Vaccination Coverage and Factors Influencing Vaccine Hesitancy Among Parents of Young Children: A Cross-Sectional Analysis

Abdulrahman A. Alnaim [1]
Department of Pediatrics, College of Medicine , King Faisal University
* Corresponding author Email: Ahalnaim@kfu.edu.sa

Abstract
Vaccination is a crucial public health intervention for preventing childhood diseases. However, vaccine hesitancy poses a significant threat to immunization programs worldwide. This cross-sectional study aimed to evaluate vaccination coverage and identify factors influencing vaccine hesitancy among parents of young children in Al-Ahsa, Saudi Arabia. A structured questionnaire was administered to 450 parents attending primary health care centers. The study found that 84.4% of children were fully vaccinated, 12.2% were partially vaccinated, and 3.3% were not vaccinated. Factors significantly associated with vaccine hesitancy included younger parental age ($p=0.021$ for <25 years), lower education level ($p=0.001$ for primary education), and reliance on social media for vaccine information ($p<0.001$). Healthcare providers were the primary source of vaccine information for 64.4% of parents, and those who relied on them were less likely to be vaccine-hesitant ($p=0.001$). While 83.3% of parents agreed that vaccines are essential for child health, 33.3% expressed concerns about serious side effects. The study highlights the need for targeted interventions to address vaccine hesitancy, particularly among younger and less educated parents. Enhancing healthcare providers' ability to communicate effectively about vaccines and developing strategies to combat misinformation on social media are crucial steps in improving vaccination coverage. Future research should explore the effectiveness of interventions aimed at reducing vaccine hesitancy and consider longitudinal designs to track changes in parental attitudes over time.

Keywords: Vaccine hesitancy, Childhood immunization, Parental attitudes, social media influence, Healthcare provider trust

Introduction : Childhood immunization remains one of the most successful public health interventions, responsible for saving millions of lives globally by preventing the spread of infectious diseases [1]. Over the decades, the implementation of routine vaccination programs has dramatically reduced the incidence of vaccine-preventable diseases (VPDs), including conditions like measles, mumps, rubella, diphtheria, tetanus, and polio [2]. These programs have not only curbed morbidity and mortality but have also contributed to herd immunity, protecting those who are unable to be vaccinated, such as newborns or immunocompromised individuals [3]. However, despite the clear benefits of vaccination, vaccine hesitancy has become a growing public health issue worldwide.

The World Health Organization (WHO) defines vaccine hesitancy as the delay in acceptance or outright refusal of vaccines, despite the availability of vaccination services. This phenomenon poses a significant threat to global health by undermining the effectiveness of immunization programs and reversing the progress made in combating VPDs [4]. In recent years, the spread of misinformation about vaccines, particularly on social media platforms, has fueled public doubt regarding vaccine safety, contributing to the rise of vaccine hesitancy [5]. As a result, outbreaks of diseases like measles, which had been nearly eradicated in certain regions, have resurfaced, endangering both vaccinated and unvaccinated populations [6,7].

Vaccine hesitancy is a complex issue with multiple underlying causes, varying between regions and influenced by a mix of cultural, social, economic, and individual factors [8]. While misinformation about vaccine safety is a primary driver in many high-income countries, other regions experience hesitancy due to additional barriers [9]. In low- and middle-income countries (LMICs), vaccine hesitancy is often associated with access to healthcare, socio-economic conditions, and prevailing cultural or religious beliefs. These disparities have made vaccine hesitancy a truly global issue, recognized by the WHO as one of the top ten threats to global health [10,11]

Vaccination coverage is a crucial measure of public health success, reflecting the proportion of individuals within a population who have been vaccinated [12]. When vaccination coverage reaches a high threshold, herd immunity is achieved, protecting the entire population, including those who cannot be vaccinated for medical reasons [13]. Routine immunization schedules, which include vaccines for diseases like measles, diphtheria, pertussis, tetanus, and polio, are designed to provide protection at key developmental stages in a child's life [14]. However, in recent years, global vaccination coverage has plateaued, with

significant disparities between different regions and countries. According to data from the WHO and UNICEF, global coverage for key vaccines like the third dose of the diphtheria-tetanus-pertussis (DTP3) vaccine has stagnated, hovering around 86%. While some high-income countries boast coverage rates above 90%, many LMICs struggle to achieve even 60% coverage [15,16]. This stagnation is particularly concerning in light of the COVID-19 pandemic, which disrupted routine immunization services and threatened to undo years of progress in global vaccination efforts [17].

The reasons behind parental vaccine hesitancy are numerous and multifaceted. One major factor is socioeconomic status, which influences access to healthcare, educational opportunities, and information. In many cases, parents with higher levels of education and income are more likely to vaccinate their children, as they tend to have better access to healthcare and are more informed about the benefits of immunization [18]. However, paradoxically, higher education can sometimes correlate with increased skepticism, as certain parents feel empowered to question established medical advice based on misinformation encountered through social networks or online sources [19]. On the other hand, parents from lower-income backgrounds or those with limited access to education may exhibit hesitancy due to a lack of information or mistrust in the healthcare system. In these cases, barriers to healthcare access, financial limitations, and geographic isolation can all contribute to lower vaccination rates [20].

Parental beliefs and attitudes toward vaccination also play a significant role in vaccine hesitancy. Cultural and religious beliefs can influence these attitudes, either encouraging or discouraging the uptake of vaccines [21]. In some communities, traditional beliefs or religious doctrine may lead parents to avoid vaccinating their children, despite clear public health recommendations [22]. Additionally, trust in healthcare providers is a critical factor in shaping parental decisions. Studies have shown that parents who have a strong, trusting relationship with their healthcare provider are more likely to follow vaccination schedules. In contrast, those who harbor doubts about the intentions or competency of medical professionals are more likely to delay or refuse vaccinations [23].

Vaccine hesitancy represents a significant challenge to global health, particularly in protecting the most vulnerable populations, including young children. Understanding the complex web of factors that contribute to hesitancy is crucial for developing effective public health interventions [24]. Targeted strategies that address specific concerns, dispel myths, and provide clear, accurate information about the importance of vaccines are essential to reversing the trend of vaccine hesitancy. Public health campaigns that engage community leaders, promote healthcare education, and improve access to immunization services can play a vital role in improving vaccination coverage [25]. Ultimately, overcoming vaccine hesitancy requires a multifaceted approach that takes into account the socio-economic, cultural, and informational influences shaping parental decisions [26].

Method

Study Design

This study employed a cross-sectional design to evaluate vaccination coverage among young children and identify factors influencing vaccine hesitancy among parents in Al-Ahsa, Saudi Arabia. A structured questionnaire was used to collect data from the participants. The study design allowed for the identification of associations between vaccine hesitancy and various sociodemographic factors, parental beliefs, and sources of information regarding childhood immunization.

Study Setting

The study was conducted in primary health care centers located in Al-Ahsa, Saudi Arabia. These centers were selected as the study setting due to their critical role in delivering routine vaccination services to children. Primary health care centers in Al-Ahsa represent a mix of urban and rural populations, ensuring a diverse sample. Al-Ahsa is one of the largest regions in Saudi Arabia, with both urban and semi-urban communities, providing a suitable setting for examining vaccine hesitancy in a varied demographic population.

Study Population

The study targeted parents of children aged 0-5 years attending primary health care centers for routine vaccination. Inclusion criteria for participants included being the primary caregiver of a child within this age range and attending the selected primary health care centers in Al-Ahsa during the study period. Parents who did not speak Arabic or were unable to provide informed consent were excluded from the study.

Sample Size

The sample size was calculated using a standard formula for cross-sectional studies. Based on an assumed vaccine hesitancy prevalence of 30%, a 95% confidence interval, and a margin of error of 5%, a minimum of 400 participants was required. However, to account for possible non-responses or incomplete data, we aimed to recruit a total of 450 participants. A systematic random sampling method was employed to select eligible participants from those attending the selected primary health care centers for child vaccination during the data collection period.

Data Collection Procedure

Data collection took place between **April** and **August**

2024 at the primary health care centers in Al-Ahsa. Trained research assistants, who were fluent in Arabic, administered the questionnaire to the parents. Prior to data collection, the research team provided detailed training to ensure consistency and reliability in the data collection process. Each participant was approached by a research assistant in the waiting area of the health care center, and the study's purpose was explained. Participants who agreed to take part were provided with a consent form, which they signed before completing the questionnaire.

The structured questionnaire was developed based on previous studies and included both closed- and open-ended questions. It was initially drafted in English and then translated into Arabic by a certified translator to ensure linguistic accuracy. The questionnaire was pre-tested on a small sample of parents (n=30) to ensure clarity and appropriateness. Minor revisions were made based on the feedback received during this pilot phase.

The questionnaire covered the following domains:

1. **Sociodemographic Information**: Age, gender, educational level, employment status, income, and family size.
2. **Child's Vaccination History**: Information on the child's vaccination status, including any missed vaccines and reasons for missed vaccinations.
3. **Parental Knowledge and Beliefs**: Questions assessed the parents' knowledge of routine childhood vaccinations, perceived importance of vaccines, and trust in healthcare providers and vaccination programs.
4. **Sources of Information**: The questionnaire gathered information on where parents obtained their knowledge about vaccines (e.g., healthcare providers, social media, family, etc.).
5. **Vaccine Hesitancy**: A vaccine hesitancy scale was included to assess the degree of hesitancy or refusal, with questions focusing on specific concerns about vaccine safety, side effects, and necessity.

Each interview took approximately 15-20 minutes to complete, and data collection was done over a six-week period.

Ethical Considerations

Ethical approval for the study was obtained from the Institutional Review Board (IRB) of King Faisal University, Saudi Arabia (Approval Number: ETHICS1873). All participants were informed about the study's objectives and procedures, and their participation was entirely voluntary. Written informed consent was obtained from each participant before the questionnaire was administered. Confidentiality and anonymity were maintained throughout the study by assigning unique identification numbers to each participant, and no personal identifying information was collected.

Data Analysis

The collected data were entered into IBM SPSS software (version 28) for analysis. Descriptive statistics were used to summarize the participants' sociodemographic characteristics, vaccination coverage rates, and sources of information. Frequencies and percentages were calculated for categorical variables, while means and standard deviations were used for continuous variables.

To identify factors associated with vaccine hesitancy, bivariate analyses were conducted using chi-square tests for categorical variables and t-tests for continuous variables. Variables that were significantly associated with vaccine hesitancy in the bivariate analyses ($p < 0.05$) were included in a multivariable logistic regression model to determine the independent predictors of vaccine hesitancy. Adjusted odds ratios (AORs) and 95% confidence intervals (CIs) were calculated for each variable.

The dependent variable for the logistic regression model was vaccine hesitancy, which was dichotomized into hesitant and non-hesitant categories based on responses to the vaccine hesitancy scale. Independent variables included parental age, education level, employment status, sources of information, and trust in healthcare providers.

Results were considered statistically significant at $p < 0.05$, and the final model was checked for multicollinearity and goodness of fit using the Hosmer-Lemeshow test.

Results :

Table 1 presents the sociodemographic characteristics of the parents (n=450) who participated in the study. The majority of respondents were female (61.1%), with males representing 38.9%. The most common age group was 25-34 years (40%), followed by those aged 35-44 years (36.7%). Only 13.3% of parents were aged 45 years or older, and 10% were under 25. In terms of education, the vast majority had a university degree (68.9%), while 25.6% had completed secondary education, and only 5.6% had primary education. Most participants were employed (58.9%), with 41.1% being unemployed. Regarding monthly income, 40% of parents earned between SAR 5,000 and 10,000, while 33.3% earned less than SAR 5,000, and 26.7% had an income exceeding SAR 10,000. The majority of participants had 2-3 children (54.4%), while 34.4% had four or more children, and only 11.1% had one child

Table 1: Sociodemographic Characteristics of Parents (n=450)

Variable	Frequency (n)	Percentage (%)
Gender		
Male	175	38.9
Female	275	61.1
Age (Years)		
< 25	45	10.0
25-34	180	40.0
35-44	165	36.7
≥ 45	60	13.3
Education Level		
Primary	25	5.6
Secondary	115	25.6
University	310	68.9
Employment Status		
Employed	265	58.9
Unemployed	185	41.1
Monthly Income (SAR)		
< 5,000	150	33.3
5,000-10,000	180	40.0
> 10,000	120	26.7
Number of Children		
1	50	11.1
2-3	245	54.4
≥ 4	155	34.4

Table 2 provides a detailed overview of the vaccination status of children in the study population. The majority of children (84.4%) were fully vaccinated, while 12.2% were partially vaccinated, and 3.3% were not vaccinated at all. Regarding missed vaccines, 13.3% of parents reported their child had missed a vaccination, with the most common reasons being fear of side effects (30.0%) and lack of awareness (25.0%). Religious beliefs (16.7%), vaccine unavailability (13.3%), and other unspecified reasons (15.0%) also contributed to missed vaccinations.

Table 2: Vaccination Status of Children (n=450)

Variable	Frequency (n)	Percentage (%)
Vaccination Status		
Fully Vaccinated	380	84.4

Partially Vaccinated	55	12.2
Not Vaccinated	15	3.3
Missed Vaccines		
Yes	60	13.3
No	390	86.7
Reasons for Missed Vaccines		
Lack of Awareness	15	25.0
Fear of Side Effects	18	30.0
Religious Beliefs	10	16.7
Vaccine Unavailability	8	13.3
Other	9	15.0

The results from Table 3 reveal that the majority of parents (83.3%) agree that vaccines are essential for their child's health, indicating strong overall support for vaccinations. Similarly, 71.1% of parents believe that the benefits of vaccines outweigh the risks, though 17.8% remain neutral, and 11.1% disagree, highlighting some persistent concerns. Notably, 33.3% of parents are worried that vaccines may cause serious side effects, despite 48.9% disagreeing with this belief. Trust in healthcare providers is relatively high, with 73.3% of parents agreeing they trust their healthcare provider's advice on vaccinations, though 17.8% are neutral. Interestingly, 15.6% of parents prefer to delay vaccinating their child, indicating a subset with lingering hesitancy despite generally positive attitudes.

Table 3: Parental Beliefs and Attitudes Toward Vaccination (n=450)

Belief/Attitude	Agree (n)	Disagree (n)	Neutral (n)
Vaccines are essential for child's health	375	35	40
Vaccines have more benefits than risks	320	50	80
Vaccines can cause serious side effects	150	220	80
I trust healthcare providers about vaccines	330	40	80
I prefer to delay my child's vaccinations	70	310	70

Table 4 highlights the primary sources of information parents rely on regarding vaccines. The majority of parents (64.4%) cited healthcare providers as their main source, reflecting strong trust in professional medical advice. Family and friends were the second most common source, influencing 16.7% of participants. Notably, 12.2% of parents obtained information from social media, indicating the growing impact of online platforms. Traditional media, such as television and radio, accounted for 5.6%, while only 1.1% of respondents relied on non-social media internet sources. These findings suggest the crucial role of healthcare providers in shaping parental decisions, while also underscoring the need to address the potential influence of social media on vaccine perceptions.

Table 4: Sources of Information About Vaccines (n=450)

Source	Frequency (n)	Percentage (%)
Healthcare Providers	290	64.4
Family and Friends	75	16.7
Social Media	55	12.2
Television/Radio	25	5.6
Internet (non-social media)	5	1.1

Table 5 shows the factors associated with vaccine hesitancy among parents. Age was significantly

associated with vaccine hesitancy, with younger parents under 25 years showing a higher likelihood of hesitancy (20%) compared to non-hesitant parents (8.0%, p=0.021). Similarly, parents aged 25-34 years were more hesitant (26.7%) compared to non-hesitant counterparts (42.7%, p=0.038). Education level was also a significant factor; parents with a primary education had the highest hesitancy (16.0% vs. 3.5%, p=0.001), while those with a university degree were less hesitant (44.0% vs. 73.8%, p=0.002). Employment status did not significantly affect hesitancy. Notably, parents who relied on healthcare providers for information were less likely to be hesitant (40.0% vs. 69.3%, p=0.001), while those obtaining information from social media were more likely to exhibit vaccine hesitancy (40.0% vs. 6.7%, p<0.001). Information from family and friends was not significantly associated with hesitancy.

Table 5: Factors Associated with Vaccine Hesitancy (n=450)

Variable	Hesitant (n=75)	Non-Hesitant (n=375)	p-value
Age (Years)			
< 25	15 (20%)	30 (8.0%)	0.021
25-34	20 (26.7%)	160 (42.7%)	0.038
35-44	25 (33.3%)	140 (37.3%)	0.412
≥ 45	15 (20.0%)	45 (12.0%)	0.025
Education Level			
Primary	12 (16.0%)	13 (3.5%)	0.001
Secondary	30 (40.0%)	85 (22.7%)	0.005
University	33 (44.0%)	277 (73.8%)	0.002
Employment Status			
Employed	40 (53.3%)	225 (60.0%)	0.280
Unemployed	35 (46.7%)	150 (40.0%)	0.297
Sources of Information			
Healthcare Providers	30 (40.0%)	260 (69.3%)	0.001
Social Media	30 (40.0%)	25 (6.7%)	<0.001
Family and Friends	15 (20.0%)	60 (16.0%)	0.417

Discussion:

This cross-sectional study conducted in Al-Ahsa, Saudi Arabia, provides valuable insights into vaccination coverage and factors influencing vaccine hesitancy among parents of young children. The findings reveal a complex interplay of sociodemographic factors, parental beliefs, and information sources that contribute to vaccine hesitancy in this population.

The study found that 84.4% of children were fully vaccinated, which is encouraging but falls short of the World Health Organization's (WHO) target of 90% coverage for most vaccines [27]. This coverage rate is similar to those reported in other parts of Saudi Arabia, such as Riyadh (85.6%) and Jeddah (83.1%) (Al-Saeed et al., 2022; Mahmoud et al., 2023. However, it is concerning that 12.2% of children were only partially vaccinated, and 3.3% were not vaccinated at all. These figures highlight the need for targeted interventions to improve vaccination coverage and address barriers to full immunization [28].

Factors Influencing Vaccine Hesitancy: The study identified several key factors associated with vaccine hesitancy, including parental age, education level, and sources of information. Younger parents, particularly those under 35 years old, were more likely to exhibit vaccine hesitancy. This finding aligns with previous research by [29], which found that younger parents are more susceptible to vaccine misinformation circulating on social media platforms. The increased vaccine hesitancy among younger parents may be attributed to their greater reliance on digital sources of information and potentially less experience with vaccine-preventable diseases.

Education level emerged as a significant factor, with parents having only primary education showing the highest levels of vaccine hesitancy. This result is consistent with a systematic review by [30], which found that lower educational attainment was associated with increased vaccine hesitancy across multiple countries. However, it is important to note that education alone does not guarantee vaccine acceptance, as some highly educated parents in our study also exhibited hesitancy. This phenomenon, often referred to as the "educated hesitancy paradox," has been observed in other studies [31–61] and may be related to increased exposure to anti-vaccine rhetoric or a tendency to question established medical advice.

Sources of Information: Our findings underscore the

critical role of healthcare providers as the primary and most trusted source of vaccine information, with 64.4% of parents relying on them. This result is encouraging and aligns with previous research highlighting the importance of healthcare provider recommendations in promoting vaccine acceptance [62]. However, the significant association between social media use and vaccine hesitancy is concerning. Parents who obtained vaccine information from social media were more likely to be hesitant, echoing findings from studies in other countries [63]. This trend highlights the urgent need for public health initiatives to combat vaccine misinformation on social media platforms and to enhance digital health literacy among parents.

Parental Beliefs and Attitudes: The study revealed generally positive attitudes towards vaccination, with 83.3% of parents agreeing that vaccines are essential for their child's health. This high level of recognition of vaccine importance is promising and provides a foundation for further improving vaccination rates. However, the fact that 33.3% of parents expressed concerns about serious side effects indicates persistent safety concerns that need to be addressed. These findings are consistent with a meta-analysis which found that perceived vaccine safety was a key determinant of vaccine acceptance across diverse populations [64].

The preference of 15.6% of parents to delay vaccinations is noteworthy and reflects a form of vaccine hesitancy that may not be captured by looking at overall coverage rates alone. This "fence-sitting" behavior, can lead to under-vaccination and increased vulnerability to vaccine-preventable diseases. Addressing this subset of hesitant parents requires tailored communication strategies that emphasize the importance of timely vaccination and the risks associated with delays [65].

Implications for Public Health Practice:

The results of this study have several implications for public health practice in Saudi Arabia and potentially other countries with similar sociocultural contexts. First, there is a clear need for targeted education and outreach programs, particularly for younger parents and those with lower educational attainment. These programs should focus on addressing specific concerns about vaccine safety and efficacy, using evidence-based communication strategies [66].

The strong influence of healthcare providers on vaccine decisions underscores the importance of ensuring that these professionals are well-equipped to address parental concerns and provide accurate, up-to-date information about vaccines. Continuing education programs for healthcare providers should include training on effective vaccine communication and strategies to address vaccine hesitancy [67].

Third, the significant role of social media in promoting vaccine hesitancy calls for innovative digital health interventions. Public health authorities should consider partnering with social media platforms to promote accurate vaccine information and develop strategies to counter misinformation [68].

Limitations and Future Research:

This study has several limitations that should be considered. The cross-sectional design limits our ability to establish causal relationships between the identified factors and vaccine hesitancy. Additionally, the study was conducted in a single region of Saudi Arabia, which may limit its generalizability to other areas or countries. Future research should consider longitudinal designs to track changes in vaccine hesitancy over time and explore the effectiveness of interventions aimed at reducing hesitancy.

Moreover, qualitative research could provide deeper insights into the nuanced reasons behind vaccine hesitancy, particularly among the subset of parents who prefer to delay vaccinations. Such studies could inform the development of more targeted and effective interventions to promote vaccine acceptance.

Conclusion

While vaccination coverage in Al-Ahsa is relatively high, there is room for improvement, particularly in addressing partial vaccination and vaccine hesitancy. By focusing on evidence-based education, leveraging the trust in healthcare providers, and developing strategies to combat misinformation on social media, public health authorities can work towards achieving optimal vaccination coverage and protecting children from vaccine-preventable diseases.

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