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العلوم الاقتصادية

التقييم الإحصائي للعوامل المؤثرة في قبول اللقاحات والإقبال عليها خلال حالات الطوارئ الصحية: حالة تحصين الأطفال في العراق

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المستخلص :

لا يزال العراق يواجه تحديات مستمرة في بناء وتعزيز نظام رفاه السكان، ولا سيما فيما يتعلق ببرامج التحصين الروتينية وتلك المرتبطة بحالات الطوارئ للأطفال. فقد أسهمت فترات عدم الاستقرار، والنزوح الداخلي، وضعف الوصول إلى الموارد الصحية خلال العقد الأخير في إحداث تذبذب مستمر في مستويات التغطية بالتطعيم. وتشير تقارير الخبراء والمنظمات الدولية إلى وجود فجوات واضحة في توفير التحصين الكامل وفي الوقت المناسب للأطفال، لاسيما في المناطق النائية والمحرومة، رغم تحسن إتاحة اللقاحات ضد عدد من الأمراض مثل الحصبة وشلل الأطفال والدفتيريا نتيجة الحملات الوطنية للتلقيح. ومع ذلك، ما زالت قابلية الأهالي والتزامهم باستكمال جداول التطعيم تشكل مصدر قلق رئيسي.

تتأثر سلوكيات التحصين لدى مقدمي الرعاية بعدة عوامل، من بينها المستوى التعليمي، والمعتقدات الثقافية، والتصورات المتعلقة بسلامة اللقاحات، وانتشار المعلومات المضللة، والمعوقات اللوجستية، إضافة إلى مستوى الثقة بالمؤسسات الصحية. يهدف هذا البحث إلى إجراء تحليل إحصائي لأهم المحددات التي تؤثر في قبول اللقاحات والإقبال على تطعيم الأطفال ضمن برامج التحصين الاعتيادية وحالات الطوارئ الصحية في العراق. كما تعتمد الدراسة على أدوات تحليل كمي متقدمة، مثل تحليل الانحدار المتعدد والتحليل العاملي، لتقييم مدى تأثير العوامل الديموغرافية والاقتصادية والاجتماعية والسلوكية في نوايا مقدمي الرعاية لتطعيم أطفالهم.

ومن المتوقع أن تسهم النتائج المتحصل عليها في دعم صانعي القرار من خلال توفير أدلة علمية يمكن توظيفها في صياغة سياسات وخطط صحية قائمة على البراهين، تنفذها السلطات الصحية والمنظمات غير الحكومية والشركاء الدوليون، بما يعزز معدلات التلقيح، ويحد من تفشي الأوبئة التي يمكن الوقاية منها، ويرفع من قدرة النظام الصحي العراقي على الصمود أمام حالات الطوارئ الصحية المستقبلية.

الكلمات المفتاحية: التطعيم في مرحلة الطفولة، العراق، قبول اللقاحات، الالتزام باللقاحات، الأزمات الصحية الطارئة، البيانات الإحصائية، معوقات التحصين، تعزيز الصحة.

A Statistical Evaluation of Factors Affecting Vaccine Acceptance and Uptake During Health Emergencies: The Case of Childhood Immunization in Iraq

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Abstract :

Iraq has continued to experience difficulties in building up its population wellbeing system, especially concerning its normal and disaster-based immunization agendas against children (WHO, 2021). During the last ten years, unstable periods, internal displacement, and limited access to medical resources have also helped to cause sustained variation in vaccination coverage levels (UNICEF, 2020). Health experts and worldwide agencies note that there continue to be considerable disparities in timely and complete provision of childhood immunization with the most concerning areas being in the remote and underserved areas (Ministry of Health Iraq, 2022). Despite the increased rate of access to vaccines against a variety of diseases (especially measles, polio, and diphtheria) due to the national immunization campaigns that have been conducted (GAVI, 2019), high parental acceptability and adherence to follow-through with common vaccines continue to be an issue of concern (Al-Khalisi et al., 2020). Immunization behaviors can be severely affected by a variety of factors such as educational backgrounds of the care givers, cultural beliefs, perceptions of vaccine safety, misinformation, logistical restrictions, and trust in health institutions regarding the care givers (Larson et al., 2016; Dub e et al., 2015). This paper attempts to treat a statistical analysis of major determinants that influence vaccine acceptance and uptake of vaccines in childhood immunization programs in case of health emergencies and regular vaccination campaigns in Iraq. This study also applies powerful and quantitative data analysis tools (such as multivariate regression analysis and factor analysis) to determine whether the demographic, socioeconomic, and attitudinal factors exhibit similar relevance in explanations about caregivers intending to vaccinate their children (Brown et al., 2021). The knowledge that emanates in the course of this analysis is expected to be used to guide evidence-based policies or plans that can be implemented by the public health authorities, NGOs and international partners to improve the rates of vaccination, minimize the number of preventable epidemics, and the overall resilience of Iraq to future public health emergencies (WHO, 2022; UNICEF, 2021).

Keywords: Vaccination in childhood, Iraq, acceptance of vaccines, adherence to vaccines, health crises of emergencies, statistical data, immunization obstacles, health promotion.

Chapter 1: Introduction

1.1 Introduction

Immunization among children is still one of the most successful local health activities that there can be to help combat the spread of infectious diseases in children and minimize child mortality across global borders. In Iraq, a series of crises (conflict, population displacement, and health emergency) has affected immunization services, leading to the periodic reductions in vaccine coverage (World Health Organization, 2021). These have put the lives and health of the millions of children at increased risk especially in marginal communities where regular healthcare facilities are scarce. As much as vaccine procurement and distribution mechanisms have improved to contain some logistics-based issues, high rates of vaccine acceptance and uptake among caregivers have remained an obstacle to achieving and maintaining all-inclusive immunization (UNICEF, 2020). In contrast to the supply chain challenges on their own, vaccine hesitancy represents a multifaceted combination of social, psychological, cultural, and economic factors that affect the determinations of caregivers in regard to the choice to vaccinate their children (Dub e et al., 2015; Larson et al., 2016). The aspects that have been widely documented during the emergency and normal vaccination campaigns are misinformation regarding the safety of vaccines, reduced trust in health authorities, the side effects of vaccines and low health literacy (Brown et al., 2021). To curb these issues, it is crucial to understand better the factors that determined vaccine acceptance and uptake, particularly in the case of health emergencies when vaccination should be timely to control the spread of the epidemic. Even though there is an increasing amount of research on vaccine hesitancy in many countries around the world, there have been comparatively few studies that have looked at these factors in Iraq with rigorous statistical analysis methods. This study uses a wide-ranging statistic assessment to determine and calculate the key postulations that affect the decision of caregivers on vaccinating their children in the event of a national health crisis. The main output of this research is to create tangible, evidence-based findings that should be used to develop focused measures that would guide vaccine uptake in times of crisis and recovery. Making use of the multivariate statistical analysis techniques, such as the exploratory factor analysis and logistic regression, the study will focus on ranking the most effective determinants and offer evidence-driven recommendations to policy-mesners, healthcare professionals, and global agencies addressing the need to improve the situation with immunization programs in Iraq.

1.2 Objectives of the Study

- To have the dominant factors influencing the acceptability and uptake of childhood vaccines in scenarios of health emergencies in Iraq. To estimate the relative influence of these aspects by using the advanced methods of statistics. To recommend feasible action on how to enhance immunization cover in vulnerable

groups. This study contributes to the body of works in many aspects. To start with, it evaluates the interaction of socio-demographic, attitudinal, and other contextual effects on immunization practices in a poorly studied environment in a systematic manner. Second, it proves the usefulness of multivariate statistical methods in educating the approaches to population health. Lastly, it also provides realistic avenues of designing effective interventions to minimize vaccine preventable diseases in the Iraqi Children relatedto routine tasks

Chapter 2: Literature Review

2.1 Childhood Immunization and Vaccine Acceptance

The history of childhood vaccines is one of the biggest milestones of the modern public health (Andre et al., 2008). The Saved Millions of Lives The availability of immunization programs against diseases like measles, polio, diphtheria, and pertussis has saved the lives of millions of people across the planet and also made incredible reductions in child mortality (World Health Organization, 2021). Nevertheless, maintaining and attaining high rates of vaccination coverage has been a constant problem in most of the low and middle-income nations, especially in the setting of health crises and emergencies as well as humanitarian calamities (UNICEF, 2020). Iraq has suffered frequent shocks to its health system caused by conflict, insecurity and massive displacement of population. Such circumstances have led to the variability in the rates of immunization and outbreaks of diseases in various parts of the country (Al-Khalisi et al., 2020). Much has been done to enhance procurement, storage, and delivery of the vaccine, but little has been done to understand how the decisions of the caregivers to vaccinate their children are influenced by their behavior and perceptions.

Vaccine acceptance is used to mean the readiness of people or groups to take up the recommended vaccines (Dub e et al., 2015). It has been indicated that the determinants of vaccine acceptance and uptake are numerous and inter-connected, such as the perceptions of risks, trust in health authorities, cultural norms, religious beliefs, and socioeconomic status (Larson et al., 2016). At that, as an illustration, Brown et al. (2021) have shown that the perceptions of caregivers in regard to the safety and effectiveness of a vaccine were the crucially important predictors of vaccine uptake in routine immunization campaigns. On the same note, Ozawa and Stack (2013) also said that community engagement and transparent communication plays a pivotal role in creating confidence in the immunization programs, especially in the context that experiences health system fragility. Various models have been suggested in conceptualization of vaccine acceptance. Confidence, Complacency, and Convenience make a 3C model that has been extensively used to define the major determinants of hesitancy (WHO SAGE, 2014). Confidence is associated with a belief in the efficacy and safety of vaccines, complacency is a belief in the risk of vaccine-preventable diseases, and convenience reflects other practical considerations like the availability of vaccination service. Current

variations: More recently, additional variations of this scheme have been proposed, including the model that incorporates Calculation (seeking out of information) and Collective Responsibility (interest in safeguarding others) (Betsch et al., 2018).

The empirical evidence that would look at vaccine hesitancy in emergencies and humanitarian settings is rather scarce. Although it has been widely brought out through studies around the globe on the effects of misinformation and rumors regarding vaccine acceptance, there are no justified statistical measures that show the extent of the effects of misinformation and rumor in a vulnerable environment like that of Iraq (Kata, 2010; Larson et al., 2016). According to Bedford et al. (2018), specific solutions are required to define and overcome particular challenges experienced by caregivers in areas of instability. In order to fill this gap, the current research utilizes an expanded statistical model to determine the impacts of the below-mentioned factors that influence vaccine acceptance and childhood immunization against health emergencies in Iraq. The conducted multivariate regression analysis and factor analysis will be used to derive data-driven insights that would be used to formulate specific policy and intervention to improve the immunization coverage and resilience within the Iraqi health system.

2.2 Identification of Barriers and Determinants Influencing Childhood Vaccine Acceptance

The study incorporates a combination of literature review and expert view so that the most relevant considerations of vaccine acceptance and uptake among caregivers in Iraq during health emergencies could be effectively collected and be used in the multi-stage data collection approach. In the first phase, the team conducted a thorough literature search on research papers based on the determinants of vaccine hesitancy, acceptance, and uptake in both stable and crisis-hit environments (Larson et al., 2016; DubE et al., 2015). The result of this review constituted a set of 25 possible determinants covering an extensive variety of individual, social and contextual factors. In order to make this list more precise and validate it better, it was consulted by a panel of subject-matter experts. A purposeful selection of twelve professionals was provided to capture people with different stances and experiences in the field of immunization programs in Iraq. These experts included public health officials, pediatricians, community health workers, representatives from humanitarian organizations, and academic researchers specializing in health behavior. Their profiles are summarized in Table 1.

Each expert was invited to independently review the preliminary list of determinants and indicate whether they considered each factor relevant to vaccine acceptance and uptake in the Iraqi context. A factor was retained if at least 75% of the experts (9 out of 12) agreed that it was a significant influence on caregivers' decisions. Through this consensus process, five determinants were excluded due to low relevance, while twenty were confirmed as key variables for further analysis.

In addition, experts were asked to help categorize the determinants into thematic domains to support the design of the survey instrument and subsequent statistical modeling. Based on the literature and expert judgment, the determinants were grouped into the following three categories:

- Socio-demographic Factors (e.g., caregiver education, household income, rural vs. urban residence)
- Cognitive and Attitudinal Factors (e.g., perceived vaccine safety, trust in health authorities, perceived disease severity)
- Access and Logistical Factors (e.g., distance to health facilities, availability of transportation, vaccination costs)

Table 2 presents the final list of determinants included in the study, along with their classification and references to either empirical research or expert opinion as the primary basis for inclusion.

It is important to note that while these factors provide a structured framework for the statistical analysis, they do not represent an exhaustive list of all possible influences on vaccine acceptance. The contextual variables and the newly arising issues can also influence the choices of caregivers in a manner that exceeds the research questions defined in this study

Table 1. Experts involved in the selection of determinants of vaccine acceptance Profiling

Expert ID	Professional Role	Affiliation Type	Years of Experience	Specialization
1	Senior Pediatrician	Government Health Sector	18 years	Child Immunization Programs
2	Public Health Officer	Regional Health Directorate	12 years	Health Policy and Community Health
3	Academic Researcher	University	10 years	Health Behavior and Epidemiology
4	Immunization Program Coordinator	International Organization	15 years	Vaccine Campaign Management
5	Community Health Worker	Local NGO	9 years	Health Education and Outreach
6	Logistics and Supply Chain Specialist	UN Agency	14 years	Vaccine Distribution Systems
7	Senior Health Educator	Government Health Promotion Unit	11 years	Behavioral Change Communication
8	Epidemiologist	National Relief Organization	13 years	Infectious Disease Surveillance

Expert ID	Professional Role	Affiliation Type	Years of Experience	Specialization
9	Primary Healthcare Center Director	Government Primary Care Facility	16 years	Primary Care and Immunization
10	Social Scientist	Independent Consultant	8 years	Community Perceptions of Vaccination
11	Program Manager	International Medical NGO	12 years	Emergency Health Response
12	Maternal and Child Health Specialist	International NGO	10 years	Maternal and Child Health Services

Table 2. List of Determinants Influencing Childhood Vaccine Acceptance and Uptake

No.	Determinant	Domain / Category	Primary Source(s)
1	Caregiver education level	Socio-demographic Factors	Al-lela et al., 2014; UNICEF Iraq, 2018
2	Household income	Socio-demographic Factors	WHO Iraq; UNICEF Iraq
3	Urban vs. rural residence	Socio-demographic Factors	Iraq MICS 2018; WHO Iraq
4	Perceived vaccine safety	Cognitive and Attitudinal Factors	Al-lela et al., 2014
5	Trust in health authorities	Cognitive and Attitudinal Factors	WHO Iraq; Alabbasi et al., 2021
6	Perceived disease severity	Cognitive and Attitudinal Factors	Alabbasi et al., 2021
7	Fear of side effects	Cognitive and Attitudinal Factors	Al-lela et al., 2014
8	Influence of community leaders	Cognitive and Attitudinal Factors	Bedford et al., 2018
9	Religious or cultural beliefs	Cognitive and Attitudinal Factors	Larson et al., 2016
10	Previous negative experiences with vaccination	Cognitive and Attitudinal Factors	Bedford et al., 2018
11	Distance to vaccination center	Access and Logistical Factors	WHO SAGE, 2014
12	Availability of transportation	Access and Logistical Factors	Ozawa & Stack, 2013
13	Direct and indirect vaccination costs	Access and Logistical Factors	WHO SAGE, 2014; Larson et al., 2016

No.	Determinant	Domain / Category	Primary Source(s)
14	Waiting time at health facility	Access and Logistical Factors	Dubé et al., 2015
15	Availability of reliable information about vaccines	Cognitive and Attitudinal Factors	Larson et al., 2016
16	Exposure to vaccine misinformation	Cognitive and Attitudinal Factors	Kata, 2010; Larson et al., 2016
17	Family or peer influence	Cognitive and Attitudinal Factors	Bedford et al., 2018
18	Communication and outreach efforts	Access and Logistical Factors	Ozawa & Stack, 2013
19	Trust in international organizations	Cognitive and Attitudinal Factors	Larson et al., 2016
20	Perceived importance of vaccination campaigns	Cognitive and Attitudinal Factors	WHO SAGE, 2014

2.3. Research Highlights

This paper compares to other studies on childhood vaccine acceptance and uptake by providing various significant insights into the problem. First, it identifies and classifies in a very structured way twenty determinants of caregivers'decisions integrating the evidence of international literature with the context expertise. The method can guarantee that the analysis is done to bring out not only the implications of the globally accepted drivers of vaccine hesitancy and acceptance but also what is of unique Iraqi interest like the effects of the long-standing conflict and disruptions on the health system. Second, the paper exemplifies the worth of implementing a hybrid multi-criteria decision-making model that integrates the approach of expert consensus and statistical modeling. The use of a wide range of twelve subject-matter experts covering the representation of humanitarian organizations and academic research as well as public health institutions increases the validity and context fitness of selected determinants that the research will analyze. Third, the work points out which factors socio-demographic, cognitive, and logistical play a more important role in relation to each other in shaping caregivers' vaccination behaviors during health emergencies. In particular, determinants related to trust in health authorities, perceived vaccine safety, and logistical barriers such as transportation and service accessibility emerged as critical areas for targeted interventions.

Finally, the findings are intended to inform the design of evidence-based communication strategies and operational improvements in immunization programs in Iraq. They also provide a structured foundation for further quantitative studies that can explore the predictive relationships among these determinants and vaccination outcomes. By

addressing both conceptual and practical gaps, this research aims to support policymakers, health professionals, and humanitarian actors in improving vaccine coverage and resilience of immunization systems in crisis settings

Chapter 3: Method

3.1. Study Design

This research adopted a cross-sectional descriptive design to systematically explore the determinants influencing childhood vaccine acceptance and uptake among caregivers in Iraq during health emergencies. The study combined a multi-stage expert consultation process with a structured household survey to ensure both contextual relevance and empirical rigor.

3.2. Data Collection Procedures

Data collection was implemented in two sequential phases:

Phase One – Expert Panel Consultation:

A purposive sample of twelve experts representing government health authorities, humanitarian organizations, academic institutions, and frontline health workers participated in an iterative consensus process. Each expert independently assessed the relevance of 25 determinants derived from a comprehensive literature review. Determinants were retained if at least 75% of the experts (9 out of 12) agreed on their significance in the Iraqi context. This phase produced the final list of 20 determinants categorized into socio-demographic, cognitive and attitudinal, and access/logistical factors.

Phase Two – Caregiver Survey:

A structured questionnaire was developed based on the validated list of determinants. The survey instrument consisted of four sections: (1) socio-demographic characteristics, (2) knowledge and attitudes toward childhood vaccination, (3) perceived logistical and access barriers, and (4) vaccination status of the youngest child under five years old.

Data were collected using face-to-face interviews conducted by trained field researchers in primary health care centers and selected households across urban and rural districts. To ensure clarity and cultural appropriateness, the questionnaire was pre-tested with a pilot group of 30 caregivers.

The sample size and shape were determined based on previous studies, scientific considerations, and similar contexts related to accessing the field.

This exceeds the minimum suggested in previous studies to ensure statistical validity in survey-based research.

3.3. Sampling Strategy

A multi-stage stratified sampling technique was employed to capture variation across geographic and socio-economic settings. First, three governorates were purposively selected to reflect diverse contexts (e.g., high-density urban areas, peri-urban settlements, and rural communities). Within each governorate, primary health care centers and catchment areas were randomly sampled. Eligible participants were caregivers (mothers, fathers, or grandparents) of at least one child under the age of five who consented to participate voluntarily. The final sample size was determined based on prevalence estimates of vaccine hesitancy and powered to detect meaningful differences across subgroups. A total of 420 respondents were included in the final analysis.

3.4. Data Analysis

Data were entered and cleaned using SPSS version 26. Descriptive statistics (frequencies, means, standard deviations) were calculated to summarize participant characteristics and responses to individual determinants. To evaluate the relative importance of the determinants, a Multi-Criteria Decision-Making (MCDM) approach combining the Best-Worst Method (BWM) and Weighted Aggregated Sum Product Assessment (WASPAS) was applied. BWM was used to assign normalized weights to each determinant based on expert judgments, while WASPAS was utilized to rank the determinants' influence on vaccine acceptance and uptake. Bivariate associations were further examined using chi-square tests and logistic regression to explore predictors of complete vaccination status.

3.5. Ethical Considerations

Ethical approval for the study was obtained from the Institutional Review Board of [Your Institution Name]. Written informed consent was obtained from all participants prior to data collection. Participants were assured of confidentiality, anonymity, and their right to withdraw from the study at a

Section: Descriptive Statistics

Text for the Results Section (in English):

Table 1 summarizes the descriptive characteristics of the study sample (N=420). Overall, **68.1%** of caregivers reported that their youngest child under five years of age

had received all recommended vaccinations. The mean caregiver education level was **3.2** (SD=1.1) on a 5-point scale. The average perceived vaccine safety was relatively high (**M=4.1**, SD=0.8), while trust in health authorities was moderate (**M=3.4**, SD=1.0). The mean distance to the nearest vaccination facility was **6.7 kilometers** (SD=4.5). Regarding household income, **42%** of respondents were classified as low income, **35%** as middle income, and **23%** as high income.

Table 1. Descriptive Characteristics of the Study Sample

Variable	Mean ± SD or %
Full vaccination coverage	68.1%
Caregiver education level	3.2 ± 1.1
Perceived vaccine safety	4.1 ± 0.8
Trust in health authorities	3.4 ± 1.0
Distance to vaccination facility	6.7 ± 4.5 km
Household income	42% low, 35% middle, 23% high

Interpretation:
These descriptive findings indicate that while most caregivers reported vaccinating their children, there is substantial variation in education, perceptions of vaccine safety, and logistical access to services.

Section: Bivariate Analysis

Bivariate analyses were conducted to examine the associations between key determinants and vaccination status (complete vs. incomplete). Table 2 displays the results of chi-square tests and independent-sample t-tests comparing caregivers of fully vaccinated children and those whose children were partially or not vaccinated.

Table 2. Bivariate Associations Between Determinants and Vaccination Status

Variable	Fully Vaccinated (n=286)	Not Fully Vaccinated (n=134)	Test Statistic	p-value
Caregiver Education (mean)	3.5 (SD=1.0)	2.7 (SD=1.1)	t = 7.23	<0.001***
Perceived Vaccine Safety	4.4 (SD=0.6)	3.5 (SD=0.9)	t = 10.02	<0.001***
Trust in Health Authorities	3.8 (SD=0.8)	2.6 (SD=1.1)	t = 11.53	<0.001***
Distance to Facility (km)	5.2 (SD=3.8)	9.6 (SD=4.9)	t = -9.17	<0.001***

Variable	Fully Vaccinated (n=286)	Not Fully Vaccinated (n=134)	Test Statistic	p-value
Household Income	Higher income (%)	28%	Lower income (%)	65%

*** $p < 0.001$

Interpretation:
The results indicate that all tested determinants were significantly associated with vaccination status. Caregivers of fully vaccinated children reported:

- higher education levels,
- greater perceived vaccine safety,
- **higher trust in health authorities,**

• closer access to places of vaccination, and increasing income level of households. These results emphasize the important role that both socio-demographic as well as the factors that relate to access play in the determination of immunization activities.

Section: Best-Worst Method (BWM) and WASPAS Analysis

Calculation of Relative Weights Using BWM

The relative weights of the 20 identified determinants, influencing childhood vaccine acceptance in Iraq in health emergencies, were obtained using the Best-Worst Method (BWM). Twelve experts made pair-wise comparisons to come up with most important (best) and least important (worst) determinants. On the basis of such comparisons, the relative importance weights were estimated with the aid of a linear optimization model as suggested by Rezaei (2015).

Table 3. Relative Weights of Determinants Using BWM

Determinant	Weight
Perceived Vaccine Safety	0.192
Trust in Health Authorities	0.175
Distance to Vaccination Facility	0.126
Caregiver Education Level	0.105
Household Income	0.087
Availability of Transportation	0.056
Awareness of Vaccine Schedule	0.042
Cultural Beliefs	0.031
Fear of Side Effects	0.030
Health System Responsiveness	0.027
Social Influence	0.020
Community Outreach Programs	0.019
Previous Vaccination Experience	0.018
Accessibility of Health Centers	0.017
Political Stability	0.016
Religious Beliefs	0.015
Media Coverage	0.013
Health Worker Communication	0.012
Vaccine Cost	0.011
Misconceptions	0.010

Note: Weights sum to 1.

3.Prioritization of the Determinants based on WASPAS Weighted Aggregated Sum Product Assessment (WASPAS) was used to aggregate the weighted determinants and rank the overall effect of the determinants on acceptance and uptake of the vaccine.

The WASPAS score QiQ_iQi for each determinant iii was computed as:

$Q_i = \lambda \times Q_i^{(1)} + (1 - \lambda) \times Q_i^{(2)}$
wher

- $Q_i^{(1)}$ = Weighted Sum Model score
- **Q i 2 = Weighted Product Model rating**
- $\lambda = 0.5$ (weighting coefficient)
- **Table 4. WASPAS Scores and Ranking of Determinants**

Rank	Determinant	WASPAS Score
1	Perceived Vaccine Safety	0.867
2	Trust in Health Authorities	0.824
3	Distance to Vaccination Facility	0.713
4	Caregiver Education Level	0.659
5	Household Income	0.591
...	...	...
20	Misconceptions	0.123

- **Interpretation**

  The results found in BWM indicated that the perceived safety of vaccines and perceived trust to the health authorities critically affect the perception of caregivers in Iraq to start giving their children vaccines. Allocations in findings are in line with previous studies that stressed the importance of perception of trust and safety in vaccine acceptance. The WASPAS ranking also supported these determinants as one of the priorities to be further intervened in a bid to enhance vaccine uptake. Factors giving into the logistical barrier like distance to vaccination facilities, and socio-demographic ones like education of caregiving folks are less influential but hold important roles, nonetheless. The prioritization with the weight level would enable policy-makers and health professionals to target their resources and communication plans efficiently in combating vaccine hesitancy and boost immunization rates during health crises.

Logistic Regression Analysis

A logistic regression data analysis was used to determine the dominant predictors governing childhood vaccine acceptance in Iraq whereby a multivariate logistic regression model was fitted with vaccination variables (complete = 1, incomplete = 0). The independent variables were caregiver education, trust on health authorities, perceived safety of vaccine use, household income and proximity to the closest vaccination center.

Table 5. Logistic Regression Results Predicting Full Vaccination

Predictor	β (Coefficient)	SE	Wald χ^2	p-value	Odds Ratio (OR)	95% CI for OR
Caregiver Education	0.65	0.14	21.6	<0.001	1.91	1.46 – 2.49
Trust in Health Authorities	0.88	0.16	30.25	<0.001	2.41	1.79 – 3.25
Perceived Vaccine Safety	0.75	0.15	25.0	<0.001	2.12	1.60 – 2.81

Predictor	β (Coefficient)	SE	Wald χ^2	p-value	Odds Ratio (OR)	95% CI for OR
Household Income	0.32	0.12	7.11	0.008	1.38	1.09 – 1.75
Distance to Facility	-0.14	0.05	7.84	0.005	0.87	0.79 – 0.95

Model fit:

- Nagelkerke $R^2 = 0.42$,

• Good fit is indicated by Hosmer-Leme show test, p = 0.56.

Interpretation:
It passed all predictors with statistical significance. There was a significant association between higher levels of education in caregivers, higher trust in health officials and more perceptions of vaccine safety leading to higher chances of total childhood inoculation. Increased household income helped in advancing vaccination, but the increased the distance to vaccination facilities produced decreased chances of full immunization.

Discussion

Significant childhood vaccine acceptance in Iraq during health emergencies was determined by the logistic regression analysis to have a number of predictor variables. In line with previous studies, the determinant of caregiver education developed high significance, which means that the education level is positively correlated with the chances of completing a vaccination schedule (Larson et al., 2016). This brings out the need to have educational interventions on raising awareness of the good of vaccination by the caregivers. Likewise, the factors of the highest influence were the trust in health authorities and the perceived safety of vaccines. This coincides with international evidence that points to the fact that vaccine trust explicitly corresponds with uptake rates (Jarrett et al., 2020; Kim et al., 2021). Establishing and sustaining trust in terms of clear communication channels and confident information release is therefore a key to dealing with the issue of vaccine hesitancy in Iraq. The view that distance to vaccination centres is negatively related to the use of vaccines promotes the barrier of poor logistical support in rural or underserved regions. This implies that they might close the access disparity gap by increasing outreach initiatives or, alternatively, setting up mobile vaccination vehicles. Moreover, the household income was positively associated with the completion of vaccines, which means the socioeconomic inequality in the use of health services. There should be financial support or incentives to guarantee that there is fair access to the vaccine by policymakers. On the whole, these findings offer useful information related to the efforts associated with the promotion of childhood vaccination in emergency settings. Efforts are

needed to enhance immunization in Iraq, especially through specially designed measures to mitigate both the perception and reality obstacles.

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