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# PARENTAL KNOWLEDGE OF MENINGOCOCCAL DISEASE AND VACCINATION IN LAHORE, PAKISTAN: A CROSS-SECTIONAL STUDY

Zohaib ul Hassan<sup>1</sup>, Waqas Akram<sup>1</sup>, Mohammad Abdullah<sup>1</sup>, Mustafa<sup>1</sup>, Zaem Ullah<sup>1</sup>, Ali Akhtar<sup>1\*</sup>

<sup>1</sup>Faculty of Pharmaceutical Sciences, University of Central Punjab, Lahore, Pakistan

\*Corresponding Author: Ali Akhtar. E. mail: [aliakhtar5657@gmail.com](mailto:aliakhtar5657@gmail.com)



## Abstract

*Invasive meningococcal disease is caused by the pathogen Neisseria meningitidis, which is an encapsulated Gram-negative bacterium that causes disease in humans, particularly children. It is a serious threat to the general health of the population in Pakistan. This cross-sectional research will examine the awareness of parents in Lahore on the same disease and the respective vaccinations, with the aim of informing future health policies. A survey was done on 351 parents in Lahore with children aged below 18 years. A pretested questionnaire was used to measure sociodemographic variables, general awareness about the disease, and awareness of preventive vaccines. The questionnaire had 8 questions, out of which 5 are knowledge-based questions with a maximum score of 5. The statistical methods of analysis were used to reveal the correlations between demographic factors and general levels of knowledge. Out of 351 respondents, 67 percent of them were able to tell that the disease is caused by bacteria, and 57.8 % of them knew it was life-threatening. Only 35.9% reported knowledge of transmission via respiratory droplets. Sociodemographic factors had a great impact on knowledge levels. Parents aged between 26- 40 years, post-graduate educated parents have a higher income level were more understanding. Parents who used the medical services of healthcare specialists demonstrated a significantly better level of knowledge than those who used social media. Although parents exhibit a basic level of knowledge on invasive meningococcal disease, there are some critical information gaps related to the transmission of the disease and its prevention. Only 44% of parents had sufficient knowledge. It is imperative to improve the education level in certified healthcare channels. This will enhance vaccine literacy and decrease the rates of diseases.*

**Keywords:** Bacterial meningitis, Health literacy, Invasive meningococcal disease, Lahore, Neisseria meningitidis, Pakistan, Parental knowledge

## INTRODUCTION

Meningococcal disease (MD) is a well-known public health issue worldwide that has existed more than 2 centuries. Neisseria meningitidis is an encapsulated Gram-negative bacterium that causes the disease and only infects humans. This pathogen can lead to severe conditions, and in particular, meningococcal meningoencephalitis and meningococemia (1). Of the 12 known serogroups, (groups of bacteria with the same antigens), six (A, B, C, Y, W and X) are the most significant causes of invasive meningococcal disease (IMD) in the world (2). The incidence has been estimated to be 500,000 cases per year worldwide with a fatality rate of 6-10% and 4.3-11.2% survivors with severe sequelae (3). MD has a very high burden, sometimes with a lasting neurologic impact and imposing an enormous financial burden to healthcare systems. The typical length of inpatient stay of acute hospital admissions is 6-18 days (4). Nasopharyngeal carriage with no symptoms is a critical aspect of the transmission of IMD, and varies with age. The rates of carriages are highest in late teens (23.7 percent) and 5-10 percent of adults are asymptomatic carriers at any moment. Carriage may rise to 90% in tightly-knit populations or epidemic conditions (5). Although serogroup B is the most common worldwide, cases known to be caused by W and Y have significantly risen in the past ten years, indicating the dynamic nature of the disease (6). In Pakistan, bacterial central nervous system infections continue to be a significant medical challenge. Local research indicates that meningitis is the most prevalent type of these infections (55%), which mainly affects low- to middle-income individuals



with limited education (7). A local pediatric study of 200 patients presenting with infectious diseases found that meningitis accounted for 20% of cases. Concerning, infectious diseases are highly prevalent in rural areas, and up to 48.5% of patients in some areas have gone without treatment (8).

Vaccination remains the most cost-effective method for IMD prevention. Protein-conjugate vaccines are highly recommended because they induce longer-lasting immunity and reduce bacterial carriage, effectively disrupting transmission chains (9). Targeting high-carriage groups, such as children and adolescents, with these vaccines has successfully generated indirect herd protection (when a large part of the population is immune through vaccination, protecting those who are not) and drastically reduced disease incidence in developed nations (10, 11). However, the developing world countries like Pakistan still struggles with implementing these vaccination programs due to financial barriers and inadequate epidemiological data (12).

For pediatric vaccination programs to succeed, parental knowledge is of necessity. Evidence shows a significant knowledge gap among parents regarding IMD and its available vaccines. While many parents recognize the disease generally, they often lack an understanding of specific serogroups and the vaccines available to deal with them (13). Parental vaccine literacy is directly related to their decision regarding vaccinations. Better interaction and searching for information increase vaccine literacy among parents; difficulty comprehending medical information leads to increased vaccine hesitancy (14). Lahore was chosen as the site for this study because it has significant burden of disease as well as a dense population that call for the need to investigate local awareness levels and also because the lack of sufficient epidemiological data on this specific public health issue.

Globally, meningococcal disease has an annual incidence of approximately 500,000 cases. The fatality rate ranges from 6% to 10%. Among adults, asymptomatic carriage of the bacteria is estimated at 5–10%, while the carriage rate is notably higher in late teens, reaching 23.7%.

## MATERIALS AND METHODS

In order to evaluate parents' knowledge of invasive meningococcal disease (IMD) and vaccination among parents living in Lahore, Pakistan, this study used a cross-sectional design. Data was collected from Dec 2025 to Feb 2026. Gender, age, education level, monthly income, source of medical information, and occupation were all requested of the participants to measure socio-demographic data. Five multiple-choice questions were used in the survey to gauge parents' knowledge of meningococcal disease. A correct answer earned one point for each question and the right answers in this section were added to determine the overall knowledge score, which ranged from zero to five. Furthermore three multiple-choice questions were included in this section to gauge parents' knowledge of meningococcal vaccinations. Parents living in Lahore with children under the age of 18 who consent to participate in the study meet the inclusion criteria. Those without children under the age of 18, those employed in the medical industry, and those who do not give informed consent were not allowed to participate.

Convenience sampling was used to find participants. Cochran's method with a 95% confidence level, a 50% predicted frequency, and a 5% margin of error was used to establish a minimum sample size of 351 people. A validated questionnaire taken from the previously published study was used to collect data (15). The questionnaire was translated into Urdu for parents who could not read English. The survey was disseminated via social media sites as well as a printed validated Questionnaire. Prior to participation, each participant gave their informed consent, and answers was private and anonymous. It takes three to four minutes to complete the questionnaire.

## DATA ANALYSIS AND STATISTICAL CLASSIFICATION

After collecting, analyzing, and coding the variables, the data was input into IBM SPSS Statistics for Windows, Version 21.0 (IBM Corp., Armonk, NY). When the P-value was less than 0.05, the data were deemed statistically significant. Any right response was worth one point in terms of knowledge. Discrete scores for various accurate knowledge items were added up to determine parents' overall IMD knowledge levels.

If a participant's overall knowledge score fell between 0 and 2, it was classified as an insufficient level of knowledge; if it fell between 3 and 5, it was judged sufficient. For the study variables, including the personal information of the participants, a descriptive analysis was carried out using percentages and frequency distributions. The significant relationships between sociodemographic characteristics and IMD knowledge were evaluated using the chi-square test.

## RESULTS

A total of 351 people consented to take part in the study, and as they all satisfied the inclusion requirements, none of them were disqualified. In terms of the sociodemographic characteristics of the participants, some were men and mostly were women. A portion of the participants were in the 18–25 age range. Of all the participants, a certain number were between the ages of 26 and 40, some were between the ages of 41 and 60, and just few were older than 60. Graduation-level education was held by the majority of participants. In terms of monthly income, a group of participants earned less than 30,000 PKR, while less no of participants earned more than 100,000 PKR. Furthermore, nearly all participants relied on medical professionals for their medical information. Lastly, a great no of participants was employed (Table I).

**Table I.** Socio-demographic characteristics of study participants

Characteristics		Frequency	Percent (%)
Age	18-25	26	7.4
	26-40	198	56.4
	41-60	123	35
	>60	4	1.1
Gender	Male	120	34.2
	Female	231	65.8
Education level	No formal education	36	10.3
	Primary education	68	19.4
	Graduated	165	47
	Post graduated	82	23
Monthly income	<30000	125	35.6
	30000-50000	86	24.5
	50001-100000	98	27.9
	>100000	42	12
Source of information	Family and friends	86	24.5
	Internet articles	35	10
	Social media	114	32.5
	Health care workers	116	33
Occupation	Employed	252	71.8
	Unemployed	94	26.8
	Retired	5	1.4

The participants' responses to questions about IMD knowledge are shown in Table II. Many participants knew that IMD is a life-threatening, disease whereas others knew that IMD is caused by bacteria. Out of all the participants, some knew that droplets can spread bacterial meningitis. Furthermore, a portion thought that vaccinations against meningococcal also prevent sepsis, and others thought that immunizations could prevent bacterial meningitis. On the other hand, parents reported that their children had completed routine vaccinations. Lastly, some expressed concerns about vaccinating their child, while others said it was crucial for the safety and protection of other members of society.

**Table II.** Participants' knowledge of IMD and vaccines

Items	Yes, n (%)	No, n (%)	I don't know, n (%)
<b>Invasive meningococcal disease (IMD) knowledge among parents</b>			
IMD is caused by bacteria	235 (67)	49 (14)	67 (19.1)
IMD is a life-threatening disease	203 (57.8)	73 (20.8)	75 (21.4)
Bacterial meningitis is transmitted by droplets.	126 (35.9)	115 (32.8)	110 (31.3)
Bacterial meningitis could be prevented by	161 (45.9)	95 (27.1)	95 (27.1)

vaccinations			
Vaccination against meningococcal also protects against sepsis	117 (33.3)	108 (30.8)	126 (35.9)
<b>Parental awareness to ward vaccines</b>			
Is routine vaccination complete?	213 (60.7)	57 (16.2)	81 (23.1)
Vaccinating a child is important for other society members	208 (59.3)	90 (25.6)	53 (15.1)
Do you have any concerns about vaccinating your children?	147 (41.9)	159 (45.3)	45 (12.8)

The participants were divided into two groups: those with an insufficient level of knowledge (aggregate score 0-2), 56% of parents exhibited insufficient knowledge and those with sufficient level of knowledge (aggregate score 3-5), 44% of parents exhibited sufficient knowledge (Fig. 1).

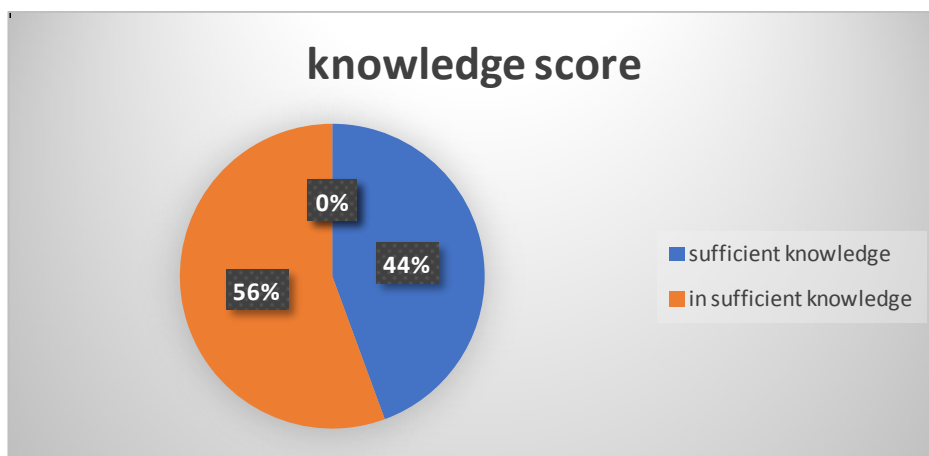


Fig. I. Level of knowledge of the participants toward meningococcal disease and vaccination

The knowledge score was significantly correlated with age (<0.001), gender (0.0035), educational attainment (0.006), monthly income (<0.001), and the source of medical information (0.005). It was discovered that the occupation correlation was not significant (0.725). Associations that are statistically significant have p values of less than or equal to 0.05 (Table III).

Table III. Association of sociodemographic factors with IMD knowledge levels IMD, invasive meningococcal disease

Socio-demographic factors	Total number of participants, n (%)	Knowledge level		p- value*
		Insufficient knowledge	Sufficient knowledge	
<b>Age (Years)</b>				
18-25	26(7.4)	14 (53.8)	12(7.7)	<0.001
26-40	198 (56.4)	92 (46.5)	106 (53.5)	
41-60	123 (35)	88 (71.5)	35 (28.5)	
>60	4 (1.1)	1 (25)	3 (75)	
<b>Gender</b>				
Female	231 (65.8)	119 (51.5)	112 (48.5)	0.035
Male	120 (34.2)	76 (63.3)	44 (36.7)	
<b>Educational level</b>				
No formal education	36 (10.3)	17 (47.2)	19 (52.8)	0.006
Primary education	68 (19.4)	46 (67.6)	22 (32.4)	
Graduated	165 (47)	98 (59.4)	67 (40.6)	
Post graduated	82(23.4)	34 (41.5)	48 (58.5)	
<b>Monthly income (PKR)</b>				

<30000	125 (35.6)	59 (47.2)	66 (52.8)	<0.001
30000-5,0000	86 (24.5)	62 (72.1)	24 (27.9)	
50001-100000	98 (27.9)	58 (59.2)	40 (40.8)	
>100000	42 (12.0)	16 (38.1)	26 (61.9)	

**Source of medical information**

Family and friends	86 (24.5)	44 (51.2)	42 (48.8)	0.005
Internet articles	35 (10)	20 (57.1)	15 (42.9)	
Social media	114 (32.5)	78 (68.4)	36 (31.6)	
Healthcare workers	116 (33)	53 (45.7)	63 (54.3)	

**Occupation**

Employed	252 (71.8)	139 (55.2)	113 (44.8)	0.725
Unemployed	94 (26.8)	54 (57.4)	40 (42.6)	
Retired	5 (1.4)	2 (40)	3 (60)	

\*A p-value less than 0.05 means the result is statistically significant

Concerns about vaccinating your child were found to be not significant (0.084), but there was a statistically significant correlation between the knowledge score and the completion of routine vaccinations (<0.001) and their belief that vaccination is essential for the protection of other members of society (<0.001) (Table IV).

**Table IV.** Association of parental awareness toward vaccines with IMD knowledge levels. IMD, invasive meningococcal disease

Response	Total number of participants, n (%)	Knowledge level, n (%)		p-value*
		Insufficient knowledge	Sufficient knowledge	
<b>Is routine vaccination complete?</b>				
Yes	213 (60.7)	97 (45.5)	116 (54.5)	<0.001
No	57 (16.2)	38 (66.7)	19 (33.3)	
I don't know	81 (23.1)	60 (74.1)	21 (25.9)	
<b>Is vaccinating a child important for other society members?</b>				
Yes	208 (59.3)	85 (40.9)	123 (59.1)	<0.001
No	90 (25.6)	68 (75.6)	22 (24.4)	
I don't know	53 (15.1)	42 (79.2)	11 (20.8)	
<b>Do you have any concerns about vaccinating your children?</b>				
Yes	147 (41.9)	72 (49)	75 (51)	0.084
No	159 (45.3)	98 (61.6)	61 (38.4)	
I don't know	45 (12.8)	25 (55.6)	20 (44.4)	

\*A p-value less than 0.05 means the result is statistically significant

## DISCUSSION

The study's primary goal was to evaluate the level of parental education about invasive meningococcal disease (IMD) and the vaccines against the disease in Lahore, Pakistan. The data gathering process was very effective, with a strong and representative sample of 351 parents who participated.

Comparing these results with a recent sister study carried out in Makkah region of Saudi Arabia, some similarities and structural differences can be identified. The Makkah survey that included 597 parents also revealed that most of the population lacked in-depth knowledge, with only 65 percent of the respondents showing an inadequate level of knowledge on IMD. In both articles, the recognition of disease spread was found to have significant gaps; as an example, 24.6% of parents in the Makkah study were not aware that bacterial meningitis was spread through the droplet, and this is a close reflection of the

knowledge gaps found in Lahore. While the present results show significant association between sociodemographic influence on parental knowledge, the Saudi Arabian sister study found no such correlation across variables like age or income. Despite this disparity, both studies conclude that high knowledge levels with over 57.8% recognizing the disease's severity and 67% its bacterial cause are positively linked with vaccination rates and community protection. Note that Saudi Arabia has a highly centralized government funded healthcare system with vaccination requirements being mandatory for school entry and Hajj which may lead to a better standardized awareness compared to Pakistan's more fragmented system(15).

But upon closer examination of the details of the disease, one can see some areas of concern that create a gap in knowledge that can be applied in real life. Most notably, only 35.9% of parents knew that bacterial meningitis is transmitted by droplets compared to a study conducted in Poland where 58.9% of parents knew that meningococcal disease spreads via respiratory droplets (16).

Health literacy and education levels play a major role in parental vaccine compliance. The completion rate achieved in this study was 60.7% but similar Turkish data, conducted in parents with university education, achieved a higher completion rate of 90.1%(17).

Importantly, parents who had good knowledge of invasive meningococcal disease (IMD) were much more likely to ensure that their children received routine vaccinations ( $P < 0.001$ ). This highlights the importance of educating parents to better the outcomes of pediatric preventative healthcare(16). Also, there is a strong base of understanding of herd immunity in the population with 59.3% of participants understanding the value of vaccinating their child to protect the community. This is consistent with past studies that revealed more than half of the population in Pakistan would prefer to be vaccinated than to become infected (18).

Despite these positive trends in adherence and community awareness, vaccine hesitancy remains a prominent challenge. A substantial proportion of the respondents (41.9%) explicitly stated that they still have concerns about vaccinating their children. Previous research indicates that 32.7% participants had experienced vaccine hesitancy (19). This persisting hesitancy can be contextualized by the established premise that parental vaccine literacy directly dictates immunization decision-making. A local study found a significant link between delayed vaccination and the parent's level of education(20).

The age was a very important variable ( $P < 0.001$ ) affecting parental knowledge. In particular, parents with younger age (26-40 years) showed the best level of understanding, as 53.5% of them showed adequate understanding. Conversely, older parents (41-60 years old) had an overall knowledge gap with 71.5 per cent of them classified under insufficient knowledge. Older parents may have less access to the internet or social media, where health information is commonly shared today. Similarly, a significant association was seen between age and parents' knowledge on the importance of immunization in a study done in Sudair region, Saudi Arabia(21).

Disease awareness was significantly higher among females (48.5%) than among males (36.7%) and this difference was statistically significant ( $P = 0.035$ ). This result is in contrast with a related study in which gender was found to have no significant effect ( $P = 0.643$ )(15).

The level of education in a parent demonstrated very strong correlation with the knowledge score ( $P = 0.006$ ). But these relationships were cross sectional and do not necessarily mean causal; higher income does not necessarily mean higher knowledge and vice versa but these two variables co-occur in this sample. The results demonstrate a distinct pattern: 58.5% of post-graduates had the necessary amount of knowledge, and the rest (67.6) of individuals with primary education only did not have the necessary level of awareness. Previous research reinforces this concept (22).

The health literacy was significantly associated with monthly income ( $P < 0.001$ ), as high earners (above 100,000 PKR) had a score of 61.9% indicating insufficient knowledge while the lower-middle earners (up to 100,000) had 72.1% indicating insufficient knowledge. This is similar to research findings that more affluent parents are more knowledgeable about vaccinations and less likely to refuse them. In conclusion, these results indicate the significant financial and educational obstacles associated with lower awareness

and preventative health measures. In case of Pakistan these “knowledge gap” is increased by “digital divide” and language barriers as a lot of health information is primarily available in English. This leaves low literacy populations vulnerable to miss information (23).

The medical information source had a statistically significant value ( $P = 0.005$ ) in influencing the levels of knowledge. The most positive results were obtained with the dependency on healthcare workers, as 54.3% of parents in this group showed adequate knowledge. More than 68% of parents who use social media are not knowledgeable enough about the medical aspects, a serious deficiency compared to parents who use professional information sources. This reinforces the importance of high levels of communication, from trusted providers via trusted channels, to keep vaccine literacy high and programs successful (24).

Vaccination is still the most economical way of prevention of invasive meningococcal disease (IMD) and it Reduced More Deaths and Sequelae as documented by previous studies (25).

Literacy adapted educational campaigns to reach disadvantaged communities are needed in Pakistan and like areas. They should be done by healthcare workers who are knowledgeable about vaccines to ensure they are able to reach and protect high-risk populations (26).

Improved advocacy, community involvement, and increased immunization coverage are essential steps to make the WHO's 2030 goals a reality. This comprehensive approach is key to containing bacterial meningitis epidemics and reducing vaccine preventable cases by 50% (27).

## CONCLUSION

Although almost half the parents had sufficient knowledge on meningococcal disease, significant gaps are found in their understanding of disease and vaccination. Targeted parental education should be increased in an effort to enhance the level of vaccine literacy and decrease the disease burden in Pakistan. The government and health departments should launch awareness campaigns targeting parents with low education and low income. The medical staff should be the first to lead such efforts by converting obscure medical information into easy-to-understand information by making and displaying simple posters about meningococcal disease in waiting areas.

### Study Limitations:

The study used a cross-sectional approach. This method limits the ability to demonstrate direct causal links between the assessed socio-demographic characteristics and IMD knowledge levels, even if it is very successful at obtaining a snapshot of parents' awareness and attitudes at a particular point in time.

Second, the study recruited participants using a convenience sample technique. The results might not fairly represent the knowledge and attitudes of the larger Pakistani community because the inclusion criteria only included parents who now reside in Lahore. This means the results cannot be applied to all parents in Pakistan. Future research should aim to employ multicenter study design that include populations of both rural and urban to capture a diverse and socioeconomic and geographic demographic. Thus, caution should be exercised while extrapolating the findings to other regions of Pakistan, particularly rural areas where healthcare access, literacy rates, and vaccination awareness may differ substantially.

Finally, a significant part of the data collection method involved a self-administered online poll that was distributed through social media sites, which may have excluded parents who do not use the internet. The study did not ask parents about their children's actual vaccination status against meningococcal disease, only about general knowledge. The future studies should evaluate both parental awareness and actual vaccine uptake behaviors. Furthermore, this study did not assess parental knowledge about specific vaccine sero-groups (A, B, C, W, Y) which may limit our findings regarding detailed vaccine literacy.

While the questionnaire was adapted from validated, previously published research and translated into Urdu to ensure linguistic clarity Cronbach's alpha was not initially performed. Future studies should include pre-test reliability assessments to further validate the tool within the specific cultural context of Lahore.

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## Conflict of interest:

Authors declared no conflict of interest.

## Authors' contribution:

ZUH Data curation, formal analysis & software; WA Methodology, supervision & project administration; MA Conceptualization, data curation, investigation & writing the original draft; MU Investigation, resources & results validation; ZU Investigation & visualization; AA Supervision, writing, review & editing.

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