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Approaches to the Perceptions of Kazakhstani Citizens on the Effects of Fake News on Vaccine Hesitancy

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Abstract

Vaccine hesitancy remains a major public health challenge, particularly in the context of widespread misinformation and declining institutional trust. This study investigates the effects of fake news, trust in official sources, prior vaccination behavior, and demographic factors on COVID-19 vaccination uptake in Kazakhstan. A cross-sectional survey was conducted among 262 respondents, and the data were analyzed using logistic regression with L2 regularization. Key findings indicate that individuals who received other vaccines in the past five years were nearly four times more likely to be vaccinated against COVID-19. Trust in government sources was also a significant positive predictor, while belief in fake news reduced vaccination likelihood by approximately 10%. Demographic variables such as age, gender, and education played additional roles, with men and less-educated individuals showing higher hesitancy. The study highlights the critical importance of behavioral consistency, institutional credibility, and information source reliability in shaping vaccination decisions. These results contribute to the broader literature on public health communication and vaccine acceptance, offering insights relevant to post-Soviet and digitally connected societies. Policy implications include strengthening trust-based communication, promoting routine immunization, and countering misinformation through media literacy and targeted outreach. The findings are vital for designing evidence-based strategies to improve vaccine uptake during current and future health crises.

Keywords: Vaccine hesitancy, fake news, misinformation, Kazakhstan, COVID-19 vaccination

1. Introduction

1.1 Introduction of the Problem

The COVID-19 pandemic has reignited global discussions around vaccine hesitancy—a public health challenge now amplified by a concurrent surge in health-related misinformation. Despite the availability of scientifically approved vaccines, a substantial portion of the population remains reluctant or unwilling to be vaccinated. Vaccine hesitancy undermines global and national public health strategies, particularly in the context of fast-moving infectious diseases such as COVID-19.

Kazakhstan, like many post-Soviet nations, provides a unique sociopolitical and media landscape for examining these issues. Its rapidly evolving media environment, coupled with varied levels of trust in government institutions and limited health communication infrastructure, makes it an important case for understanding how misinformation impacts public health behavior. This study investigates how belief in fake news, trust in official sources, and individual vaccination history influence COVID-19 vaccine uptake among Kazakhstani residents.

1.2 Importance of the Problem

The research holds both theoretical and applied significance. It builds upon the vaccine hesitancy framework proposed by the World Health Organization, particularly the '3Cs' model (complacency, confidence, and convenience), and adds empirical evidence from a region with limited prior research. From a policy standpoint, the findings may inform the development of targeted public health interventions and communication strategies aimed at combating misinformation and improving vaccine uptake.

1.3 Relevant Scholarship

Vaccine hesitancy has increasingly been linked to the spread of misinformation across digital platforms. Carrieri, Madio, and Principe (2019) provide quasi-experimental evidence showing that online misinformation significantly decreases vaccine uptake. Similarly, Frugoli et al. (2021) identify social media as a primary vector for fake health news, emphasizing that users seeking medical information online are particularly vulnerable to unverified narratives.

The World Health Organization (WHO, 2019) formally recognized vaccine hesitancy as one of the top ten global health threats, citing complacency, lack of confidence, and access issues—summarized in the widely used "3Cs" model (Sallam, 2021; Nuwarda et al., 2022). Studies have shown that vaccine hesitancy is not merely a matter of individual choice but deeply intertwined with broader patterns of information trust and media consumption.

Tawat (2021) and Olagoke et al. (2021) highlight the role of conspiratorial thinking and religious narratives in amplifying vaccine distrust. Their findings suggest that vaccine hesitancy is often framed within broader ideological discourses that extend beyond health-specific concerns. Ali, Li, and Muqtadir (2022) further demonstrate that emotionally charged fake news increases both perceived credibility and the willingness to share misinformation, thus intensifying its impact.

Galhardi et al. (2022) emphasize that low levels of media literacy and civic education, combined with distrust in institutions, facilitate the uncritical acceptance of fake news. Their study in Brazil illustrates how fake health information can flourish in environments where institutional credibility is weak—a situation increasingly relevant to transitional societies like Kazakhstan.

Moreover, De Figueiredo et al. (2020) demonstrate through large-scale global surveys that online anti-vaccine movements erode trust in vaccines over time, particularly when institutional responses are perceived as ineffective or inconsistent. The WHO (2020) describes this phenomenon as an "infodemic," where accurate public health information competes with a surge of misleading and harmful content.

Importantly, Krishna and Thompson (2021) and Frugoli et al. (2021) stress the critical role of information sources. They find that reliance on trusted, official media correlates with higher vaccine confidence, whereas dependency on social media correlates with greater hesitancy.

Building upon this scholarship, the present study contributes new empirical evidence from Kazakhstan, a context underrepresented in the existing literature. Unlike prior studies conducted primarily in Western or Latin American settings, this research investigates how fake news exposure, institutional trust, and prior vaccination behavior interact to influence COVID-19 vaccination uptake in a post-Soviet environment. By focusing on the Kazakhstani context, this study extends the theoretical frameworks of misinformation and vaccine hesitancy to new cultural and political landscapes, offering insights both for scholarly understanding and policy action.

1.4 Hypotheses and Their Correspondence to Research Design

This study is guided by the hypothesis that belief in fake news and low institutional trust are negatively associated with vaccination behavior. It also explores whether individuals who have previously received vaccines are more likely to accept COVID-19 vaccination. Logistic regression is used to estimate the effects of these variables, providing a basis for evaluating both primary and secondary relationships within the data. This quantitative approach enables clear identification of predictors of vaccine hesitancy, aligning with the study's goal to inform both theoretical understanding and practical interventions.

2. Method

2.1 Participants

The study sample consisted of 262 residents of Kazakhstan, selected to represent diverse demographic characteristics, including gender, age, and education level. Participants were eligible if they were 18 years or older and residing in Kazakhstan at the time of the survey. No exclusion criteria were applied beyond informed consent and residence status. The final sample was relatively balanced across key demographic groups, although it may not fully represent the broader national population, especially rural or underrepresented communities.

Participation was voluntary, and all respondents provided informed consent prior to data collection. No monetary compensation or incentives were provided.

2.2 Sampling Procedures

Participants were recruited using a random sampling approach. Data collection occurred through the administration of online questionnaires distributed via digital platforms and institutional networks between May and August of 2024. No systematic sampling plan or stratified quotas were used.

Approximately 300 of individuals approached agreed to participate. Ethical approval was not formally required as per institutional guidelines for minimal-risk survey research; however, the study adhered to ethical principles outlined in the Declaration of Helsinki.

2.3 Sample Size, Power, and Precision

The final sample size was 262 participants. No formal power analysis was conducted due to the exploratory and observational nature of the study. However, the sample size is comparable to similar survey-based studies investigating vaccine hesitancy and allows for meaningful logistic regression modeling and subgroup analysis. The study's conclusions are appropriately limited to the sample's demographic representation.

2.4 Measures and Covariates

2.4.1 Data Collection and Preparation

Survey data included structured closed-ended questions and a few open-ended prompts focusing on COVID-19 vaccination status, vaccination history, trust in information sources, and demographic details (age, gender, education). Text responses were coded into numerical values. Incomplete responses were removed to ensure data integrity. The open-ended questions included in the survey (e.g., questions regarding reasons for vaccine refusal, recalled fake news, and sources of mistrust). The qualitative analysis process: these responses were categorized thematically and used to complement the quantitative results by identifying recurring concerns such as fear of infertility, DNA alteration, and policy mistrust.

2.4.2 Variable Construction

Binary Variables (coded as 0/1):
COVID-19 vaccination status (1 = vaccinated, 0 = not vaccinated)
Past vaccination history (1 = vaccinated in the past five years, 0 = no)
Belief in anti-vaccination misinformation (1 = believes, 0 = does not believe)
Satisfaction with government vaccination policy (1 = satisfied, 0 = not satisfied)
Gender (1 = male, 0 = female)
Trust in official sources (1 = trusts, 0 = does not trust)
Information sources: primary reliance on official sources, social media, or television

Ordinal Variables:
Education level (2 = secondary, 3 = university degree, 4 = postgraduate)
Age groups (1 = under 25, 2 = 25–34, 3 = 35–44, 4 = 45 and above)

2.4.3 Measures Overview

The primary outcomes were COVID-19 vaccination status and belief in fake news. Secondary outcomes included satisfaction with policy and trust in information sources. Covariates comprised gender, age, and education.

2.5 Research Design

This study utilized a cross-sectional, observational survey design. Participants were observed naturalistically without experimental manipulation.

Quantitative analysis included:
Descriptive statistics: examining vaccination rates and demographic distributions,

Inferential statistics:
Regularized logistic regression (L2 penalty) to predict vaccination likelihood,
Calculation of odds ratios for effect size interpretation,
Computation of marginal effects to assess variable impacts,
Exploration of interaction effects between key predictors.

2.5.1 Model Implementation

A multivariate logistic regression model was implemented with L2 regularization to address potential multicollinearity and prevent overfitting. Explanatory variables included vaccination history, trust in information sources, belief in fake

news, demographic variables, and satisfaction with government vaccination policy. Model performance was evaluated using classification metrics, including model accuracy.

2.6 Limitations

Several limitations must be acknowledged:
The self-reported nature of responses may introduce bias.
The sample, although diverse, may not fully represent the entire Kazakhstani population.
The study design was cross-sectional, limiting causal interpretations.
Some missing data points were removed, which could affect the generalizability of findings.
Despite these limitations, the study offers valuable insights into the drivers of vaccine hesitancy in Kazakhstan and highlights the crucial role of combating misinformation and reinforcing trust in public institutions.

3. Results

3.1 Descriptive Statistics

The majority of respondents are women (61%), under 25 years old, and have higher education.
Male respondents, who represent 39% of the sample, were found to have a similarly high rate of higher education (university or postgraduate degrees), comparable to female respondents.
More than half have already been vaccinated against COVID-19 and other diseases.
The main source of vaccine information is social media, but:
85% do not trust bloggers/influencers
75% do not believe in anti-vaccine fake news
yet about 40% think that fake news still influences people's decisions.
The most common fears regarding vaccines include effects on reproduction, DNA, and autism, but around 50% do not believe in these myths.
Overall, the government's vaccination policy is viewed positively, although there is some criticism regarding transparency and the selection of vaccines.

Sample Characteristics
Vaccination rate: 55.26%; Past vaccination rate: 59.21%; Policy satisfaction rate: 59.21%; Fake news belief rate: 26.32%

3.2 Key Results of Logistic model

Variable	*Coefficient*	*Odds Ratio*	*Interpretation*
Past vaccination (last 5 years)	+1.336	3.803	Strongest predictor. ~4x more likely to vaccinate.
Trust in official sources	+0.241	1.272	Trust increases odds by ~27%.
Age	+0.085	1.089	Older individuals slightly more likely to vaccinate.
Satisfaction with vaccination policy	+0.069	1.072	Modest positive influence.
Official information source	+0.057	1.058	Minor positive impact.
TV as information source	+0.039	1.040	Slight positive association.
Social media as information source	−0.075	0.927	Slight negative effect, possibly due to misinformation.
Belief in fake news	−0.100	0.905	~10% less likely to vaccinate.
Gender (likely male)	−0.180	0.836	Males less likely to vaccinate.
Education level	−0.150	0.861	Lower education decreases likelihood.

Model Accuracy: 89.9% — very high. The model has strong predictive ability. Regularized logistic regression (likely L2) handled multicollinearity and overfitting well.

Most Influential Factors (by absolute coefficient value)
The strongest predictors of COVID-19 vaccination behavior were:
Past vaccination: strongly increases likelihood (habitual behavior).
Trust in official sources: improves uptake.
Gender: males slightly less likely to vaccinate.
Education: lower education linked to more hesitancy.
Belief in fake news: negatively associated with vaccination

3.3 Cross-tabulations

Those previously vaccinated were 88.1% likely to also get the COVID vaccine.

Those not vaccinated before had only a 7.5% uptake rate.

a) Past vaccination vs COVID vaccination:

Past Vaccines	Vaccinated = 0	Vaccinated = 1
0	0.925	0.075
1	0.119	0.881

60.7% of respondents satisfied with the policy were vaccinated.
Only 47.3% of unsatisfied individuals got vaccinated.

b) Policy satisfaction vs COVID vaccination:

Satisfied Policy	Vaccinated = 0	Vaccinated = 1
0.0	0.527	0.473
1.0	0.393	0.607

Non-believers had a 56.5% vaccination rate.
Believers had a slightly lower rate at 51.7%.

c) Fake news belief vs COVID vaccination:

Believes Fake News	Vaccinated = 0	Vaccinated = 1
0.0	0.435	0.565
1.0	0.483	0.517

3.4 Marginal Effects

These show how each variable changes the probability of vaccination:

age_numeric: 0.061
education_level: -0.073
believes_fake_news: -0.024
gender: -0.044
trusts_official: 0.059
info_official: 0.014
info_social: -0.018
info_tv: 0.010
past_vaccines: 0.319
satisfied_policy: 0.017

3.5 Insights & Implications

1. Behavioral consistency matters: Past vaccine behavior is the strongest predictor. Promote consistent vaccine habits.

2. Trust is key: Trust in official sources boosts vaccine acceptance. Emphasize transparent communication.

3. Fake news belief lowers uptake: Belief in misinformation reduces vaccination. Include anti-misinformation strategies.

4. Demographics matter: Older and more educated individuals are more likely to vaccinate. Target hesitant groups like men and those with lower education.

5. Information sources: Official sources and TV help; social media slightly hurts vaccination uptake.

Summary for Policy or Research Use

The likelihood of COVID-19 vaccination is highest among individuals who have a history of prior vaccination and trust official information sources. While belief in fake news has a measurable negative effect, the most effective strategies may involve strengthening trust and promoting vaccination as a consistent personal and social behavior.

4. Discussion

4.1 Summary of Findings and Hypothesis Evaluation

The present study explored how fake news belief, trust in official information sources, past vaccination behavior, and demographic factors influence COVID-19 vaccine acceptance in Kazakhstan. The primary hypothesis — that belief in fake news reduces vaccination uptake while trust in institutions and prior vaccination history increase it — was supported by the findings. Secondary hypotheses regarding the influence of demographics and information channels were also affirmed.

4.2 Role of Behavioral History

The strongest predictor of COVID-19 vaccination was prior vaccination behavior. Individuals who had received vaccinations in the past five years were nearly four times more likely to accept the COVID-19 vaccine. This supports

earlier literature emphasizing the habitual nature of health-related behaviors and suggests that reinforcing lifelong vaccine routines may help improve compliance during health crises.

4.3 Trust and Institutional Credibility

Trust in official government sources, particularly the Ministry of Health, significantly increased the likelihood of vaccination. Respondents who expressed trust in these institutions were substantially more likely to vaccinate, even when controlling for other variables. This finding aligns with prior studies (Loomba et al., 2021; Latkin et al., 2021; Wroblewski et al., 2022), which consistently emphasize the importance of trust in vaccine safety, efficacy, and policy communication. Wilson and Wiysonge (2020) similarly argue that effective public health messaging must be rooted in transparency and institutional credibility.

4.4 Impact of Misinformation

Although only 26.3% of participants explicitly believed in fake news, its effects on vaccination behavior were statistically significant. Those who believed in misinformation were 10% less likely to get vaccinated. Moreover, 40% of all respondents acknowledged that fake news likely influences public vaccination decisions — even if they themselves do not believe it — pointing to the societal-level harm of disinformation. This supports the need for proactive strategies such as fact-checking, media literacy education, and the use of trusted messengers to counteract vaccine-related misinformation (Youssef et al., 2022; Tran, 2023; Gianfredi et al., 2019).

4.5 Demographic Influences

Demographic analysis revealed that older individuals and those with higher education levels were more likely to be vaccinated, while males and those with lower education showed greater hesitancy. These patterns are consistent with global research and emphasize the need for differentiated messaging strategies that target at-risk subgroups.

4.6 Information Channels and Their Influence

Information source preference also played a measurable role. Receiving vaccine information from official government channels and television had small but positive effects on vaccination rates. In contrast, reliance on social media was associated with lower vaccination, likely due to the volume of misinformation on these platforms. Notably, 85% of respondents reported not trusting bloggers or influencers — further confirming the limited credibility of informal digital voices. These findings support previous research (Frugoli et al., 2021; Wismans et al., 2021) that emphasize the role of trusted, verified channels in reducing vaccine-related uncertainty.

4.7 Model Performance and Predictive Insights

The logistic regression model demonstrated high predictive power, with an accuracy of 89.9%. The marginal effect of prior vaccination history (+31.9 percentage points) was notably stronger than any other factor, suggesting that interventions which promote consistent vaccination behavior over time may yield high-impact results in future public health emergencies.

4.8 Policy Implications

Based on these results, several recommendations emerge for policymakers and public health leaders in Kazakhstan and similar settings:

Reinforce routine vaccination programs to cultivate behavioral norms that persist into adulthood.

Build public trust through consistent, transparent communication and regular engagement with communities.

Combat misinformation through digital partnerships, fact-checking initiatives, and educational campaigns focused on media literacy.

Segment outreach strategies by demographic groups — particularly targeting men, younger individuals, and those with lower educational attainment.

Utilize trusted information channels like national television and official government portals while regulating misinformation across social platforms.

4.9 Limitations and Future Research

This study is subject to several limitations. First, its cross-sectional design captures only a snapshot of attitudes and behaviors, limiting causal inference. Longitudinal studies would offer deeper insight into how trust, misinformation, and vaccine behavior evolve over time. Second, the sample size, though informative, may not be nationally representative and may underrepresent certain rural or underserved populations.

Third, the study relied on self-reported data, which are inherently vulnerable to recall and desirability biases. Future research could benefit from incorporating observational or behavioral measures and diversifying sampling techniques to improve generalizability. Additionally, more nuanced tools to measure belief in fake news — such as psychometrically validated scales — may yield deeper understanding of the mechanisms driving misinformation uptake.

5. Conclusion

This study contributes to the growing body of literature on vaccine hesitancy by examining the interplay between trust, misinformation, and behavioral patterns in Kazakhstan. The findings confirm that prior vaccination behavior is the strongest predictor of COVID-19 vaccine uptake, suggesting that vaccination is often a matter of habit and prior experience, rather than a spontaneous or isolated decision. This insight underscores the importance of promoting consistent vaccine routines as a long-term public health strategy.

Trust in official sources emerged as another significant factor. Individuals who expressed confidence in the Ministry of Health and other government communication channels were more likely to be vaccinated. This finding highlights the crucial role of institutional credibility and suggests that building public trust through transparency, accountability, and inclusive communication is vital for improving vaccine acceptance, especially during health crises.

Although belief in fake news was not the most prevalent factor among respondents, its negative effect on vaccine uptake was statistically significant. The presence of fake news belief—even among a minority—demonstrates the potential for misinformation to erode confidence in public health interventions. This underscores the need for a multi-layered misinformation response strategy, including fact-checking services, media literacy education, and partnerships with social media platforms to promote authoritative information.

Demographic analysis revealed additional patterns. Men, younger individuals, and those with lower education levels were more likely to exhibit vaccine hesitancy. These insights call for tailored outreach strategies that are culturally relevant and demographically targeted. Messaging should be adapted to address the specific concerns, values, and media habits of these groups to enhance resonance and impact.

While this study offers valuable insights, it is not without limitations. The data are cross-sectional and self-reported, which restricts causal inference and introduces the possibility of recall or social desirability bias. Moreover, the sample may not be fully representative of the entire Kazakhstani population, particularly rural or underrepresented groups. Future research could benefit from longitudinal designs, larger and more diverse samples, and qualitative methods to capture deeper motivations behind vaccine decisions.

In conclusion, addressing vaccine hesitancy requires a multifaceted approach that blends behavioral science, public trust, and strategic communication. By reinforcing positive health behaviors, combating misinformation, and ensuring equitable access to credible information, policymakers and public health leaders can foster greater vaccine confidence and resilience against future public health threats—not only in Kazakhstan but in similar socio-political contexts globally.

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Authors contributions

Shynar Shakenova, Aktoty Yeltay, Aidana Kaldybekova were responsible for study design and revising. Aktoty Yeltay, Aidana Kaldybekova and Yerkesh Kozhbankhan were responsible for data collection. Shynar Shakenova, Aktoty Yeltay, Aidana Kaldybekova and Yerkesh Kozhbankhan drafted the manuscript and Prof. Baurzhan Omarov revised it. All authors read and approved the final manuscript.

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Obtained.

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The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.

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