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Case Study

Assessment of Knowledge, Attitude and Behaviors Towards Invasive Meningococcal Disease and Its Vaccination Among Young Adults in Saudi Arabia: A Cross-Sectional Study

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Abstract

Background: Invasive meningococcal disease (IMD) remains a life-threatening infection associated with high mortality and long-term morbidity. Effective vaccines are available but meningococcal vaccination in Saudi Arabia is not mandatory outside specific high-risk groups. Public knowledge, attitudes and behaviors (KAB) toward IMD and its vaccination play a pivotal role in disease prevention and vaccine uptake.

Methods: A cross-sectional survey was conducted among 382 residents of Saudi Arabia between July and August 2024 using a validated, Arabic-translated questionnaire distributed via social media. The survey assessed socio-demographic characteristics, knowledge of IMD, attitudes toward vaccination, vaccination behaviors and sources of information. Knowledge scores were categorized as good (≥2) or poor (<2). Data were analyzed using SPSS. Descriptive statistics and binary logistic regression analyses were performed to identify predictors of knowledge and vaccine acceptance.

Results: Most participants we` re male (90.3%), Saudi nationals (94.2%), students (71.2%) and residents of Mecca (98.7%), with a mean age of 23.9 ± 8.2 years. Good knowledge of IMD was observed in 71.7% of respondents; however, misconceptions regarding disease transmission were prevalent, with 63.1% incorrectly identifying insects as the main transmission route. Although 86.6% expressed willingness to receive the meningococcal vaccine, only 51.8% were aware of vaccine availability. Age, occupation, education level and nationality were significant predictors of knowledge, while occupation was the only significant predictor of vaccine acceptance.

Conclusions: Despite generally favorable attitudes toward meningococcal vaccination, substantial knowledge gaps and misinformation persist. Healthcare providers and digital platforms represent critical channels for targeted public health education. Strengthening awareness strategies may enhance vaccine uptake and support national and global meningitis elimination goals.

Keywords: Meningococcal Disease, Meningitis, Vaccination, Knowledge, Attitude, Saudi Arabia, Public Health.

Abbreviations

IMD: Invasive meningococcal disease. KAB: Knowledge, attitude, and behavior. SD: Standard deviation. OR: Odd ratio. CI: Confidence interval. KSA: Kingdom of Saudi Arabia. HCP: Healthcare provider.

1.Introduction

Invasive meningococcal disease (IMD) is a severe bacterial infection caused by *Neisseria meningitidis*. It is characterized by rapid onset and potentially devastating outcomes, including meningitis, septicemia and death. Survivors frequently experience long-term sequelae such as neurological impairment, hearing loss, limb amputations and cognitive dysfunction. Globally, IMD accounts for approximately 1.2 million cases annually and is responsible for an estimated 135,000 deaths worldwide [1–3]. Twelve serogroups of *N. meningitidis* have been identified, of which six (A, B, C, W, X and Y) account for the majority of invasive disease [3]. Epidemiological patterns vary by region, age group and time, influenced by population immunity, vaccination strategies and socio-environmental factors [4]. In the African meningitis belt, incidence rates may range from 10 to over 10,000 cases per 100,000 population during epidemics [4]. Saudi Arabia represents a unique epidemiological context for IMD due to the annual influx of millions of pilgrims during Hajj and Umrah. Between 2002 and 2019, 228 confirmed cases of IMD were reported in the Kingdom, with MenW, MenA and MenB being the most frequently identified serogroups during earlier reporting periods [5]. However, serogroup-specific surveillance data remain incomplete in recent years, limiting comprehensive epidemiological assessment [5].

Vaccination is the cornerstone of IMD prevention. The introduction of conjugate and polysaccharide meningococcal vaccines has led to substantial reductions in disease incidence and has contributed to herd immunity, particularly among adolescents [6,7]. In Saudi Arabia, meningococcal vaccination is mandatory for pilgrims, healthcare workers and residents of holy cities, and the MenACWY conjugate vaccine has been incorporated into the national immunization schedule for infants and adolescents [8,9]. Nevertheless, vaccination remains non-mandatory for the broader population, potentially leaving immunity gaps. Public knowledge, attitudes and behaviors toward IMD and its vaccination strongly influence vaccine uptake and disease prevention. Studies from Europe and elsewhere have demonstrated that misconceptions about disease transmission, perceived vaccine safety and trust in healthcare providers significantly affect vaccination decisions [2,6]. Recent studies in IMD vaccination and prevention by proper education of patients, education of physicians practicing on the available vaccinations and involvement of digital platforms and education for healthcare providers [10–15] have provided increased awareness and responsibility for protecting the people with IMD.

Despite Saudi Arabia's unique exposure risks and public health infrastructure, data on population-level awareness and perceptions of IMD remain limited. Aligned with the World Health Organization's "Defeating Meningitis by 2030" roadmap [16], assessing public awareness and vaccine attitudes is essential for guiding targeted interventions. This study therefore aimed to evaluate the knowledge, attitudes and behaviors of the general population in Saudi Arabia toward IMD and its vaccination, identify predictors of knowledge and vaccine acceptance, and explore sources of health information relevant to meningococcal disease.

2.Methodology

2.1. Study Design and Population

This was an observational, descriptive, cross-sectional study conducted online between July and August 2024. The target population was citizens and residents of Saudi Arabia aged 18 years and above. Tourists, visitors and pilgrims on temporary visas were excluded. The minimum sample size was calculated using OpenEpi version 3.0, assuming a 50% prevalence of knowledge, a 95% confidence level and a margin of error of 5%. The calculated sample was 300. Accounting for potential incomplete responses, a final sample of 350 was targeted. A convenience sampling method was employed via online distribution. The study protocol was approved by the Institutional Review Board of Umm Al-Qura University (Approval No. HAPO-02-K-012-2023-09-1714). Electronic informed consent was obtained from all participants at the beginning of the online survey. Participation was voluntary and anonymous, with no personally identifiable information collected.

2.2. Data Collection Tool

A structured, self-administered questionnaire was adapted from a validated instrument used in a prior Italian study [17] and translated into Arabic. Prior to data collection, the instrument underwent a comprehensive expert-based validation process. Three independent consultant experts, each possessing extensive experience in the field , and proficient in both Arabic and English, meticulously evaluated the questionnaire for content and face validity. Their assessments encompassed conceptual equivalence, clarity, cultural appropriateness, and relevance to the study's objectives. Subsequently, based on their consensus feedback, minor linguistic refinements were implemented to enhance the questionnaire's quality. The questionnaire comprised five sections: Section A: Socio-demographics (age, gender, marital status, nationality, residence, occupation, education). Section B: Knowledge about meningitis (5 items: awareness, transmission, affected groups, prevention, perceived seriousness). A knowledge score was computed (1 point per correct answer; range 0-5). A score of ≥2 was classified as "Good Knowledge." Section C: Attitudes towards IMD and vaccination (perceived worry, perceived vaccine usefulness, willingness to vaccinate, reasons for acceptance/refusal). Section D: Behavior/Vaccination history (awareness of vaccine availability). Section E: Sources of information and need for further information.

2.3. Data Analysis

Data were analyzed using IBM SPSS Statistics (version 29). Descriptive statistics (frequencies, percentages, mean, standard deviation) summarized all variables. Binary logistic regression analyses were performed to identify demographic predictors (independent variables: age, gender, marital status, residence, occupation, education, nationality) of the two primary outcomes: 1) Good Knowledge (dependent variable: poor vs. good) and 2) Willingness to Vaccinate (dependent variable: no vs. yes). Odds ratios (OR) with 95% confidence intervals were reported. A p-value <0.05 was considered statistically significant. The study protocol was approved by the Institutional Review Board of Umm Al-Qura University (Approval No. HAPO-02-K-012-2023-09-1714). Electronic informed consent was obtained from all participants at the beginning of the online survey. Participation was voluntary and anonymous, with no personally identifiable information collected.

3. Results

3.1. Socio-Demographic Characteristics

A total of 382 complete responses were analyzed. The sample was predominantly male (90.3%), single (88.2%) and Saudi nationals (94.2%). The majority were students (71.2%) residing in Mecca (98.7%). The mean age was 23.87 years (SD=8.17). Education levels were relatively high, with 49.0% holding a bachelor's degree and 46.9% having completed high school (Table 1).

3.2. Knowledge about Meningitis

Overall, 74.6% of participants had heard of meningitis and 76.7% agreed it is a serious disease. However, knowledge was inconsistent. While 74.6% knew the affected groups, only 36.9% correctly identified respiratory droplets as the mode of transmission; a majority (63.1%) erroneously selected "through insects." Regarding prevention, 60.7% knew vaccination was an option (Table 2). The mean knowledge score was 1.72 (SD=0.45). Based on the defined cutoff (≥2), 71.7% (n=274) were classified as having "Good Knowledge."

3.3. Predictors of Good Knowledge

Binary logistic regression identified occupation and education level as significant predictors. Students were significantly more likely to have good knowledge than workers/employees (OR=0.116, p<0.001). Participants with a PhD (the highest education category) had significantly higher odds of good knowledge compared to the reference (OR=47.746, p=0.032). Age (OR=1.057, p=0.039) and Saudi nationality (OR=0.313 for non-Saudis, p=0.022) were also significant predictors. Gender, marital status and residence were not significant (Table 3).

3.4. Sources of Information

Healthcare providers were the most cited source of information on meningitis (56.0%), followed by the internet (23.3%). Friends (12.0%), formal studying (8.6%) and traditional media (5.5%) were less common sources.

Table 1. Socio-Demographic Characteristics of Participants (N=382)

Characteristic	Category	n (%) / Mean ± SD
Gender	Male	345 (90.3%)
	Female	37 (9.7%)
Age (years)		23.87 ± 8.17
Marital Status	Single	337 (88.2%)
	Married	45 (11.8%)
Nationality	Saudi	360 (94.2%)
	Non-Saudi	22 (5.8%)
Residence	Mecca	377 (98.7%)
	Other	5 (1.3%)
Occupation	Student	272 (71.2%)
	Worker/Employee	110 (28.8%)
Education	High School	179 (46.9%)
	Bachelor's Degree	187 (49.0%)
	Postgraduate (Master/PhD)	11 (2.9%)
	Diploma/Middle School	5 (1.3%)

Table 2. Participant Knowledge Regarding Meningitis (N=382)

Knowledge Item	Correct Response, n (%)	Incorrect/Don't Know, n (%)
Heard of Meningitis	285 (74.6%)	97 (25.4%)
Transmission via droplets	141 (36.9%)	241 (63.1%)
Knows affected groups	285 (74.6%)	97 (25.4%)
Knows prevention by vaccine	232 (60.7%)	150 (39.3%)
Believes it is a serious disease	293 (76.7%)	89 (23.3%)

Table 3. Logistic Regression Analysis for Predictors of Good Knowledge (≥2 score)

Predictor	B	S.E.	p-value	Odds Ratio (Exp(B))	95% C.I. for Exp(B)
Occupation (Student)	-2.156	0.353	<0.001	0.116	0.058 – 0.231
Education (PhD)	3.866	1.799	0.032	47.746	1.394 – 1635.2
Age (Years)	0.055	0.027	0.039	1.057	1.003 – 1.114
Nationality (Saudi)	-1.163	0.508	0.022	0.313	0.116 – 0.847
Gender	0.659	0.467	0.158	1.933	0.774 – 4.827
Marital Status	-0.010	0.500	0.985	0.990	0.372 – 2.636
Residence	-0.876	1.013	0.388	0.417	0.057 – 3.037
Constant	-2.041	2.025	0.314	0.130	

Table 4. Reasons Cited for Acceptance of Meningococcal Vaccine (N=331 willing)

Reason for Acceptance	n	% of Accepting Group
Vaccine is useful	265	80.1%
Vaccine is safe	261	78.9%
Believe in usefulness of vaccinations	236	71.3%
Support many vaccinations	155	46.8%
Vaccine has been in use for a long time	98	29.6%
Meningitis is frequent in KSA	89	26.9%
Vaccine is not expensive	73	22.1%
Recommended by physician	56	16.9%

3.5. Attitudes and Behaviors Regarding Vaccination

Awareness that a meningitis vaccine is available in KSA was limited, with only 51.8% answering affirmatively; 48.2% reported "I don't know." Despite this, **willingness to receive the vaccine was very high at 86.6%** (n=331). The primary reasons for acceptance were belief in the vaccine's usefulness (69.4%), safety (68.3%) and a general belief in vaccine effectiveness (61.8%). Physician recommendation influenced only 14.7% (Table 4).

Among the 13.4% (n=51) unwilling to vaccinate, the most common reasons were "Meningitis is not frequent in KSA" (n=24, 47.1% of unwilling group) and "Vaccine was not recommended by my physician" (n=24, 47.1%). Concerns about safety (n=7, 13.7%) or general opposition to vaccines (n=11, 21.6%) were less prevalent.

Predictors of Willingness to Vaccinate

In binary logistic regression, occupation was the sole significant demographic predictor of vaccine acceptance. Students had significantly higher odds of being willing to vaccinate compared to workers/employees (OR=0.246, $p<0.001$). No other demographic variable (age, gender, education, etc.) showed a statistically significant association (all $p>0.05$). A strong majority (83.2%, n=318) expressed a need for more information about the meningococcal vaccine. The most desired sources for this information were healthcare providers (61.8%) and the internet (42.9%).

4. Discussion

This study offers a thorough and context-specific evaluation of knowledge, attitudes, and behaviors (KAB) regarding IMD and its vaccination among the general Saudi population and specific at-risk groups. The findings reveal clear discordance with important public health implications. Positive attitudes toward vaccination and high perceived disease severity co-exist with serious deficiencies in foundational knowledge and low awareness of vaccine availability. This misalignment reflects a major weakness in existing public health communication infrastructures. Although 71.7% of participants were classified as having “good” knowledge, this aggregate figure masks important qualitative shortcomings. Most respondents recognized IMD as a serious and potentially fatal condition, a finding consistent with international literature [4,18,19]. However, misconceptions surrounding disease transmission were strikingly prevalent. Nearly two-thirds of respondents incorrectly identified insects as the primary mode of transmission, indicating poor understanding of IMD epidemiology. This reflects failures in conveying essential public health information and mirrors similar, albeit less pronounced, misconceptions reported in European populations [18,20]. Inaccurate beliefs regarding transmission may distort risk perception, diminishing the perceived relevance of vaccination or adherence to recommended preventive behaviors during outbreaks.

The gap between perceived severity and epidemiological understanding is particularly concerning given the demonstrated willingness to accept vaccination. In this cohort, 86.6% expressed readiness to receive the meningococcal vaccine, yet only half were aware of its availability. This discrepancy suggests that structural and informational barriers, rather than vaccine hesitancy, are the primary obstacles to uptake. Similar patterns have been observed in settings with strong national immunization programs, where trust in vaccines is high but awareness of specific indications and access pathways remains limited [9,19]. Analysis of information sources provides critical insight into the persistence of these gaps. Healthcare providers (HCPs) were identified as both the most common and most trusted source of information, consistent with global evidence showing clinicians’ influence on vaccine decision-making [4,19,17]. Despite this, physician recommendation was not a strong predictor of vaccine acceptance in this study, while the absence of such recommendations was frequently cited as a reason for non-vaccination. This paradox highlights missed opportunities within routine healthcare encounters and points to deficiencies in proactive vaccine counseling.

Resemblance of some of the characteristics in our investigation in the present report was found in a study comprising twenty IMD participants of the age of 16-23 years that revealed four major concerns associated with the willingness of the participants to get vaccinated [13]. These four characteristics are, the knowledge and general information towards vaccination, attitudes of the participants towards vaccination, perception for IMD, and attributes of the vaccine. A substantial number of the participants in that study (60%) were quite concerned about IMD and were

having the positive views for vaccination (80%), whereas majority of their participants (90%) had a choice of having vaccination rather than not having the vaccination (compared to the present study comprising 86.6% individuals expressing willingness for receiving the vaccine) without thinking on the consequences of the incidence rate of IMD, the rate of disability or how fatal could be the IMD [13]. The participants in the current study had misconceptions towards disease transmission with an incorrect attitude for identifying the insects as the main transmission pathway (63.1%), and awareness of vaccine availability (51.8%). Digital platforms and education for healthcare providers are the influential channels for expeditious diagnosis, improved prevention methods, and targeted public health education [11,14,15]. Present cross-sectional study relied mainly on collecting samples via social media since the media coverage for a better vaccine compliance among healthcare workers [10] is helpful for the transmission of the required general knowledge, information, and awareness to the participants. We plan to involve the use of vaccine based digital tools for educational purposes [15] in our further studies for increasing vaccination awareness.

Structured integration of meningococcal vaccine discussions into primary care, student health services, and preventive visits may therefore represent a high-yield intervention. Regression analyses further contextualize these findings. Students demonstrated significantly higher knowledge levels and greater willingness to accept vaccination, likely reflecting higher health literacy and increased exposure to health-related information within academic environments. This observation aligns with prior research and is particularly relevant given the recognized role of adolescents and young adults in meningococcal transmission dynamics [16,20]. The global burden of IMD, estimated at approximately 1.2 million cases and 135,000 deaths annually, underscores the need for targeted prevention strategies among specific age groups and supports the requirement for country-specific KAB data to inform policy decisions [20].

The association between higher education and improved knowledge also reveals inequities in health information dissemination. Working adults and individuals with lower educational attainment demonstrated comparatively poorer knowledge, suggesting that current awareness efforts disproportionately reach younger and academically engaged populations. This gap is further emphasized when compared with international data. An Italian study reported that 79.8% of parents correctly identified respiratory droplets as the primary transmission route more than double the proportion observed in the present study [17]. These findings highlight the urgent need for targeted educational interventions tailored to the Saudi context.

Limitations

Several limitations must be acknowledged. The cross-sectional design limits causal inference, and reliance on convenience sampling through social media introduces selection bias. The sample was predominantly young, male, and residents of Mecca, restricting generalizability to other demographic groups. Additionally, the relatively lenient knowledge scoring threshold may have overestimated true knowledge levels. Nonetheless, the study provides a valuable snapshot of current public perceptions and identifies specific, actionable deficiencies. Evidence indicates that improving IMD prevention in Saudi Arabia requires more than reinforcing disease severity or promoting vaccine safety. Public health strategies must prioritize accurate communication regarding transmission, prevention, and vaccine accessibility. Aligning knowledge with existing positive attitudes is essential to translating willingness into action and advancing Saudi Arabia's contribution to the WHO "Defeating Meningitis by 2030" roadmap [16].

Conclusion

This study clearly shows how the general population in Saudi Arabia understands and responds to invasive meningococcal disease (IMD) and its vaccination. Attitudes toward vaccination were largely positive with most participants expressing willingness to be vaccinated. The readiness was not matched by adequate knowledge. Important gaps are evident regarding disease transmission and vaccine availability which reveal disconnect between acceptance and informed decision-making.

Over two-thirds of respondents were classified as having good knowledge, misconceptions were common. Widespread belief that IMD is transmitted by insects reflects limited understanding of basic disease mechanisms and may weaken prevention efforts or delay care-seeking. Nearly half of participants were unaware that the meningococcal vaccine is available in

Saudi Arabia which shows insufficient public communication despite established immunization policies. Healthcare providers are the most trusted source of information for their pivotal role in education and vaccine advocacy. Targeted and evidence-based communication through clinical encounters and digital platforms is essential. Addressing educational and occupational disparities will be critical to strengthening awareness and improving vaccine uptake and supporting Saudi Arabia's contribution to the WHO "Defeating Meningitis by 2030" goals

Authors' Contributions

All authors contributed equally to the conception, design, data collection, analysis, interpretation, and writing of the manuscript. All authors read and approved the final version of the manuscript.

Conflict of Interest

The authors declare that they have no conflict of interest.

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Ethical approval:

The study protocol was approved by the Institutional Review Board of Umm Al-Qura University (Approval No. HAPO-02-K-012-2023-09-1714). Electronic informed consent was obtained from all participants at the beginning of the online survey. Participation was voluntary and anonymous, with no personally identifiable information collected.

Data Availability

The supplementary materials supporting the findings of this study are available at the following link:

https://drive.uqu.edu.sa/_/s.toxicology.s/files/e44ae2ef-ba33-4d3f-a43f-9dedec0d02d1.pdf

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Data availability

The data that support the findings of this study are available from the corresponding authors upon reasonable request.

Declarations
Use of Artificial Intelligence

The authors declare that no artificial intelligence (AI) tools or technologies were used in the conception, design, data analysis, interpretation, or writing of this manuscript.

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