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A Scientific and Survey-Based Perspective on Vaccines and Public Perception

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Abstract. Public views on vaccination are often pieced together from a mix of impressions—some scientific, some intuitive, and some simply picked up from daily conversation. To see how these considerations play out in practice, we surveyed 138 respondents about their immunology knowledge, exposure to common vaccine myths, trust in health authorities, and sense of social responsibility. The results showed a noticeable split: many participants could outline how immune memory forms after vaccination, yet a substantial group still treated well-known misinformation as plausible. These differences were not trivial. People who understood basic mechanisms and the idea of herd immunity generally reported greater trust in official guidance and were more comfortable recommending vaccination to others. Those who endorsed misinformation tended to hesitate, especially when asked about vaccine mandates. A logistic regression analysis indicated that knowledge, trust, and skepticism each contributed independently to recommendation behavior. Rather than pointing to a single explanation, the findings show how individuals combine scientific information with their own judgments about credibility and community obligations. Improving uptake will likely require straightforward explanations paired with efforts that rebuild trust and speak directly to the shared stakes involved in vaccination.

Keywords: vaccine, public awareness, immunology

1. Introduction

Vaccination is widely regarded as one of the most dependable ways to prevent infectious disease, yet vaccine hesitancy remains common and rarely stems from a single clear reason [1,2]. While misinformation does play a part, people often make decisions through a broader lens—how much they understand the biology, whether they feel institutions are trustworthy, and what they believe they owe to others in their community. Prior studies highlight that real-world decision-making rarely follows a purely biomedical logic; social expectations and personal interpretations shape attitudes just as strongly [3,4].

Herd immunity illustrates this well. The idea is simple enough, but many people do not immediately see how it protects individuals who cannot be vaccinated. When researchers explain the concept with familiar, everyday examples, willingness to vaccinate often rises, and people start to view their own choice as contributing to a collective benefit rather than acting alone [5,1]. This shift in understanding can influence motivation and help sustain community-level protection [6,2].

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Social framing is another factor that consistently appears in behavioral studies. Presenting vaccination as a cooperative act—or simply showing that peers tend to support it—can increase acceptance across diverse groups [2,7]. These normative cues rarely operate in isolation, but they nudge people toward decisions that align with perceived community expectations [4]. Overall, the literature suggests that vaccine confidence emerges from an interplay of knowledge, trust, and individuals' interpretations of their place within a social network, rather than from any single determinant.

2. Methods

A cross-sectional online survey was conducted to examine how knowledge, trust, skepticism, and information sources shape vaccine attitudes and recommendation behaviors. A total of 138 participants completed the 22-item questionnaire anonymously in September 2025. Respondents were recruited via community and educational platforms, and consent was obtained electronically. Participation was voluntary and open to individuals aged 16 or older.

The survey included several conceptual domains. Demographic variables captured age, gender, education, and healthcare background. Vaccine experience asked which vaccines participants had received. Decision-making and information sources assessed preferred channels and time taken to decide on vaccination. Knowledge was measured through four items: understanding of vaccine mechanisms (Q8) and herd immunity (Q9) were scored as 1 for correct and 0 for incorrect answers; misinformation beliefs (Q11) were scored +1 for scientifically valid concerns and −1 for misconceptions (range −3 to +3); and risk–benefit reasoning (Q19) was scored 1 for accurate interpretation of low-probability risk. These items were summed into a composite Knowledge Index (0–6), standardized to a 0–100 scale.

Attitudes and beliefs were measured by five Likert-scale items (1–5) assessing trust in vaccines and health authorities, perceived transparency, and concern over long-term side effects. Reliability analysis produced two subscales: Pro-Trust Index ($\alpha = 0.69$) and Skepticism Index ($\alpha = 0.46$). Behavioral intentions were assessed through willingness to recommend vaccines and support for vaccine mandates.

3. Results

3.1. Sample characteristics

A total of 138 valid responses were included in the analysis. The largest age group was 35–44 years (36%), followed by 45–54 years (25%), and the majority identified as female (55.8%). Over half of the respondents held a bachelor's degree (54.3%), while 17% reported postgraduate training. Only 9.4% of participants worked or studied in healthcare, public health, or related research. Independent-samples t-tests showed no difference in vaccine trust between healthcare-affiliated and non-affiliated respondents ($t = –0.03$, $p = 0.98$), suggesting that vaccine confidence was not primarily determined by professional background.

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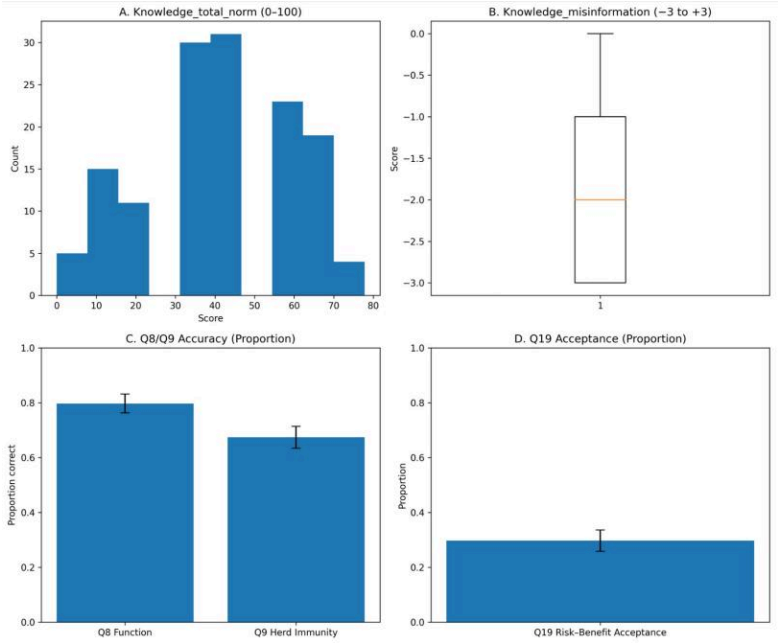

Figure 1. Public knowledge profile on vaccines

Panels summarize participants' understanding of vaccine mechanisms, herd immunity, misinformation, and risk–benefit reasoning (n = 138). (A) Distribution of standardized total knowledge scores (0–100). (B) Misinformation discernment scores (−3 to +3), with higher values indicating better distinction between true and false claims. (C) Proportion of correct responses for Q8 (vaccine function) and Q9 (herd immunity). (D) Proportion of participants correctly interpreting a risk–benefit scenario (Q19). Overall, participants showed moderate knowledge (M ≈ 41/100) with considerable variability in identifying misinformation.

3.2. Knowledge and understanding

As shown in Figure 1, participants demonstrated uneven vaccine knowledge across domains. Mechanistic understanding was relatively strong: 79.7% correctly recognized that vaccines stimulate immune memory (Q8), and 67.4% understood the principle of herd immunity (Q9). In contrast, only 30% accurately interpreted the probabilistic risk–benefit trade-off (Q19).The misinformation recognition score (Q11) averaged –1.76 ± 1.25 (range: –3 to +3), indicating that most participants endorsed one or more misconceptions such as "vaccines might damage DNA" or "contain toxic substances." The standardized knowledge score (0–100 scale) averaged 40.9 ± 19.2, reflecting moderate literacy overall. These findings highlight a distinct discrepancy between conceptual knowledge and misinformation resistance.

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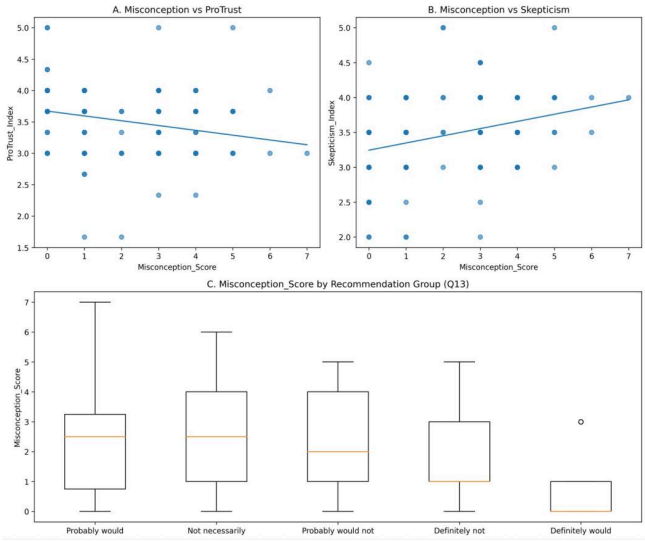

Figure 2. Relationship between misinformation, trust, and recommendation intent

(A–B) Pearson correlations between misinformation scores and two attitudinal indices: the Pro-Trust Index and the Skepticism Index. Higher misinformation endorsement is associated with lower trust ($r = -0.24$, $p = 0.005$) and greater skepticism ($r = 0.30$, $p < 0.001$). (C) Boxplots of misinformation scores across vaccine recommendation intention groups (Q13) show that individuals who "definitely would recommend" vaccines hold the fewest misconceptions, whereas hesitant groups display greater variability.

3.3. Attitudes and beliefs

Exploratory reliability analyses yielded two internally consistent dimensions: a Pro-Trust Index ($\alpha = 0.69$) and a Skepticism Index ($\alpha = 0.46$). On average, respondents scored similarly on both (means $\approx$ 3.5/5). As shown in Figure 2, the misconception score correlated negatively with Pro-Trust ($r = -0.24$, $p = 0.005$) and positively with Skepticism ($r = 0.30$, $p < 0.001$), confirming that misinformation endorsement is strongly associated with distrust and doubt. Participants expressing clear willingness to recommend official vaccines (Q13) exhibited markedly lower misconception scores than hesitant or opposing groups (Fig. 2C).

Analysis of information sources showed a meaningful link with trust ($F = 3.09$, $p = 0.049$). Participants who relied on official or government outlets had the highest Pro-Trust scores (3.62 ± 0.53), while those who mainly turned to social or peer networks tended to express lower trust. Education level did not relate to Pro-Trust, but it did affect skepticism ($F = 2.93$, $p = 0.023$): respondents with less formal education reported higher skepticism overall (Fig. 3B). Taken together, these patterns suggest that where people get their information—and the broader cognitive context they bring to it—both contribute to shaping their vaccine attitudes.

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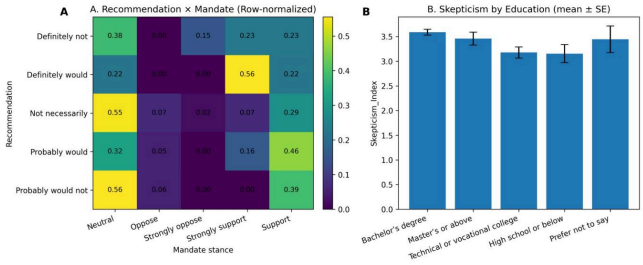

Figure 3. Normative and educational influences on vaccine attitudes

A) The heatmap illustrates how responses to vaccine recommendation (Q13) relate to support for mandates (Q18). Darker shading reflects a greater proportion of respondents within each recommendation category who also favor the corresponding mandate option. The two measures track closely with each other ($\chi^2 = 37.16$, $p = 0.002$), indicating that personal recommendation and policy support tend to move in the same direction.(B) Mean ± SE values of the Skepticism Index across education levels. Although the ANOVA indicates a statistical difference ($F = 2.93$, $p = 0.023$), skepticism remains fairly elevated across all groups, implying that higher educational attainment does not necessarily translate into greater vaccine confidence.

3.4. Social norms and behavioral alignment

A clear pattern appeared between vaccine recommendation (Q13) and support for mandates (Q18) ($\chi^2 = 37.16$, $df = 16$, $p = 0.002$; Cramer's $V = 0.30$). As shown in Figure 3A, people who said they would recommend vaccines generally also favored mandate policies, while those who were hesitant or opposed to recommending them tended to reject mandates as well. This parallel between personal decisions and policy preferences hints that respondents may be drawing on a similar set of values when thinking about individual choice and collective responsibility.

Table 1. Inferential tests linking knowledge, trust, skepticism, and behavioral outcomes

Analysis	Variables/Groups	Test/Statistic	Value	p Value	Interpretation
Healthcarebackground→Pro-Trust	Yes vs No	t(136)=-0.025		0.98	No difference
Information source→Pro-Trust	Top 3 categories	ANOVAF(2,125)=3.09		0.049	Government source> others
Education→Skepticism	5 levels	ANOVAF(4,133)=2.93		0.023	Lower education→higherskepticism
Recommendation×Mandate	5×5 table	$x^2(16)=37.16$		0.002	Significant association
MisconceptionPro-Trust	Pearson r	-0.24		0.005	Negative correlation
MisconceptionSkepticism	Pearson r	0.30		<0.001	Positive correlation
Logistic regression	Knowledge,Trust,Skepticism	OR≈1.2		<0.05	Predictive ofrecommendation

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3.5. Integrative predictive analysis

A logistic regression model combining knowledge, trust, skepticism, and healthcare background significantly predicted vaccine recommendation behavior ($p < 0.05$). As summarized in Table 1, higher knowledge and stronger Pro-Trust independently increased the likelihood of recommending official vaccines (OR ≈ 1.2 per unit), while greater skepticism and endorsement of misinformation decreased it. These patterns converge with the other statistical results to reveal three key drivers of vaccine acceptance. First, cognitive competence—especially understanding mechanisms and evaluating risks—provides the foundation for positive attitudes. Second, attitudinal orientation—trust versus skepticism—is shaped by information reliability and education level. Third, social-norm alignment—reflected in the link between personal recommendation and support for mandates—connects individual belief with collective responsibility. Overall, vaccine acceptance emerges from the interaction of these cognitive, psychological, and social-norm dimensions. Efforts to improve vaccination uptake should therefore combine factual education, transparent communication, and community framing that reinforces both personal and civic responsibility.

4. Discussion

This study provides a clearer picture of how scientific understanding, trust, and social reasoning jointly contribute to vaccine confidence. Participants who understood immune mechanisms and herd immunity were generally more open to vaccination, a trend consistent with earlier findings that comprehension can strengthen cooperative motivation [1,5]. However, their knowledge was often uneven—many could explain immune memory yet still endorsed common myths—suggesting that understanding in this area is partial rather than comprehensive.

Trust in health authorities appeared to reinforce positive attitudes, aligning with work showing that vaccination decisions depend not only on facts but also on whether people feel institutions are credible and transparent [2,4]. Misinformation played a substantial role here: respondents who endorsed misconceptions reported more skepticism, echoing studies showing how misinformation can reshape perceptions of reliability and the social contract behind vaccination [6,7].

The close alignment between personal recommendation and support for mandates suggests that social-norm reasoning also shapes vaccine attitudes. Individuals who would recommend vaccines tended to endorse broader policies as well, fitting with research that frames vaccination as a cooperative act rooted in shared responsibility [3,8].

Taken together, the findings imply that improving vaccine acceptance likely requires more than correcting inaccurate beliefs. Clear explanations matter, but so do efforts that rebuild trust and acknowledge the social dimensions of vaccination. Approaches that combine factual clarity with attention to people's concerns and community expectations may prove more effective than information alone.

5. Conclusion

In this study, vaccine confidence emerged from a combination of scientific understanding, trust, and social reasoning. Participants who understood immune mechanisms and herd immunity were generally more willing to vaccinate, while misinformation and skepticism weakened both personal intent and support for broader measures. These patterns suggest that improving vaccine acceptance is not simply a matter of supplying accurate facts. Trust, perceived transparency, and a sense of shared responsibility also shape how information is received. Efforts to strengthen vaccination

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uptake may therefore be more effective when they pair clear explanations with communication strategies that acknowledge concerns, reinforce credibility, and highlight the communal benefits of protection.

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