune reaction, making them more prone to infection and difficulties (16). Moreover, the health awareness and deplorable conditions of hygiene persist to be the longstanding determinants in achieving the right to health, most particularly in the low-profile city communities, the interior villages and rural areas (17).
Vaccine rejection is a significant issue to immunization in Pakistan. Cultural myths, religious misconception, and mistrust of the healthcare system as the factors blocking the acceptance of the vaccine have been documented in multiple studies. Other rumors in the KPK include parents not wishing to have their children vaccinated because the vaccines make children infertile or have various groups of extended health problems. In many cases, local leadership or inexperienced medics can support such beliefs. Besides, the presence of political instability and conflict has caused a drop in healthcare outreach and has on certain occasions put health workers under violence, and therefore acts to even more hinder the vaccination campaigns (18).

CONCLUSION

This study has underscored the continued public health threat posed by diphtheria in KPK. While the majority of patients recover, the young age distribution, low immunization coverage, poor sanitation, overcrowding, and limited access to healthcare all compound the risk. The findings reinforce that diphtheria is far from eliminated, and localized outbreaks as witnessed at LRH can emerge when routine vaccination and awareness programs lapse. The high recovery rate (95.7%) is encouraging, suggesting effective hospital-based management yet the mortality rate (3.6%) is concerning, especially as diphtheria is preventable. . Despite the reported vaccination status of over 70%, detailed breakdowns reveal that nearly 40% were either partially or completely unvaccinated, and a

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similar number lacked verifiable records.

Recommendation

To control diphtheria cases, hospital management should ensure steady vaccine supply, trained staff, and coordination with local health bodies. Digital record systems can improve tracking and follow-up of missed doses. Community outreach through female health workers can help counter vaccine hesitancy. Emergency units must be equipped with antitoxin and diagnostics. Strengthening internal reporting and staff training, along with school-based booster programs, will support early response and public trust.

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