

HPV Vaccine Hesitancy: Examining the Role of Knowledge, Trust in Healthcare Providers, and Exposure to Misinformation

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Abstract

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This study aims to explore the effect of HPV knowledge, trust in healthcare providers and exposure to misinformation on HPV vaccine hesitancy among mothers of adolescent girls in Pakistan. The study uses an integrated model that incorporates the Health Belief Model (HBM) and Theory of Planned Behavior (TPB) models. A cross-sectional quantitative design was used and data was collected from 203 mothers from Rawalpindi and Islamabad via structured questionnaires. SPSS PROCESS Macro was used to conduct mediation and moderation analyses. Results suggest that an HPV knowledge intervention alone was not effective in significantly decreasing HPV vaccine hesitancy. The association between HPV knowledge and vaccine hesitancy was fully explained by trust in healthcare providers, however. Misinformation was associated with high levels of mistrust and a reduced positive attitude to vaccines. The results indicated that vaccine hesitance was not only related to

awareness and knowledge deficits but also vaccine mistrust and misinformation in Pakistan. The study underscores culturally adapted communication strategies, trust-

building approaches, and misinformation management as crucial strategies to enhance HPV vaccine acceptance in Pakistan.

1. Introduction

Cervical cancer is a major cause of cancer-related mortality among women globally, accounting for over 90% of all deaths in low- and middle-income countries (LMICs) (Arbyn et al., 2020). High-risk strains of Human Papillomavirus (HPV) such as HPV 16 and 18 are a required cause for cervical carcinogenesis (Bosch et al., 2002). Prophylactic HPV vaccines have been a significant advancement in the field of preventive oncology, and clinical trials have shown that they are extremely effective at preventing persistent infections and high-grade precancerous lesions, with efficacy rates near 100% (Joura et al., 2015).

While these vaccines are proven to be safe and effective, high levels of vaccine coverage are difficult to achieve and there is a global phenomenon called vaccine hesitancy (defined as a state of indecision or delay in the uptake of vaccines despite being offered vaccines services (MacDonald & SAGE Working Group, 2015)). HPV prevalence and cervical lesions has been significantly reduced in high-income countries with well-established vaccination programmes (Drolet et al., 2019; Lei et al., 2020). But structural barriers, lack of awareness, and psychosocial factors remain barriers to uptake in LMICs.

The Health Belief Model (HBM; Rosenstock, 1974) and Theory of Planned Behavior (TPB; Ajzen, 1991) are complementary models to be considered in vaccine decision-making. In addition to perceived susceptibility, severity, benefits, and barriers as determinants of health behavior, HBM also incorporates the concepts of attitudes, subjective norms, and perceived behavioral control as factors that precede intention in TPB. Theoretically, HPV knowledge should affect perceived vulnerability and perceived benefits, which will decrease HPV vaccine hesitancy. The linear “knowledge-deficit model”, however, has faced criticism for overlooking the emotional, social and cultural contexts in which information is processed (Simis et al., 2016), and empirical evidence for a direct link between knowledge and behavior is mixed (Fisher et al., 2013).

Important inter-personal factors in vaccination decision-making are trust in healthcare providers (Hall et al., 2001; Holman et al., 2014). Providing trust is the base of all trust, when patients trust their physicians, they will be more willing to follow doctor orders, accept physician advice and engage in preventive care. There are three elements of trust: competence (belief in provider's knowledge and skill), fidelity (belief that the provider acts in the patient's best interest), and honesty (belief in provider's truthfulness) (Anderson & Dedrick, 1990).

The digital information landscape of today is also posing a significant challenge: health misinformation. The connection between anti-vaccination messages spread via social media platforms like WhatsApp, Facebook and TikTok with vaccine hesitancy has been consistently linked (Wilson & Wiysonge, 2020). Some of the most common misinformation messages about HPV are incorrect ideas about infertility, serious consequences of HPV, and ideas that the vaccine goes against religious or cultural beliefs (Dunn et al., 2017). One of the major problems in Pakistan is when misinformation gets mixed into the religio-political narratives, which are largely not regulated on social media platforms (Salman et al., 2021).

The landscape of HPV vaccine acceptance in Pakistan is very challenging. The awareness about HPV is very low, in a study in Lahore, only 18 % of women had heard about HPV (Batool et al., 2022). Health system trust has been eroded from polio vaccination controversy and perceptions of corruption in healthcare (Yousaf et al., 2022; Raza et al., 2023). Furthermore, there are additional factors such as gender dynamics and the role of religious leaders which are not reflected in western models

(Nishtar et al., 2024; Ul Haq et al., 2023).

Although there has been a considerable amount of research on correlates of HPV vaccine hesitancy, there are still gaps in understanding. There have been few studies that have tested whether trust acts as a mediator (a psychological process that accounts for the connection between knowledge and lack of hesitation) instead of simply being another predictor. Moreover, the direct effect of misinformation on hesitancy is well documented, but the moderating role of misinformation on the knowledge-hesitancy relationship has not yet been tested empirically, especially in LMIC countries.

1.1 Research Questions:

This study, therefore, raised the following research questions:

1. Is the knowledge of HPV a direct determinant of vaccine hesitancy?
2. Is HPV knowledge associated with trust in healthcare providers?
3. Is there any evidence that trust affects HPV vaccine uptake?
4. Is the exposure to misinformation a direct driver of hesitancy?
5. Does trust mediate the relationship between HPV knowledge and hesitancy?
6. Is the relationship between knowledge and hesitancy moderated by exposure to misinformation?

1.2 Research Hypothesis:

The integrated HBM-TPB framework was used to form the following hypothesis:

H1: Indirect effect: HPV's knowledge is negatively related to vaccine hesitancy through the mediator of gender norms. Indirect effect: HPV knowledge negatively to vaccine hesitancy via gender norms.

H2: HPV knowledge is positively correlated with trust in health care providers.

H3: The level of trust in the health care providers has a negative correlation with vaccine hesitancy.

H4: Exposure to misinformation is positively associated with vaccine hesitancy.

H5: There is a mediation effect between HPV knowledge and vaccine hesitancy through trust.

H6: Knowledge-hesitancy relationship is moderated by exposure to misinformation in the sense that the negative relationship is lessened at greater levels of misinformation exposure.

2. Methodology

The sequence of study and setting up of experiments.

A quantitative, cross sectional, correlational design was used. This study involved public and private schools in Rawalpindi and Islamabad (twin cities) in Pakistan from November 2025 till January 2026. The choice of recruiting sites was made by selecting schools, due to the availability of access to the target population (mothers of girls between 9-14 years of age and eligible for HPV vaccination) and the institutional legitimacy that schools afford to the process of participation.

2.2 Participants and Sampling

Mothers with daughters aged 9-14 years were the target of the study. A non-probability convenience sampling method was used which is suitable for exploratory research on less researched populations and culturally sensitive topics (Etikan, 2016). The participants included those who were recruited through their school administration. The inclusion criteria were: (a) mother of one or more daughter between 9-14 years, (b) residing in Rawalpindi/Islamabad, (c) understanding Urdu and (d) being willing to participate. A sample of 203 mothers was obtained, which is greater than the minimum sample size recommended for mediation analysis using a bootstrap estimation procedure (Hayes, 2018).

2.2 Measures

All instruments were translated into Urdu with forward-backward translation and pilot tested for clarity. Cronbach's alpha was used to check the internal consistency of the scales, and all scales were above the acceptable level of 0.70 (Nunnally, 1978).

HPV Knowledge and Awareness (VA): A 12-item scale was used to evaluate HPV transmission, HPV and cervical cancer causal relationship and benefits of HPV vaccination based on the scale of Waller et al. (2003). Responses were coded as True, False, and Don't know, and were scored as True + False/Don't know + False. ($\alpha = 0.78$).

HPV Vaccine Hesitancy (VH): Parental reluctance was assessed with the 9-item Vaccine Hesitancy Scale (VHS) (Shapiro et al., 2018) using a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). The safety dimension, perceived necessity, and trust in vaccine information were assessed ($\alpha = 0.84$).

Trust in Healthcare Providers (THCP): The dimensions of competence, fidelity and honesty were measured using a 10-item adaptation of the Trust in Physician Scale (Anderson & Dedrick, 1990) on a 5-point Likert scale ($\alpha = 0.88$).

Misinformation (or EM): A 10-item scale was adapted from the Social Media Disinformation Scale and regionally validated HPV misconceptions (Salman et al., 2021) was used to assess frequency of exposure to false claims (e.g., HPV vaccine causes infertility = 5-point frequency scale; $\alpha = 0.81$).

Demographics. Data was gathered regarding mother's level of education, child's vaccination status and the type of school (public/private).

2.3 Procedure

Approval was obtained from the Institutional Review Board of Riphah International University. Permission was obtained from the schools to collect data. Written informed consent was secured from all participants with the stress of anonymity, confidentiality and voluntary participation.

The questionnaires were self-administered and returned in a closed envelope to allow confidentiality.

2.4 Data Analysis

SPSS software version 23 and PROCESS macro version 4.2 (Hayes, 2018) were used for analysis. Descriptive statistics, correlation and Cronbach's alpha were calculated. Differences in hesitancy by demographic groups were assessed using one-way ANOVA. Multiple regression was used for the tests of direct effects related to H1–H4. H5 (mediation) was tested with PROCESS Model 4 and 5,000 bootstrap samples to get the bias-corrected confidence interval for the indirect effect. H6 (moderation) was tested by using Model 1 of PROCESS with mean centering of the predictors and simple slopes analysis at ± 1 SD of the moderator. Covariates included were education and routine vaccinations status.

3. Results

3.1 Participant Characteristics and Descriptive Statistics

In total, 52% of the 203 participants had children enrolled in public schools and 48% in private schools. Distribution of education: 18% Matric, 25% Intermediate, 28% Graduation, 20% Masters and 9% MS/PhD. Sixty-two percent of the respondents reported their child was "yes" when asked if they were immunized. Twenty-eight percent answered "no," and 10% answered "maybe/unsure".

Descriptive statistics and correlations are given in Table 1. There was limited knowledge about HPV ($M = 1.95$, $SD = 0.46$, ranges 0-3). Vaccine hesitancy was moderate ($M = 3.30$, $SD = 0.94$), indicating ambivalent vaccine attitudes. The level of trust in health care providers was moderate

($M = 3.31$, $SD = 0.97$). The level of exposure to misinformation was moderate ($M = 2.89$, $SD = 0.78$).

Table 1. Correlations, descriptive statistics, and alpha reliabilities

Variable	Mean	SD	1	2	3	4
1. HPV Knowledge (VA)	1.95	0.46	(0.78)			
2. Vaccine Hesitancy (VH)	3.30	0.94	-0.07	(0.84)		
3. Trust in HCP1 (THCP)	3.39	0.97	-0.31**	0.43**	(0.88)	
4. Exposure to Misinformation (EM)	2.89	0.78	0.02	0.30**	0.19**	(0.81)

*Note: N = 203. Cronbach's alpha reliabilities on diagonal. * $p < .01$.

However, and unlike H1, there was no significant relationship between HPV knowledge and vaccine hesitancy ($r = -0.07$, $p > .05$). There was, however, a very significant negative correlation between HPV knowledge and trust in healthcare providers ($r = -0.31$, $p < .01$) a counterintuitive "knowledge-trust paradox. Trust was positively correlated with hesitancy ($r = 0.43$, $p < .01$), and misinformation exposure was positively correlated with hesitancy ($r = 0.30$, $p < .01$).

Routine vaccination status was found to have a significant influence on HPV vaccine hesitancy by One-way ANOVA ($F(2,200) = 3.857$, $p = 0.023$) and higher HPV vaccine hesitancy was seen with lower routine vaccination. Education ($F(4,198) = 0.451$, $p = 0.772$) and school type ($F(2,200) = 2.011$, $p = 0.137$) were not significant.

3.2 Direct Effects

The direct path coefficients of the mediation model are shown in Table 2. The direct effect of HPV knowledge on vaccine hesitancy was not significant ($b = 0.137$, $SE = 0.135$, $p > .05$). The other association supported in HPV was a significantly negative association between HPV and trust in health care providers ($b = -0.640$, $SE = 0.141$, $p < .001$). Results indicated a significant positive correlation between vaccine hesitancy and the H3 subscale, which is 'Trust' ($b = 0.435$, $SE = 0.065$, $p < .001$). There was a significant, positively associated relationship between exposure to misinformation and vaccine hesitancy ($r = 0.30$, $p < .01$), which was supported.

Table 2. Direct path coefficients

Hypothesis	Path	Estimate	SE	p

H1	VA → VH	0.137	0.135	> .05
H2	VA → THCP	-0.640	0.141	< .001
H3	THCP → VH	0.435	0.065	< .001

3.3 Mediation Analysis

H5 was supported. The results of the Bootstrap analysis (5,000 re-sampling) indicated that a significant indirect effect on vaccine hesitancy was found between HPV knowledge and trust in physicians and providers (indirect effect = -0.278, Boot SE = 0.078, 95% bias-corrected CI [-0.439, -0.133]). A 95% confidence interval of the knowledge hesitancy relationship excluding zero supported the assertion that trust fully mediates the knowledge hesitancy relationship. The direct effect (c') of the effect remained non-significant after adjustment for the mediator suggesting complete mediation.

3.4 Moderation Analysis

It was not possible to run the H6 supported version. There was no significant interaction between HPV knowledge and experience of misinformation (b = 0.015, SE = 0.157, p = 0.922). Simple slopes analysis further revealed that the relationship between HPV knowledge and vaccine hesitation was not statistically significant at low HPV mis informational exposure (effect = - 0.214, p > .05), mean HPV mis informational exposure (effect = -0.198, p > .05), and high level of HPV mis informational exposure (effect = -0.182, p > .05). In this regard, the effect of exposure to misinformation on the strength of the relationship between knowledge and hesitancy was non-significant even though exposure had a direct positive impact on the hesitancy relationship.

3.5 Summary of Hypotheses

Hypothesis	Relationship	Supported?
H1	VA → VH (direct negative)	No
H2	VA → THCP (positive)	No (significant negative)
H3	THCP → VH (negative)	Yes (positive direction)
H4	EM → VH (positive)	Yes
H5	VA → THCP → VH (mediation)	Yes (full mediation)

H6	VA × EM → VH (moderation)	No
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4. Discussion

This study aimed to get insights into the complex psychological mechanisms underlying HPV vaccine hesitancy among mothers in Pakistan, emphasizing the role of trust in the healthcare providers between hesitancy and vaccination, and the role of misinformation exposure as a moderating factor between hesitancy and vaccination. The results contradict the prevailing theory of a knowledge gap and provide a few significant theoretical, and practical implications.

4.1 The Knowledge-Trust Paradox

The most striking was the negative relationship between HPV knowledge and trust in healthcare providers (H2 reversed) which was significant. The assumption that increased education translates to increased trust in the medical authority turned out to be incorrect as patients who were most knowledgeable about HPV expressed distrust in their medical care providers. This we call the 'knowledge-trust paradox'.

This unexpected result is in line with the new critiques of the "knowledge deficit" model of learning (Simis et al., 2016) and to the concept of informed skepticism, aka "reactance" in the digital age (Kata, 2012). When people look up health information themselves online, they find factual information, as well as history of medical mistakes, conflicts of interest in the pharmaceutical industry, and anecdotal adverse events from taking vaccines (Tan & Goonawardene, 2017). This exposure can lead to a change in blind trust to a consumerist mindset on health care: It involves comparing the recommendations of providers with other sources more than accepting this as an unquestionable authority.

Paradoxically, this occurs despite people's growing lack of trust in health systems as a result of the negative experiences with vaccination in Pakistan in the recent past (Yousaf et al., 2022). Women who proactively educate themselves about HPV could also wonder as to why health care professionals are recommending HPV vaccines or immunizations, particularly in the private health system, where it is suspected that profit motives influence health care professionals' recommendations (Raza et al., 2023).

4.2 Trust as a fully-fledged mediational factor.

The finding of the mediation paves the way for the theoretical results of this study, namely the mediation result (H5). The direct effect of knowledge on hesitancy was not statistically significant while the direct effect of trust indirectly through knowledge was statistically significant, indicating that trust could not have been a correlate of knowledge but was instead seen as a psychological link between knowledge and vaccination decision. It's not what you know, it's what you do with it and it's in the hands of trust.

What is new about this finding is that it puts the two theories, the HBM and TPB, in a unique relationship; knowledge affects cognitive appraisals (HBM), while trust is used to explain

whether or not cognitive appraisals are translated into positive attitudes and intentions (TPB). A lack of trust makes knowledge of the facts meaningless and unconvincible. Thus, many health behavior studies have seen such an "attitudinal-behavioral gap" or "knowledge-intention gap."

Remember that trust and hesitancy go together and are important but of a positive nature because measured and supported by H3 is aspiration. Within our scales, the higher the trust scores, the lower the scores related to reluctance (how trust is linked to reluctance the more trust, the less reluctance). The positive correlation in Table 1 ($r = 0.43$) indicated that trust was measured in a negative direction on the scale as opposed

to hesitancy being measured in a positive direction.

This was because the greater the level of trust, the lower the level of hesitancy, as was seen in other literature (Holman et al., 2014; Gilkey et al., 2016).

4.3 Misinformation: Direct but Not Moderating

As reported previously (Loomba et al., 2021; Wilson & Wiysonge, 2020) exposure to misinformation directly led to vaccine hesitancy (H4 supported). That said, the lack of moderation (H6 not supported) is telling as well. Misinformation did not have a negative effect on the relationship between knowledge and hesitancy; rather, it was an independent parallel process.

That means it does not change the processing or application of accurate knowledge itself; it just means that the misinformation has to compete with other information first when comprehended. Rather, it offers an alternative story an "opposing viewpoint" that sides either with or against the factual information. The pathway through which misinformation might influence individuals' decisions whether to seek medical care is likely to be degraded during the repeated exposure to misinformation, thus reducing the impact of additional misinformation. This means, from an intervention side, that correcting misinformation is not enough, people need to be restored their trust to the interventions at the same time (Chan et al., 2017).

4.4 Theoretical Implications

This research has three theoretical values. First, it claims that the knowledge-deficit model is not the one to be challenged, as the study has shown that there is no automatic solution for reducing hesitation due to knowledge acquisition. Second, it points to these psychological processes as a fully mediating second pathway between knowledge and behaviour – the path of trust. Thirdly, it

indicates knowledge-trust paradox: a relationship between the level of knowledge and trust that prove to be negative, a finding that's not yet documented in the literature on HPV vaccine hesitancy.

4.5 Practical Implications

1. Pakistani public health officials and policymakers know the stakes they face are high and that the problem is acute. Knowledge only, rather than actions, interventions will have little effect. Rather, resources should be diverted instead to strategies for building trust such as:
2. Ensure that health care providers are trained to communicate in a trustful way, provide motivational interviewing and are trained to approach parental concerns sensitively without judgement (Kessels et al., 2021).
3. Measures at the system-level transparency to show that provider recommendations are made and conducted with the patient's well-being in mind, and not financial gain (Raza et al., 2023).
4. Engagement expertise and common views on HPV vaccine safety and effectiveness by trusted community partners, like religious and community leaders (ulama) (Ul Haq et al., 2023).
5. Prebunking and inoculation strategies which introduce individuals to a weak version of misinformation prior to them being exposed to the full, strong version of misinformation (Compton et al., 2021; van der Linden et al., 2017).
6. Education program on critical evaluation of vaccine related information for parents, especially for those who are highly active on WhatsApp and Facebook.

4.6 The limitations and future research are discussed in section

There are a number of caveats to be noted. First, the cross-sectional design does not allow for making causal inferences, so there is need for longitudinal research to determine precedence in time. Second, it does not allow generalizability to rural girls, or fathers or other male or female family decision makers who are not attending school. Thirdly, recall and social desirability bias could play a role in how the exposure to misinformation is reported. The study was conducted in limited areas of Rawalpindi and Islamabad and future studies should be conducted in various geographical areas of

Pakistan.

Future work needs to use mixed methods: qualitative interviews to help understand the reasons for decreasing trust when the knowledge is high, longitudinal designs to allow the monitoring of the changes in trust and uncertainty throughout time (e.g., in the context of a national rollout of HPV vaccines) and experimental designs to test interventions for building trust. Moreover the involvement of fathers, grandparents and religious leaders in vaccine family decisions needs to be explored.

5. Conclusion

Findings from this study confirm that trust in health care providers is not only a correlate but key mediator between having knowledge about HPV and their vaccine hesitancy among Pakistani mothers. Such a case, where knowledge is negatively correlated with trust, is known as the knowledge-trust paradox, where higher in knowledge, lower in trust of medical authority.

Whether directly lowers hesitancy, or just does not moderate the knowledge-hesitancy relationship, exposure to misinformation does not seem to interact with knowledge. Exposure to misinformation does not interact with knowledge, it directly lowers hesitancy.

The long-standing narrative of a lack of awareness leads to low uptake of HPV vaccines in LMICs like Pakistan must be broken down by strong re-establishment of trust between health providers and the people they serve, and not with more information campaigns. Today, it's not enough to win trust has to be if knowledge is to save lives in the midst of an infodemic and institutional skepticism.

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