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HISTORICAL DEVELOPMENT OF VACCINES AND PUBLIC RESISTANCE: THE IMPACT OF COVID-19 PANDEMIC ON VACCINE HESITANCY AMONG ARABS IN ISRAEL

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Abstract:
Background: Vaccine hesitancy continues to be a pressing public health challenge worldwide. Changes in public trust in vaccines have intensified since the COVID-19 pandemic, most acutely in the case of ethnic minorities, which stresses the need for elucidating the socio-cultural, institutional and cognitive drivers of vaccine behavior. **Methods:** This study was developed using an explanatory sequential mixed-methods design to examine vaccine hesitancy among Arabs in Israel. In the quantitative component of this research (200 participants), the study examined the influence of the Health Belief Model (HBM) constructs, the Theory of Planned Behavior (TPB) components, trust in science, and religious fatalism and social support, using multiple linear regression analysis. In the qualitative component, semi-structured interviews with 20 purposively selected participants were performed and analyzed using thematic analysis. Both methods' results were integrated via the explanatory sequential approach. **Results:** The regression model explained 65.3% of the variance in vaccine hesitancy (R^2 = 0.653). Attitude toward vaccination emerged as the strongest negative predictor (β = −0.376, $p < 0.001$), followed by trust in science (β = −0.278, $p < 0.001$), while perceived barriers (β = 0.300, $p < 0.001$) and religious fatalism (β = 0.162, $p < 0.001$) significantly increased vaccine hesitancy. Social support demonstrated a modest protective effect (β = −0.120, $p = 0.014$). Qualitative findings revealed that vaccine hesitancy reflected a process of critical evaluation rather than outright rejection, characterized by concerns regarding rapid vaccine development, institutional transparency, misinformation, and cultural influences. Participants expressed greater trust in healthcare professionals than in governmental institutions and emphasized the importance of culturally sensitive communication. **Conclusions:** Vaccine hesitancy among Arabs in Israel should not be understood as a simple distinction between acceptance and refusal. Rather, it reflects a dynamic decision-making process shaped by perceived barriers, attitudes toward vaccination, trust in science, religious interpretation, social support, and broader sociocultural and institutional contexts. Public health strategies should therefore move beyond standard educational messages and prioritize transparent risk communication,

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culturally tailored interventions, partnerships with trusted healthcare professionals and community leaders, and sustained efforts to strengthen institutional trust.

Keywords: vaccine hesitancy, COVID-19, Arabs in Israel, mixed-methods research, Health Belief Model, Theory of Planned Behavior, public health communication, trust

1. Introduction

Vaccination is perhaps the greatest public health advancement of all time; it prevents millions of deaths from preventable diseases every year, extends life expectancy, and promotes health equity among entire populations (Andre et al., 2008). Despite strong evidence that supports both the safety and effectiveness of vaccines (CDC, 2020b), growing vaccine hesitancy has come to be recognized as an increasingly important global public health challenge. Hesitancy leads to decreased vaccination uptake and increased incidence of vaccine-preventable diseases (Bussink-Voorend et al., 2022; Dubé et al., 2013; Okumuş et al., 2019)**.**

Vaccine hesitancy is listed by the World Health Organization as one of 10 major global health threats (WHO, 2019). Vaccine hesitancy is defined as the delay in the acceptance or the refusal of vaccination despite the availability of vaccination services (WHO, 2014). Thus, a robust explanation of vaccine hesitancy must include behavioral and social considerations along with biomedical ones.

The COVID-19 pandemic has dramatically affected public perceptions of vaccination. It brought to the forefront one of the most rapid scientific collaborations in history to develop and deliver highly effective COVID-19 vaccines in a very short period (Tregoning et al., 2021; Yan et al., 2021; Zhang et al., 2022). At the same time, the pandemic amplified political misinformation and conspiracy narratives, and created a climate of mistrust towards government institutions, public health organizations, and science itself, leading to a decline in public confidence in government and potentially other sectors, including public health.

Evidence suggests that even after the peak of the COVID-19 crisis, vaccination choices are still affected by factors including fear of and uncertainty concerning the diseases the vaccines are designed to prevent, as well as the narrative used to convey the decision to take the vaccines. This shows the significant impact of trust in institutions and messaging in convincing the public to participate in vaccinations (Chapman et al., 2026; Thompson et al., 2023).

As one of the few countries in the world with a comprehensive national health care system and a thorough vaccination system, Israel presents a valuable research setting for studying the influences on vaccine hesitancy. While vaccination uptake remains high for most vaccines for most of the Israeli population, there are specific minority communities with significantly lower vaccination coverage (ICDC, 2018). Several studies in Israel have found unique influences on the vaccination behavior of minority groups, including trust in health professionals, previous experiences with

vaccines, perceptions of risk and the benefits of vaccination and social context and community norms (Bar et al., 2021; Dopelt et al., 2024; Halperin et al., 2020; Blank, 2023).

Despite the rapid growth in research on vaccine hesitancy due to the COVID-19 pandemic, there remain several significant gaps in the literature. First, few studies have focused on Arab citizens in Israel, a cultural, religious, and healthcare community that is distinct from the more studied majority population and other groups. Second, the research base predominantly used either quantitative or qualitative methods, providing limited opportunities for the quantitative results to be better understood by the rich experiences and perspectives of participants. Finally, much of the previous research considered one or more potential determinants in isolation from each other and ignored the integration of the effects of cognition, social context, and general social-environmental factors in a holistic model explaining vaccine behavior.

This research attempts to address this issue by employing a sequential explanatory mixed methods design to investigate vaccine hesitancy in the Arab population in Israel. Specifically, the quantitative part will seek to examine the relationship among Health Belief Model factors, vaccine-related trust, social support, and vaccine hesitancy. Findings from the quantitative study will then be explained and detailed during the qualitative stage, with participants reporting on their experiences and perspectives regarding these factors. By integrating qualitative and quantitative data, this study seeks to offer a comprehensive understanding of vaccination decision-making that can support culturally grounded public health efforts in multicultural societies. This investigation of vaccine hesitancy in an Arab Israeli population is ultimately intended to strengthen theoretical frameworks on vaccine acceptance while informing an array of intervention strategies and public policies related to health behavior among minority populations.

2. Literature Review

Vaccination has been recognized as one of the most successful public health interventions in modern medicine, substantially reducing morbidity, mortality, and the socioeconomic burden associated with infectious diseases worldwide. Since the introduction of the first smallpox vaccine by Edward Jenner more than two centuries ago, immunization has transformed the prevention and control of communicable diseases and has contributed significantly to improvements in life expectancy and population health (Andre et al., 2008). The remarkable success of vaccination programs has enabled the elimination or near elimination of several infectious diseases while preventing millions of deaths annually across different regions of the world.

Despite these achievements, public acceptance of vaccines has never been universal. Throughout history, vaccination has consistently encountered varying degrees of resistance driven by concerns regarding vaccine safety, religious beliefs, cultural traditions, mistrust in governmental and healthcare institutions, and misinformation. These concerns have evolved alongside advances in vaccine science, demonstrating that scientific progress alone does not necessarily translate into public confidence (Dubé et al.,

2013; Bussink-Voorend et al., 2022). Consequently, vaccine acceptance has become increasingly recognized as a multidimensional phenomenon that extends beyond biomedical considerations to include psychological, social, political, cultural, and economic influences.

The COVID-19 pandemic fundamentally altered the global vaccination landscape. The unprecedented speed of vaccine development represented one of the greatest scientific accomplishments in contemporary medicine (Tregoning et al., 2021; Yan et al., 2021; Zhang et al., 2022). However, this rapid scientific progress occurred simultaneously with an equally unprecedented spread of misinformation, public uncertainty, political polarization, and declining institutional trust. Rather than simply influencing attitudes toward COVID-19 vaccines, the pandemic reshaped public perceptions of vaccination in general, raising concerns regarding routine immunization programs and long-term vaccine confidence (Widyaningsih & Hakim, 2024; Grills & Wagner, 2023).

Contemporary research increasingly suggests that vaccine hesitancy represents a continuum of attitudes ranging from complete acceptance to complete refusal rather than a simple dichotomous behavior (Bussink-Voorend et al., 2022).

The situation becomes particularly complex among minority populations, where vaccine-related decisions are frequently influenced by historical experiences, socioeconomic inequalities, cultural identity, language barriers, and trust in governmental institutions. These determinants have received increasing attention in multicultural societies, including Israel, where disparities in vaccine uptake have been documented between Jewish and Arab populations (Bar et al., 2021). Although Israel possesses one of the world's most advanced vaccination systems, studies indicate that Arabs in Israel continue to experience lower vaccination rates for several vaccines, particularly following the COVID-19 pandemic, highlighting the importance of understanding the broader social and pharmacological factors influencing vaccination behavior.

From a socio-pharmacological perspective, vaccination cannot be viewed solely as a medical intervention. Instead, vaccine acceptance reflects a dynamic interaction between pharmaceutical innovation, healthcare systems, social environments, cultural values, institutional trust, and individual beliefs. Understanding these interactions is essential for developing effective interventions capable of improving vaccine confidence among minority communities. Therefore, this literature review examines the historical development of vaccines, the public health significance of immunization, the evolution of vaccine hesitancy, and the theoretical perspectives explaining vaccination behavior, with particular emphasis on Arabs in Israel following the COVID-19 pandemic.

In Israel vaccination services have a very long and established history, and as presented by The Israel Center for Disease Control (2018), have continuously evolved, with the establishment of comprehensive national immunization service systems from the beginning of the health system implementation in the country, with the purpose of combining with epidemiological monitoring, primary health care services and overall vaccination operations of the public health services across the country. Israel's

vaccination system is one of the best-structured public health infrastructure programs in the world due to the centralized coordination of its health system, wide accessibility, and high vaccine coverage, especially focusing on seasonal influenza vaccinations to protect vulnerable populations like the elderly and other groups (Blank, 2023).

During the COVID-19 crisis, science managed another of its greatest achievements. Yet, COVID-19 vaccines were approved within a year of when the initial novel virus was first detected due to many years of groundwork and basic research in virology, genetics and molecular biology, especially the advent and application of Messenger RNA (mRNA) technology (Tregoning et al., 2021, Yan et al., 2021 & Zhang et al., 2022).

Even so, due to the exceptionally fast development of COVID-19 Vaccines and the subsequent approval processes, it sparked a global rise in anti-vaccination sentiments. This was often because perceived risks associated with an unknown virus were attributed to rushed processes rather than the technology involved (Widyaningsih & Hakim, 2024). This suggests that technological innovation, regardless of the degree of scientific rigor, may not in itself assure public receptiveness, especially when Technological progress Outstrips Public awareness, Trust and Acceptance (Widyaningsih & Hakim, 2024).

2.1 Theoretical Perspectives on Vaccine Hesitancy

The need for a deeper understanding of the social, psychological and behavioral aspects of why some people choose to be vaccinated while others choose not to, in the face of similar scientific evidence, has necessitated the creation of behavior change theories. In this domain, several approaches have gained considerable support and have been used more often to study vaccine hesitancy, in particular the Health Belief Model (HBM), the Social Ecological Model (SEM) and Trust-based theories.

2.1.1 Health Belief Model

The health belief model (HBM) suggests that an individual's propensity to perform health-related behaviors (i.e., vaccination) depends on their perceptions of the threat of contracting a health condition, the severity of the health problem, the perceived benefits of the vaccination against the risk of the health problem, the perceived barriers to and costs of vaccination, one's self-efficacy to act, and cues to action (Rosenstock et al., 1988). Numerous reviews show evidence that these constructs significantly explain vaccination behavior across a wide range of populations (Anuar et al., 2020; Zewdie et al., 2022). The recently evidenced finding of the mediational effect of perceived susceptibility in the relationship between ambient environmental factors and vaccination intentions further supports the model (Taflinger & Sattler, 2024). Nevertheless, critics of HBM's focus on cognitive issues at the expense of social, institutional and policy-related variables encourage an adaptation of this theory.

2.1.2 Social Ecological Model (SEM)

To overcome some of HBM's limitations, researchers have increasingly turned to the SEM, which emphasizes the interaction of multi-level influences (individual, interpersonal, organisational, community and policy level) on individual behavior (Kumar et al., 2012).

Evidence from countries in Africa and Southeast Asia demonstrated how family members, caregivers, health providers, religious leaders, community-based organizations and governmental policies influenced vaccine acceptance (Bell et al., 2022; Chait et al., 2024).

2.1.3 Trust-Based Theories

Increasingly, trust is seen as one of the most potent predictors of vaccine acceptance.

The theory of trust posits that individual willingness to engage in vaccine practices hinges on an individual's confidence in various social entities. The level of trust an individual has in health providers, research institutions, pharmaceutical companies and government is found to play a significant role in influencing vaccination behavior. In Israel, for instance, it has been shown consistently that trust in institutions is a significant predictor of COVID-19and influenza vaccine uptake (Halperin et al., 2020; Dopelt et al., 2024).

Halperin et al. (2020) described how trust was a key determinant of intentions to receive the COVID-19 vaccine among elderly adults in Israel, and the need to reestablish confidence in the system remains a major focus of preventative efforts going forward (Thompson et al., 2023).

Dopelt et al. (2024) similarly underscored how trust in the health system strongly predicted seasonal flu vaccination for university students.

The combination of these theories suggests that an explanation for vaccine hesitancy cannot rest upon a single approach. Rather, vaccination behavior is likely to be the result of the synergy between individual beliefs and perspectives, inter-personal relations, institutional trust, culture values and interaction with the health care system, hence supporting a socio-pharmacological conceptualization as utilized in this review.

2.1.4 Culture and Religion

Cultural and religious norms often drive decision-making. Public health has long acknowledged the capacity of cultural and religious contexts to significantly impact behavior, reflecting the ways in which vaccine acceptance may reflect communal norms and practices, as well as beliefs rooted in various traditions.

2.1.5 Misinformation

Undoubtedly the greatest emerging factor of concern has been misinformation. In the contemporary media environment, access to widespread and rapidly propagated misinformation via social media is directly impacting vaccine-related beliefs, often casting doubt upon the utility, safety, and necessity of vaccines (Widyaningsih & Hakim,

2024). There is growing awareness that effective communication strategies and tailored message framing are key components to mitigate the potential harm of false information and to build the trust needed to increase confidence (Chapman et al., 2026).

2.2 Impact of the COVID-19 Pandemic on Vaccine Hesitancy

Perhaps no modern public health crisis has had such an impact on public vaccination attitudes as COVID-19. The pandemic revealed the incredible ingenuity of science to produce a safe, efficacious vaccine within a remarkably short time, but it also uncovered our society's deep-seated issues with trust, mis-/disinformation, political polarization, and public communication.

First, scientific breakthroughs provided for the remarkably rapid development of unprecedented new vaccine technologies, including mRNA- and viral vectors- based COVID-19 vaccine candidates.

Second, the COVID-19 Pandemic also "broke" the information field pertaining to vaccinations. Health authorities' advice was set in competition with mist- and dis-information, Conspiracy Theories and all varieties of misinformation distributed through Social Media and the internet and on social media; as a result, according to Widyaningsih and Hakim (2024) uncertainty regarding vaccines rose exponentially with a consequent decline in confidence regarding health professionals that now translated to information (as opposed to scientific proof) becoming the decisive factor for vaccination decisions.

Third, in many countries, the epidemic resulted in a decrease of institutional confidence in governments; attitudes about whether vaccination or health related policies had or have to be mandatory played a substantial role in determining confidence in governments and the medical sector in many cases; Chapman et al. (2026) even demonstrated that fearing related communications strategies had the "*unintended consequence of increased anxiety and diminished trust in vaccines and health care*," indicating that the quality of information is potentially more important than its veracity in vaccine attitudes. Fourth and important, the COVID-19 Pandemic impacted not only vaccines against COVID-19, but also changed how the population's perception towards standard vaccinations after the pandemic – parents' attitudes toward routine immunizations toward their child for example are changed by COVID-19 and these attitudes about coronavirus vaccines had influence also upon established vaccination programs, as indicated by Grills and Wagner (2023) in their Australian study on changes to parents attitudes towards immunization for their children, and have likewise been seen in a study in the country of Turkey, where confidence towards the influenza and child vaccination programs has recently dropped post pandemic (Yılmaz et al., 2026).

In conclusion, the COVID-19 pandemic shattered and reformed the way the public thinks about vaccines; in recent years, vaccine science proved its vital use as a tool of intervention, but, at the same time, we learned to appreciate and be conscious about the weaknesses of health communications, public confidence and institutional trust, which are reflected by changed vaccination attitudes also long after the pandemic itself.

2.3 Vaccine Hesitancy among Arabs in Israel

As a unique sociocultural minority in Israel, the vaccine behavior of the Arab population is molded by diverse sociohistorical, sociocultural, and institutional variables. It is acknowledged that Arabs in Israel are entitled to the national healthcare system afforded to all citizens in the country; nevertheless, it is empirically demonstrated that vaccination uptake rates are lower in Arab populations than in Jewish ones, and these differences are not adequately elucidated solely on grounds of healthcare access. Research has revealed that COVID-19 vaccine uptake was lower among Arab citizens than among Jewish ones; an association attributed by Bar et al. (2021) to three main factors: institutional trust, concerns about safety and mistrust in pharmaceutical companies, and influence of peers within social networks.

Likewise, an investigation into vaccination behaviors in Israeli societies showed trust in health authorities, perception of risk of contracting infection, and the prevalent social norms as primary determinants for accepting an influenza vaccine (Halperin et al., 2020).

The seasonal influenza vaccine follows this pattern: Dopelt et al. (2024) documented previous vaccination uptake behavior, knowledge, attitudes and trust in medical institutions as the most prominent predictors of intent to vaccinate against influenza in Israeli adults, thus further accentuating trust in the health system. In addition to these considerations, cultural dimensions characterizing the Arab community have a profound effect on the decision-making processes of healthcare consumers in Israel. Family influence, religious beliefs, social structures and leadership, community coherence-these factors can, for instance, impact the decision whether to vaccinate an individual or an entire family. Thus, an informed decision about getting vaccinated is largely the result of the consensus within the community, not of personal preference in isolation (Bell et al., 2022; Chait et al., 2024).

Hence, from a socio-pharmacological point of view, vaccine hesitancy among Arabs in Israel is to be considered as an interaction outcome of pharmaceutical development, healthcare provision, trust and identity, and of our historical experience as a society.

2.4 Research Gap and Summary

There is significant evidence in the existing literature on the progress made in understanding vaccine hesitancy in diverse communities and health contexts. Researchers have documented multiple drivers of vaccination behavior such as perceived knowledge of vaccination, individual risk beliefs, trust, cultural and religious beliefs, norms and values, and healthcare system utilization. Behavioral science has contributed frameworks for explaining and predicting the behavior of individuals and groups through the Health Belief Model, the Social Ecological Model, and others.

Nevertheless, several critical gaps remain in our understanding. For example, many of the published studies focus primarily on COVID-19 vaccination attitudes while overlooking the broader impact of the pandemic on attitudes towards vaccination in

general. Second, while minority groups are being examined more, few studies focus on the sustained impact of COVID-19 and of ongoing debates surrounding vaccinations for the population of Arabs living in Israel, viewed from a combined socio-pharmacological angle. Third, most previous work has focused separately on Psychological, Social or institutional determinants without examining them in conjunction with each other and its impact on vaccination.

This is particularly relevant as for Arabs in Israel, vaccine behavior represents a product of the complex interplay between biological discovery and invention, history and its impact, identity and ideology, trust and confidence, institutional relationships and service. Therefore, this review addresses this void, utilizing a socio-pharmacological approach in the compilation of historical, behavioral and social literature, including the direct impact of the COVID-19 pandemic on vaccine acceptance amongst the Arabs in Israel.

3. Material and Methods

3.1 Study Design

To explore vaccine hesitancy among Arab citizens of Israel more fully, we followed an explanatory sequential mixed-methods design nested within a pragmatic research paradigm. Mixed methods research integrates quantitative and qualitative methods to both identify the strength of relations among variables and uncover explanations for the meaning that participants assign to their behaviors and experiences (Creswell & Plano Clark, 2018). In this study, quantitative data from an online, cross-sectional survey were collected in Phase I.

The survey measured Health Belief Model (HBM) constructs, trust in science, social support, and vaccine hesitancy.

This quantitative phase was followed by qualitative data collection from a subsample of survey respondents through semi-structured interviews. Thus, the purpose of this second phase was to build on quantitative data by providing a more detailed explanation of the observed patterns (Creswell & Plano Clark, 2018). Because of vaccine hesitancy's multifaceted nature (which encompasses behavioral, health promotion, cognitive, sociocultural, organizational, and environmental determinants), no single methodology could fully account for its presence; mixed methods design was useful to gather complex evidence to triangulate and validate.

3.2 Quantitative Component

3.2.1 Study Population and Sampling

The quantitative phase targeted Arab adults residing in Israel who were eligible to receive COVID-19 vaccination. Participants were recruited using a non-probability convenience sampling strategy through community organizations, social media platforms, educational institutions, and personal networks. Inclusion criteria required

participants to be at least 18 years of age, reside in Israel, identify as members of the Arab community, and voluntarily agree to participate in the study.

3.2.2 Data Collection Instrument

Data were collected using a structured self-administered questionnaire developed from previously validated instruments. The questionnaire consisted of six sections:

Demographic characteristics, Health Belief Model constructs, Trust in Science, Social Support, Theory of Planned Behavior constructs and Vaccine Hesitancy.

All measurement items were assessed using a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Prior to the main survey, the questionnaire was reviewed by experts in public health and health behavior and pilot-tested to ensure clarity and content validity.

3.3.3 Variables

The dependent variable was Vaccine Hesitancy.

Independent variables included: Perceived Susceptibility, Perceived Severity, Perceived Benefits, Perceived Barriers, Cues to Action, Attitude toward Vaccination, Subjective Norms, Perceived Behavioral Control, Trust in Science, Social Support and Religious Fatalism

3.3.4 Quantitative Data Analysis

Quantitative data were analyzed using IBM SPSS Statistics Version 29. Descriptive statistics were calculated to summarize participants' demographic characteristics and study variables. The internal consistency of the study scales was assessed using Cronbach's alpha coefficients. Pearson correlation analysis was used to examine bivariate associations between vaccine hesitancy and the main explanatory variables. Multiple linear regression analysis was then performed to identify the independent predictors of vaccine hesitancy, including perceived benefits, perceived barriers, attitude toward vaccination, trust in science, religious fatalism, and social support. Statistical significance was set at $p < 0.05$.

3.3.5 Qualitative Component

3.3.5.1 Research Design

Following completion of the quantitative analysis, a qualitative phase was conducted using semi-structured interviews. This phase aimed to explain the quantitative findings and provide deeper insights into participants' vaccination experiences, beliefs, and decision-making processes.

3.3.5.2 Participant Selection

Interview participants were purposively selected from survey respondents who agreed to participate in follow-up interviews. Maximum variation sampling was employed to

ensure diversity regarding age, gender, educational level, vaccination status, and levels of vaccine hesitancy.

3.3.5.3 Data Collection

Individual semi-structured interviews were conducted either face-to-face or online, depending on participants' preferences. The interview guide explored participants' perceptions of vaccine safety and effectiveness, trust in healthcare professionals and scientific institutions, religious beliefs, social influences, sources of health information, and factors affecting vaccination decisions.

Each interview lasted approximately 30–60 minutes and was audio-recorded with participants' informed consent before being transcribed verbatim.

3.3.6 Qualitative Data Analysis

Interview transcripts were analyzed using Braun and Clarke's (2006) six-step thematic analysis approach. The analysis involved repeated reading of transcripts, initial coding, generation of themes, review of themes, theme definition, and preparation of the final report.

To enhance research rigor, coding was independently performed by two researchers, and disagreements were resolved through discussion until consensus was achieved. Data collection continued until thematic saturation was reached.

3.4 Integration of Methods

Integration occurred during the interpretation stage following completion of both quantitative and qualitative analyses. The qualitative findings were used to explain, clarify, and expand the quantitative results through an explanatory sequential integration strategy.

A joint display matrix was developed to integrate both datasets by comparing statistical findings with participants' narratives. This integration facilitated the identification of convergence, complementarity, and divergence between quantitative and qualitative evidence, thereby producing comprehensive meta-inferences regarding vaccine hesitancy among Arabs in Israel.

The integration process enhanced the credibility of the study by providing both statistical evidence and contextual explanations for vaccination behavior.

3.5 Ethical Considerations

Ethical approval was granted from the Institutional Review Board (IRB) prior to the data collection being initiated. Both participants in phases 1 and 2 were on a voluntary basis. All participants were issued with an information sheet outlining the purpose of the study, procedures for the protection of confidentiality, any potential risks, and their right to withdraw from the research without penalty at any time.

All participants provided written consent for the completion of the questionnaire and for participation in interviews.

Anonymity of the questionnaire was maintained, while a list of identifiable characteristics was immediately removed from the interview transcripts once they had been transcribed. All electronic records were stored in secured password protected devices that could only be accessed by the members of the research group. This study adhered to the Declaration of Helsinki and the international guidelines for research involving human participants.

4. Results

4.1 Quantitative Results

4.1.1 Descriptive Statistics

The quantitative phase included 200 participants. As presented in **Table 2**, participants had a mean age of **42.8 years** (SD = 14.2). Females represented **54.0%** of the sample, while **62.0%** were married. More than half of the participants (**58.0%**) had completed secondary education or higher, **69.0%** were employed, and **76.0%** resided in urban areas. Regarding health-related characteristics, **38.0%** reported previous COVID-19 infection, **92.0%** had received at least one dose of a COVID-19 vaccine, and **21.0%** reported having chronic diseases.

Among the Health Belief Model (HBM) variables, perceived benefits demonstrated the highest mean score (M = 3.76, SD = 0.53), followed by perceived severity (M = 3.64, SD = 0.67), cues to action (M = 3.53, SD = 0.59), perceived susceptibility (M = 3.27, SD = 0.50), and health motivation (M = 3.27, SD = 0.76). Perceived barriers recorded the lowest means among the HBM constructs (M = 2.68, SD = 0.70).

Within the Theory of Planned Behavior (TPB), participants reported a highly positive attitude toward vaccination (M = 3.98, SD = 0.87), together with relatively high perceived behavioral control (M = 3.74, SD = 0.62) and subjective norms (M = 3.52, SD = 0.64). Social support also demonstrated a relatively high mean score (M = 3.52, SD = 0.65). Trust in science (M = 2.89, SD = 0.21) and religious fatalism (M = 2.78, SD = 0.77) showed comparatively lower levels. Overall, vaccine hesitancy demonstrated a moderate level (M = 3.18, SD = 0.22), indicating that although participants generally accepted vaccination, some degree of hesitation remained.

4.1.2 Reliability Analysis

The internal consistency of the measurement scales was assessed using Cronbach's alpha coefficients. Most constructs demonstrated acceptable to excellent reliability. Social Support exhibited excellent reliability (α = 0.906), while Attitude toward Vaccination (α = 0.838), Religious Fatalism (α = 0.838), and Perceived Barriers (α = 0.779) demonstrated good internal consistency.

Perceived Susceptibility (α = 0.724), Subjective Norm (α = 0.708), Cues to Action (α = 0.671), Perceived Behavioral Control (α = 0.623), and Perceived Severity (α = 0.611) all showed acceptable reliability. Lower reliability values were observed for Perceived Benefits (α = 0.577) and Health Motivation (α = 0.550). Considering that both constructs

consisted of only two items, these values were considered acceptable for exploratory research despite falling below the conventional 0.70 threshold.

4.1.3 Correlation Analysis

Vaccine hesitancy was negatively correlated with perceived benefits (r = −0.450), attitude toward vaccination (r = −0.667), trust in science (r = −0.524), and social support (r = −0.192), indicating that higher scores on these variables were associated with lower vaccine hesitancy.

Conversely, vaccine hesitancy demonstrated positive correlations with perceived barriers (r = 0.461) and religious fatalism (r = 0.266), suggesting that participants who perceived more barriers to vaccination or endorsed stronger fatalistic religious beliefs were more likely to report greater vaccine hesitancy.

Furthermore, perceived benefits were positively associated with TPB attitude (r = 0.555) and trust in science (r = 0.398), whereas perceived barriers were negatively associated with attitude (r = −0.423) and trust in science (r = −0.337). All reported correlations were statistically significant at **p < 0.05**.

Note: All reported correlations were statistically significant at $p < 0.05$.

4.1.4 Multiple Linear Regression Analysis

Multiple linear regression analysis was performed to determine the independent predictors of vaccine hesitancy. As shown in **Table 1**, the overall regression model was statistically significant (**F**(6,193) = 60.42, **p** < 0.001), explaining **65.3%** of the variance in vaccine hesitancy (**R^2 = 0.653**, Adjusted **R^2 = 0.642**).

Perceived barriers significantly increased vaccine hesitancy (β = 0.300, p < 0.001), whereas attitude toward vaccination was the strongest negative predictor (β = −0.376, p < 0.001). Trust in science also significantly reduced vaccine hesitancy (β = −0.278, p < 0.001), while religious fatalism significantly increased vaccine hesitancy (β = 0.162, p < 0.001). Social support was negatively associated with vaccine hesitancy (β = −0.120, p = 0.014), indicating that greater perceived support contributed to lower hesitancy. Perceived benefits did not significantly predict vaccine hesitancy (β = −0.066, p = 0.197).

Table 1: Multiple Linear Regression Predicting Vaccine Hesitancy

Predictor	**B**	**SE**	**t**	**p-value**	**B**
Constant	3.894	0.307	12.700	<0.001	—
HBM Benefits	-0.066	0.051	-1.294	0.197	-0.066
HBM Barriers	0.300	0.048	6.236	<0.001	0.300
TPB Attitude	-0.376	0.046	-8.114	<0.001	-0.376
Trust in Science	-0.278	0.055	-5.094	<0.001	-0.278
Religious Fatalism	0.162	0.043	3.802	<0.001	0.162
Social Support	-0.120	0.049	-2.469	0.014	-0.120

Model Statistics: R^2 = 0.653, Adjusted R^2 = 0.642, F(6,193) = 60.42, p < 0.001.

4.2 Hypothesis Testing

Of the six hypotheses posited, five received empirical support. There were statistically significant predictions of vaccine hesitancy in the directions of hypotheses from perceived barriers (H2), attitude toward vaccination (H3), trust in science (H4), religious fatalism (H5), and social support (H6). As such, none supported H1, which found that perceived benefits do not predict vaccine hesitancy.

Note: VH = Vaccine Hesitancy; ***$p < 0.001$; *$p < 0.05$.

4.3 Demographic Characteristics

Table 2: Demographic Characteristics (N = 200)

Variable	N / Mean	Percentage (%)
Age (years), M (SD)	42.8 (14.2)	—
Gender – Female	108	54.0%
Marital Status – Married	124	62.0%
Education ≥ Secondary	116	58.0%
Employment – Employed	138	69.0%
Residence – Urban	152	76.0%
Previous COVID-19 Infection	76	38.0%
COVID-19 Vaccination Status	184	92.0%
Chronic Diseases	42	21.0%

4.4 Qualitative Findings

Thematic analysis of the semi-structured interviews (n = 20 participants) identified five overarching themes that explain how the COVID-19 pandemic shaped vaccine attitudes and hesitancy among Arabs in Israel. These themes emerged through iterative coding and theme development following Braun and Clarke's six-phase approach. Collectively, the findings illustrate that vaccine hesitancy was not characterized by outright rejection of vaccination but rather by a dynamic process in which participants continuously weighed scientific evidence, personal experiences, institutional trust, and social influences before making vaccination decisions.

Theme 1: Transformation of Vaccine Confidence Following the COVID-19 Pandemic

Participants consistently described a substantial shift in their perceptions of vaccination following the COVID-19 pandemic. Before the pandemic, routine vaccines were largely perceived as unquestionable medical achievements, and most participants reported complete adherence to recommended vaccination schedules without hesitation. Vaccination was viewed as a routine preventive practice supported by unquestioned trust in healthcare professionals and public health authorities.

Following the pandemic, however, this unconditional trust evolved into a more critical and conditional form of confidence. Participants emphasized that they now evaluate scientific evidence, compare multiple information sources, and seek a better understanding of vaccine development before accepting new vaccines. Rather than indicating rejection of vaccination, this transition reflected increased critical engagement

with health information. Illustrative quotations include: "*Before COVID-19, vaccines were one of the greatest medical achievements*." (Participant 1) and "*I became much more selective and no longer accept health recommendations without understanding the evidence*." (Participant 2).

Theme 2: Factors Driving COVID-19 Vaccine Hesitancy

Although nearly all participants ultimately accepted COVID-19 vaccination, they described several factors that generated uncertainty before making their decisions. Four interconnected subthemes emerged:

- **Concerns about rapid vaccine development:** Many participants questioned the unprecedented speed of vaccine development, expressing concerns that clinical evaluation may have been accelerated compared with conventional vaccine development processes.
- **Fear of long-term side effects:** Participants frequently distinguished between short-term adverse reactions and unknown long-term consequences. Concerning fertility, cardiovascular complications, and future health risks were commonly mentioned.
- **Exposure to misinformation:** Social media platforms, WhatsApp groups, and informal community networks exposed participants to contradictory information and conspiracy narratives. While most participants indicated that misinformation rarely changed their final decision, it often delayed vaccination while they searched for additional evidence.
- **Uncertainty regarding vaccine safety:** Rather than complete distrust, participants described a state of uncertainty in which they continuously balanced the perceived risks of vaccination against the health risks associated with COVID-19 infection.

Participants noted: "*The misinformation did not stop me, but it definitely delayed my decision*." (Participant 1) and "*I wanted more scientific evidence before taking the vaccine*." (Participant 4).

Theme 3: Institutional Trust and Sources of Health Information

A clear dichotomy was found between participant trust of healthcare professionals and trust of government bodies. Physicians, nurses and specifically, Arab healthcare workers were all highly cited as trustworthy sources of information. Trust in government messages was substantially lower however, with repeated complaints that these messages were opaque, shift over time and did not relate to the issues important to the Arab minority population.

As a result of this, many participants placed more faith in scientific papers, healthcare specialists and well-trusted medical staff than in public service broadcasts.
Specific illustrative quotations in these studies revealed: "*I trust the Arab doctors as they speak for our community, for our needs*" [Participant 1] and "C*onfidence in healthcare workers remained high, yet confidence in governmental decision-making decreased*" [Participant 2].

Theme 4: Social and Cultural Influences on Vaccination Decisions

Vaccination decisions were rarely described as purely individual choices. Instead, participants emphasized that family members, friends, and the surrounding community substantially influenced their perceptions and decisions.

Family discussions frequently shaped vaccination intentions through emotional support and shared experiences. Friends who had already been vaccinated often reduced participants' anxiety, whereas reports of adverse reactions occasionally reinforced concerns.

Religion was also discussed; however, participants generally viewed religious beliefs as influencing the interpretation of vaccination rather than directly determining acceptance or refusal. Some interpreted vaccination as fulfilling the religious obligation to protect health, whereas others emphasized reliance on divine will.

Illustrative quotations included: "*Protecting my family was the strongest reason behind my decision*." (Participant 2) and "*Religion encouraged some people to vaccinate and discouraged others*." (Participant 4).

Theme 5: Future Health Decision-Making and Strategies to Improve Vaccine Confidence

Throughout the study, participants indicated that "*the pandemic had profoundly altered their decisions regarding their future health*." The majority indicated that they became more autonomous in assessing health-related information, more so relying on scientific data and healthy coping strategies to ward off illnesses. Further recommendations for strengthening the Arab vaccine acceptance movement from participants included utilizing transparency in communication, culturally tailored health campaigns tailored and communicated in Arabic, more active inclusion of trusted and credible Arab physicians/health care professionals in messaging and engaging the community with dialogue rather than coercion, with the emphasis on evidence-based communication. It was highlighted by the study participants: "*Transparency was essential*" (Participant 1) and "*We need Arabs to get the facts to our people and Arabs must communicate*" (Participant 4).

4.6 Mixed Methods Integration

There was convergent evidence for all key findings. Qualitative analysis provided support for the finding that attitude to vaccination predicted vaccine hesitancy, with participants elaborating their process of critically assessing evidence and weighing potential risks and benefits of vaccines. The qualitative context of preference for honest science informed us about how trust in science led to greater likelihoods of vaccination acceptability and use. Both forms of trust were associated with acceptance of vaccination. Governmental trust to some individuals, does not lead to acceptance of government advice regarding use of health.

Interpersonal trust among those individuals helps acceptance because of recommendations from physicians. The qualitative data also show that religious fatalism impact on hesitancy is conditioned by the interpretation of religious belief of religion

people can accept vaccination accepting, in case it can be explained as a religious requirement for self-health protection.

5. Discussion

This sequential explanatory mixed-methods study investigated factors driving vaccine hesitancy in Arab Israelis, drawing on an integrated socio-pharmacological model which integrated the Health Belief Model, the Theory of Planned Behavior, Trust Theory and overarching social influences. These findings reveal vaccine hesitancy is far more than mere vaccine refusal and represent instead a dynamic decision-making process reflecting the interplay between cognitive calculations, institutional trust, cultural values and interpersonal relationships. The synergy of both qualitative and quantitative results offers crucial insights to help us further understand decision-making related to vaccines in the post-COVID-19 context.

Not surprisingly, participants who perceived positive attitudes toward vaccines were more likely to report low vaccine hesitancy, consistent with predictions from the Theory of Planned Behavior, where attitude toward behaviors was the most immediate psychological antecedent of intentions. Participants with more positive attitudes toward vaccines consistently reported lower levels of hesitancy compared to those with more negative attitudes, with a finding supported by reports by Ajzen (2020) and Taflinger and Sattler (2024) on the use of attitudes in health behavior promotion. Interestingly, and uniquely to the present study, is our qualitative assessment revealing how this attitude toward vaccination is no longer passive and simply reflects acceptance of vaccine recommendations without critical assessment of the evidence. Our findings show that a shift has taken place in terms of a move toward more conscious and actively mediated attitudes in relation to scientific knowledge of vaccination, which now largely reflect positive views in an era of "active wisdom," supporting more recently discussed conceptualization of vaccine hesitancy as a continuum rather than a bivalent accept/refuse dichotomy (Bussink-Voorend et al., 2022).

Concerns regarding vaccine safety and side effects of vaccination were also important in explaining participants' levels of vaccine hesitancy-this supports the assumptions of the HBM, where concerns about the "perceived barriers" towards a preventive behavior determine engagement in it, a finding that is consistent with prior HBM literature on vaccines (Anuar et al., 2020; Zewdie et al., 2022). However, the present qualitative results build upon HBM explanations by providing context and deeper nuance on the exact barriers that exist within post-pandemic discourse; respondents consistently expressed concern about the rapid deployment of the COVID-19 vaccines and uncertain long-term risks. These concerns extend traditional health behavior perceptions on accessibility barriers to include ambiguity generated from continuously shifting media and scientific reports. Therefore, interventionists will need to address how vaccine hesitancy is primarily driven by risk communication rather than efficacy messages.

The current study adds value to the ongoing efforts on constructing evidence-based and conceptually coherent models of health-related trust through the strong and significant relationship that emerged between trust in science and vaccine hesitancy that is consistently observed (Thompson et al., 2023; Christodoulakis et al., 2024). The qualitative data highlight the distinction between distrust in governmental and authoritative communication and trust in physicians/healthcare providers and particularly Arab health care professionals, where culturally congruent, community-based, and personalized advice contributed positively to vaccine engagement despite widespread diminished trust in institutions. Such findings add nuances to existing theories by acknowledging the significance of interpersonal forms of trust and its role in compensating for the breakdown of institutional trust as seen within minority groups.

Our quantitative finding that religious fatalism is positively correlated with vaccine hesitancy should not be taken out of context, and the qualitative results illustrate a richer and less monolithic picture of the religious framework of vaccination. However, in the present study, religion acted as a dynamic interpretive framework where several religious respondents saw getting vaccinated as the duty of fulfilling religious teachings to preserve life. Given this finding, collaborating with respected religious leaders may present a viable strategy in targeting and overcoming vaccine hesitancy among different cultural groups.

Finally, the finding that social support serves as an important protective factor against vaccine hesitancy indicates that people make decisions about vaccination as part of complex social interactions and not as autonomous individuals. Respondents reported several interactions with family members, friends and physicians that facilitated vaccine engagement. These findings support conceptual work such as the social–ecological model emphasizing interactions at individual, community, organizational and policy levels, and similar results can be found in the literature (Bell et al., 2022; Kumar et al., 2012; Faye et al., 2022). Our qualitative findings additionally offer rich illustrations about how social influences affect how vaccine decisions are made, with observation of positive vaccination experience amongst family members often being key, as stories of adverse reactions sometimes added to concern.

Although perceived benefits were negatively associated with vaccine hesitancy in the correlation analysis, they did not remain a significant independent predictor in the regression model, suggesting that other factors, particularly perceived barriers, trust, attitudes, religious interpretation, and social support, played a stronger explanatory role. Overall, the findings suggest that vaccine hesitancy among Arab Israelis cannot be explained by a single behavioral model; rather, it reflects the combined influence of cognitive beliefs, behavioral intentions, institutional trust, religious interpretation, cultural context, and social relationships.

First and foremost, the general strategy of reducing vaccine hesitancy will hardly succeed if based solely on vaccine efficacy arguments, or if this is not complemented with measures that build up trust and restore credibility on the institutional side.

Secondly and as is well articulated above, it may be reasonable to seek to strengthen policy through and with trusted healthcare actors who share the same culture, language and may be religion and have the same kind of lived experience as the target group, in so far as this is the case (see also the result concerning 'institutional trust'). Thirdly, interventions tailored to specific contexts, such as involving religious leaders, respected cultural leaders, and community and family networks to communicate to individuals that what we and governmental agencies say is true and correct about both vaccines and other public health measures, should be more effective than uniform national efforts. This, at least implicitly, acknowledges vaccine hesitancy not because of ignorant behavior but as a logical, albeit perhaps misinformed, consequence of what in the public health world may sometimes be taken to be simple misinformation about the consequences.

6. Limitations

The present study has several limitations. The quantitative phase used a cross-sectional survey, so the findings cannot show causal relationships between the study variables and vaccine hesitancy. In addition, the use of non-probability convenience sampling may limit the generalizability of the findings to the wider Arab population in Israel. Since the data were self-reported, some responses may have been affected by recall bias or social desirability bias. The qualitative phase included 20 semi-structured interviews, which provided rich explanations of the quantitative results, but these findings should be understood as contextual rather than statistically generalizable. Nevertheless, the integration of quantitative and qualitative data helped provide a broader understanding of vaccine hesitancy in the post-COVID-19 context.

7. Conclusions

This study offers strong mixed-methods evidence that vaccine hesitancy among Arabs in Israel should not be understood as a simple distinction between acceptance and refusal. Rather, it reflects a dynamic decision-making process shaped by the interaction of perceived barriers, attitudes toward vaccination, trust in science, religious interpretation, social support, and broader sociocultural and institutional contexts. The findings indicate that, following the COVID-19 pandemic, many participants did not reject vaccination altogether but became more critical and selective in their evaluation of vaccine-related information, placing greater emphasis on transparency, credibility, and trusted sources of scientific knowledge.

The study contributes to the existing literature by developing an integrated sociocultural–pharmacological understanding of vaccine hesitancy that combines behavioral, cultural, institutional, and community-level influences. Future vaccination programs should move beyond standard educational communication approaches to focus on transparent risk communication strategies, culturally tailored interventions,

partnerships with healthcare practitioners and key community leaders, and to continually invest in enhancing societal trust in institutions.

Future research should examine how vaccine confidence changes over time among minority populations and evaluate the effectiveness of culturally tailored interventions designed to strengthen trust in vaccination and public health systems.

Conflict of Interest Statement
The author declares no conflicts of interest.

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