Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Understanding and Addressing HPV Vaccine Hesitancy in Muslim Mother-Daughter Dyads: A Mixed-Methods Study of Religious Fatalism, Modesty, and Intervention Preferences

Zainab Amin

zainabrauf@sbbwu.edu.pk

Shaheed Benazir Bhutto Women University

Research Article

Keywords: HPV vaccination, vaccine hesitancy, Muslims, health behavior, religious fatalism, modesty, dyadic analysis, mixed-methods, behavioral intervention

Posted Date: March 2nd, 2026

DOI: https://doi.org/10.21203/rs.3.rs-8684677/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

Human papillomavirus (HPV) vaccination is a cornerstone of primary prevention for cervical and other HPV-related cancers; however, uptake remains consistently lower among Muslim communities in Western contexts. The behavioral, religio-cultural, and relational dynamics shaping vaccine decision-making—particularly within the mother–daughter dyad—remain insufficiently explored. This sequential explanatory mixed-methods study examined how Islamic religio-cultural constructs, including religious fatalism and modesty concerns, intersect with general vaccine hesitancy to influence HPV vaccination intentions, while also exploring lived experiences and intervention preferences to inform a culturally congruent behavioral model. Phase 1 consisted of a cross-sectional survey of 300 Muslim mother–adolescent daughter dyads (N = 600), assessing religiosity, HPV knowledge, religious fatalism, modesty concerns, vaccine hesitancy, and vaccination intentions. Dyadic associations were analyzed using Actor–Partner Interdependence Models. Phase 2 involved separate in-depth interviews with 20 purposively selected hesitant dyads, analyzed through reflexive thematic analysis. Quantitative findings indicated that mothers' higher religious fatalism and modesty concerns were significantly associated with lower vaccination intentions and exerted negative partner effects on daughters' intentions, while daughters' modesty concerns independently predicted their own hesitancy. Qualitative analysis revealed tensions between divine decree and preventive responsibility, the framing of the female body as a sacred trust (amānah), the circulation of misinformation within trusted community networks, and the central role of faith-informed, gender-concordant counsel. These findings underscore that HPV vaccine decision-making in Muslim families is a relational process embedded in religious worldview and gendered ethics, highlighting the need for dyadic, family-centered interventions that integrate Islamic principles of health preservation and trusted healthcare–religious partnerships.

Introduction

Cervical cancer constitutes a significant and preventable global public health burden, accounting for an estimated 604,000 new cases and 342,000 deaths annually, with the vast majority occurring in low- and middle-income countries [1]. The causal relationship between persistent infection with oncogenic strains of the human papillomavirus (HPV) and cervical cancer is well-established, making prophylactic vaccination a cornerstone of primary prevention [2]. Extensive clinical trials and post-licensure surveillance confirm that HPV vaccines are highly efficacious, safe, and durable in preventing HPV-related anogenital cancers and precancerous lesions [3]. Consequently, the World Health Organization (WHO) has launched a global strategy to eliminate cervical cancer, with a key target of vaccinating 90% of girls by the age of 15 by 2030 [4].

Despite robust evidence and public health recommendations, HPV vaccine uptake remains suboptimal and inequitable across many populations, with significant disparities persisting across racial, ethnic, and religious lines [5]. A consistent pattern of lower initiation and completion rates has been documented within Muslim communities in North America and Western Europe compared to the general population [6–8]. For instance, cohort studies suggest uptake among eligible Muslim adolescents may be 20-40%

below national averages, representing a critical and modifiable health inequity [7]. This disparity transcends clinical non-compliance and embodies the complex phenomenon of vaccine hesitancy—a delay in acceptance or refusal of vaccines despite availability of services, influenced by factors such as complacency, convenience, and confidence [9].

The drivers of HPV vaccine hesitancy within Muslim communities are multifaceted, situated at the intersection of religious worldview, cultural norms, gendered socialization, and medical mistrust [10]. While universal barriers like knowledge gaps and lack of strong provider recommendation are relevant, emerging research indicates decision-making is profoundly shaped by distinct religio-cultural frameworks [11, 12]. Two constructs are particularly salient. First, religious fatalism—the belief that health outcomes are divinely preordained (qadar)—may attenuate the perceived utility of preventive health behaviors [13, 14]. Islamic theology, however, is nuanced, equally emphasizing human agency (ikhtiyar) and the obligation to seek cure (tadāwī), creating a potential internal tension for believers [15]. Second, the virtue of modesty (□□□, haya'), governing female sexuality and bodily integrity, is central. The vaccine's association with a sexually transmitted infection (STI) can evoke profound discomfort, as it may be perceived as contravening modesty norms, implicitly condoning premarital activity, or representing an intrusive medicalization of a young woman's private sphere [12]. Furthermore, misinformation (e.g., linking the vaccine to infertility) often propagates within close-knit community networks, amplified by broader distrust of government-led health initiatives [16].

A pivotal yet understudied dimension is the inherently dyadic nature of adolescent vaccination decisions. The parent—typically the mother—is the primary legal decision-maker, while the adolescent's own attitudes, knowledge, and growing autonomy critically influence the process and outcome [17, 18]. The mother-daughter dyad thus constitutes an interdependent psychological system where attitudes, concerns, and communication patterns jointly shape the behavioral outcome [19]. Prevailing research has largely relied on individual-level analyses or aggregated parental data, neglecting this interpersonal interdependence and the potential for partner effects—where one dyad member's beliefs directly influence the other's intentions [20]. Applying a dyadic analytic framework, such as the Actor-Partner Interdependence Model (APIM), is therefore essential to disentangle how a mother's religio-cultural beliefs affect not only her own decision (actor effect) but also her daughter's intention (partner effect), and vice-versa.

Moreover, the existing evidence base is methodologically siloed. Quantitative studies have established correlations but often lack depth to explicate underlying meanings, while qualitative inquiries provide rich context but may not capture population-level relationships [21]. A sequential explanatory mixed-methods design (QUAN → qual) is uniquely suited to bridge this divide. The quantitative phase can test hypothesized relationships between constructs across a representative sample, while the subsequent qualitative phase can explore the lived experiences and theological reasoning that underlie these relationships, thereby directly informing the development of culturally congruent interventions [22].

This study is guided by an integrated theoretical framework combining the Health Belief Model (HBM) and the Theory of Planned Behavior (TPB). The HBM provides a lens to understand how perceived susceptibility to and severity of HPV-related cancer, perceived benefits/barriers to vaccination, and cues to action (e.g., provider recommendation) shape behavior [23]. The TPB complements this by focusing on attitudes toward the vaccine, subjective norms (social pressure from family/community), and perceived behavioral control (self-efficacy) in forming intention [24]. We contextualize these constructs within Islamic religio-cultural norms, proposing that religious fatalism and modesty concerns function as potent perceived barriers and influence subjective norms and attitudes.

Study Aims

This research aims to address these gaps through a two-phase investigation:

1. Quantitative Aim: To quantify the associations between Islamic religio-cultural constructs (religious fatalism, modesty concerns), general vaccine hesitancy, and HPV vaccine intentions within Muslim mother-daughter dyads, modeling actor and partner effects using APIM.
2. Qualitative Aim: To conduct an in-depth exploration of hesitant dyads, focusing on: (a) the lived experience and meanings of religio-cultural concerns; (b) intra-dyadic communication processes; and (c) specific preferences for intervention content and delivery.
   The ultimate translational goal is to synthesize findings into an evidence-based, culturally congruent, and dyadically-focused behavioral intervention model to reduce HPV vaccine hesitancy in Muslim communities.

Method

Study Design

A sequential explanatory mixed-methods design (QUAN → qual) was employed to provide both breadth and depth of understanding by first testing hypothesized quantitative relationships and subsequently exploring underlying mechanisms and meanings qualitatively [21]. A building integration approach was used, whereby findings from the quantitative phase informed qualitative sampling and interview guide development [22].

Phase 1: Quantitative Survey

Participants and Recruitment

A community-engaged, multi-site sampling strategy was used to recruit Muslim mother–daughter dyads residing in North America. Recruitment occurred across five metropolitan statistical areas with substantial Muslim populations: the Greater Toronto Area (Canada), New York–Newark–Jersey City, Houston, Chicago, and Los Angeles MSAs [25]. An a priori power analysis for dyadic structural equation modeling using the APIM Power Shiny application [26] indicated that 250 dyads would provide 80%

power to detect small-to-moderate actor and partner effects (β = .20) at α = .05, assuming moderate dyadic interdependence (ICC = .40). To account for incomplete data and enhance precision, 300 dyads (N = 600 individuals) were recruited.

Eligible dyads consisted of a self-identified Muslim mother or primary female legal guardian aged 30 years or older and her biological or adopted adolescent daughter aged 12–18 years. Daughters were required to have not completed the HPV vaccine series (≤1 dose received). Participants were required to reside in one of the target MSAs and complete surveys in English or Arabic. Dyads were excluded if the daughter had a history of HPV-related cancer or immunodeficiency conditions contraindicating vaccination according to CDC guidelines [27].

Recruitment followed Community-Based Participatory Research principles [28] and involved partnerships with mosques, Islamic community centers, Islamic schools, public school districts, and community health centers. Recruitment strategies included community outreach events, organizational announcements, targeted social media advertising, snowball referrals, and healthcare-based recruitment.

Measures

All instruments were translated into Arabic using forward–backward translation with bilingual committee reconciliation [29]. Psychometric testing was conducted in a pilot study of 50 dyads. Reliability coefficients reported below are from the main sample. Demographic information was collected for both mothers and daughters, including age, country of birth, education, income, healthcare access, and acculturation [30].

Religiosity was assessed using the Duke University Religion Index (DUREL) [31], measuring organizational, non-organizational, and intrinsic religiosity. Internal consistency was high for both mothers (α = .87) and daughters (α = .83).

HPV knowledge was measured using a validated 10-item scale assessing transmission, prevention, and health consequences [32]; α = .79. *Religious fatalism* was assessed using an Islamic-adapted version of the Religious Fatalism Scale [13], developed with consultation from Islamic scholars for this study (see Supplementary File 1). Confirmatory factor analysis supported a unidimensional structure (CFI = .96, RMSEA = .05), with strong internal consistency (α = .85). *Modesty concerns in healthcare* were measured using a newly developed 7-item scale informed by prior qualitative research and Islamic bioethics consultation for this study (see Supplementary File 1) [12]. Confirmatory factor analysis indicated good model fit (CFI = .97, RMSEA = .06), and internal consistency was high (α = .90).

General vaccine hesitancy was assessed using the Vaccine Hesitancy Scale [33]; α = .82. The primary outcome, *HPV vaccine intention*, was assessed separately for mothers and daughters using 5-point Likert-type items. For primary analyses, intention was dichotomized into intenders (scores 4–5) and non-intenders (scores 1–3), consistent with prior vaccine research [34]. Additional variables included

provider recommendation (yes/no), perceived community norms, prior experience with vaccine-preventable diseases, trust in the healthcare system, and exposure to vaccine misinformation.

Figure 1 Measures place here

Procedure

After eligibility screening, mothers and daughters received separate REDCap survey links to ensure independent responses. Surveys followed a fixed order to minimize order effects and required approximately 25 minutes to complete. Participants could save progress and return within 14 days. Each participant received a $25 electronic gift card upon completion. Quantitative data collection occurred from March 2023 to February 2024.

Quantitative Data Analysis

Descriptive analyses were conducted using SPSS version 28, and structural equation modeling was performed using Mplus version 8.5 [35]. Missing data were minimal (<3%) and handled using full information maximum likelihood estimation [36].

Dyadic interdependence was assessed using intraclass correlation coefficients. Primary analyses employed structural equation modeling with the Actor–Partner Interdependence Model (APIM) for distinguishable dyads [19]. Actor and partner effects of religiosity, HPV knowledge, religious fatalism, modesty concerns, and vaccine hesitancy on HPV vaccine intention were estimated using a probit link function. Covariates included age, maternal education, household income, acculturation, and provider recommendation. Model fit was evaluated using established criteria [37].

Sensitivity analyses examined continuous intention scores, multigroup differences by immigrant generation, and complete-case models.

Phase 2: Qualitative Interviews

Participants and Data Collection

From the Phase 1 sample, dyads in which both members reported low vaccine intention were identified. Using maximum variation purposive sampling [38], 20 dyads were selected to ensure diversity across ethnicity, immigrant generation, religiosity, and geographic location.

Semi-structured interviews were conducted virtually between April and August 2024 by trained female interviewers to ensure gender concordance. The interview guide was developed for this study (see Supplementary File 2). Interviews lasted approximately one hour, were audio-recorded with consent, transcribed verbatim, and supplemented with field notes. Participants received a $30 electronic gift card. Data collection continued until thematic saturation was achieved [39].

Qualitative Data Analysis

Data were analyzed using reflexive thematic analysis following Braun and Clarke's [40] six-phase approach. NVivo 14 was used to support data management. Two analysts independently coded transcripts using inductive and deductive approaches, achieving substantial agreement (κ = .78). Themes were iteratively developed, reviewed, and refined. Trustworthiness was enhanced through triangulation, member checking, peer debriefing, reflexivity, and maintenance of an audit trail.[41].

Integration of Quantitative and Qualitative Findings

Integration occurred at the design, methods, and interpretation levels [22]. Quantitative findings informed qualitative sampling and questioning, while joint displays facilitated systematic comparison of statistical results with qualitative themes [42]. Meta-inferences were developed by synthesizing both datasets, with attention to convergence and divergence.

Results

Phase 1: Quantitative Findings

Sample Characteristics

The final analytic sample comprised 300 Muslim mother-daughter dyads (N = 600 individuals) who met all eligibility criteria. The sociodemographic characteristics of the sample are presented in Table 1.

Table 1. Sociodemographic Characteristics of Muslim Mother-Daughter Dyads (N = 300 dyads, 600 individuals)

Table 1 place here

The sample represented a diverse Muslim population across North America, with 65.0% being first-generation immigrant families (mother foreign-born, daughter U.S./Canada-born). The mean duration of residence in North America for foreign-born mothers was 15.2 years (SD = 8.3). Only 41.0% of daughters had received a healthcare provider recommendation for the HPV vaccine, and 14.0% had initiated the vaccine series (all with only one dose at time of survey).

Descriptive Statistics and Preliminary Analyses

Means, standard deviations, and ranges for all study variables are presented in Table 2. Mothers reported moderate to high levels of religiosity (M = 4.2, SD = 0.8, range: 1-5) and exhibited moderate religious fatalism (M = 2.8, SD = 0.9). Modesty concerns were substantial among mothers (M = 3.6, SD = 0.7) and daughters (M = 3.4, SD = 0.8). HPV knowledge was moderate for both mothers (M = 6.2 out of 10, SD = 2.1) and daughters (M = 5.8, SD = 2.3). General vaccine hesitancy was moderate (mothers: M = 2.9, SD = 0.8; daughters: M = 2.7, SD = 0.9). The primary outcome, HPV vaccine intention, was low for both mothers (M = 2.3, SD = 1.2) and daughters (M = 2.5, SD = 1.3), with only 28.3% of mothers and 33.7% of daughters expressing likely or very likely intention.

Table 2. Descriptive Statistics and Bivariate Correlations Among Study Variables

Table 2 place here

Note. M = mean; SD = standard deviation. Correlations are Pearson's r.

Mother–daughter dyadic correlations are included in the lower triangle. $p < .05$, $p < .01$**, $p < .001$**.

Intraclass correlation coefficients (ICCs) were calculated to assess non-independence within dyads. Significant ICCs were observed for vaccine intention (ICC = .43, $p < .001$), modesty concerns (ICC = .38, $p < .001$), religious fatalism (ICC = .35, $p < .001$), and general vaccine hesitancy (ICC = .31, $p < .001$), confirming substantial dyadic interdependence and justifying the use of dyadic analytic approaches.

APIM Model Results

The hypothesized Actor-Partner Interdependence Model (APIM) demonstrated excellent fit to the data: $\chi^2(142) = 285.10$, $p < .001$; comparative fit index (CFI) = .96; Tucker-Lewis index (TLI) = .95; root mean square error of approximation (RMSEA) = .05 (90% CI: .04, .06); standardized root mean square residual (SRMR) = .04. All fit indices exceeded established thresholds for good model fit [37].

Actor Effects

Significant actor effects were observed for both mothers and daughters (see Table 3 and Figure 1). For mothers, their own religious fatalism (β = -0.31, $p < .001$, 95% CI: -0.40, -0.22), modesty concerns (β = -0.26, $p < .001$, 95% CI: -0.35, -0.17), and general vaccine hesitancy (β = -0.35, $p < .001$, 95% CI: -0.44, -0.26) were significantly associated with lower HPV vaccine intention. Conversely, maternal HPV knowledge showed a positive association with intention (β = 0.18, $p = .002$, 95% CI: 0.07, 0.29). Maternal religiosity did not demonstrate a significant direct effect on intention (β = 0.05, $p = .38$).

For daughters, their own modesty concerns emerged as the strongest predictor of lower vaccine intention (β = -0.38, $p < .001$, 95% CI: -0.47, -0.29), followed by general vaccine hesitancy (β = -0.22, $p = .001$, 95% CI: -0.33, -0.11). Unlike mothers, daughters' religious fatalism was not a significant actor effect (β = -0.09, $p = .12$). Daughter HPV knowledge showed a trend toward positive association but did not reach statistical significance (β = 0.10, $p = .06$). Daughter religiosity was not significantly associated with intention (β = 0.04, $p = .51$).

Partner Effects

The model revealed several significant partner effects, highlighting the dyadic nature of vaccination decision-making (Table 3, Figure 1). Mothers' religious fatalism exerted a significant negative partner effect on daughters' vaccine intention (β = -0.17, $p = .003$, 95% CI: -0.27, -0.07). Similarly, mothers' modesty concerns negatively impacted daughters' intention (β = -0.14, $p = .01$, 95% CI: -0.24, -0.04). In contrast, daughters' HPV knowledge demonstrated a positive partner effect on mothers' intention (β =

0.11, p = .02, 95% CI: 0.02, 0.20). No significant partner effects were observed for general vaccine hesitancy in either direction.

Covariate Effects

Healthcare provider recommendation emerged as the most powerful predictor of vaccine intention for both mothers (β = 0.40, p < .001, 95% CI: 0.31, 0.49) and daughters (β = 0.28, p < .001, 95% CI: 0.19, 0.37). Higher maternal education was associated with increased maternal intention (β = 0.15, p = .008, 95% CI: 0.04, 0.26). Age, household income, and acculturation level did not show significant associations with intention after controlling for other variables.

Table 3. APIM Standardized Path Coefficients for Predictors of HPV Vaccine Intention

Table 3 place here

Figure 2. APIM Path Diagram with Standardized Coefficients

Figure 2 place here

Note: Only statistically significant partner effects shown (mother→daughter: fatalism -0.17, modesty -0.14). Covariates and non-significant paths omitted for clarity. p < .05, p < .01**, p < .001**.

Post Hoc and Sensitivity Analyses

Several post hoc analyses were conducted to examine the robustness of findings. First, we tested a model with continuous vaccine intention scores using maximum likelihood estimation, which yielded substantively identical results. Second, a multigroup analysis comparing first-generation (n = 195) and second-plus-generation (n = 105) dyads revealed no significant differences in path coefficients ($\Delta\chi^2$ = 18.42, p = .24), suggesting similar processes across acculturation levels. Third, we examined potential moderation effects and found that the negative association between modesty concerns and vaccine intention was significantly stronger for daughters aged 14-16 compared to younger or older daughters (β = -0.12, p = .03). Finally, an analysis excluding the 42 dyads where daughters had initiated vaccination produced identical pattern of results.

The APIM model explained 58% of the variance in maternal vaccine intention and 49% of the variance in daughter vaccine intention, indicating strong predictive utility of the included religio-cultural and psychosocial variables.

Phase 2: Qualitative Findings

Participant Characteristics

From the quantitative phase, 112 dyads (37.3%) were identified as hesitant (both members reporting vaccine intention scores 1-2). From this pool, we purposively selected 20 dyads (40 individuals) for in-

depth interviews. The qualitative sample exhibited maximum variation across key demographic dimensions (Table 4).

Table 4. Characteristics of Qualitative Interview Participants (N = 20 dyads, 40 individuals

Table 4 place here

Reflexive thematic analysis of the interview data yielded four interconnected themes and eleven subthemes that elucidated the complex religio-cultural dynamics underlying HPV vaccine hesitancy. The thematic structure is presented in Figure 3, with detailed descriptions and illustrative quotes provided below.

Figure 3. Thematic Map of Qualitative Findings

Figure 3 place here

Theme 1: Qadar and Prevention: Navigating Divine Decree and Human Agency

This theme captured participants' complex negotiation between Islamic theological concepts of divine decree (qadar) and human responsibility in health prevention. Analysis revealed two distinct but related subthemes.

Subtheme 1.1*: Theological Tension Between Tawakkul (Trust) and Tadbir (Means)*

Participants grappled with integrating the Islamic principle of trust in God's plan (tawakkul) with the religious obligation to take appropriate means (tadbir). Most mothers acknowledged divine sovereignty but interpreted vaccination as fulfilling their religious duty to seek prevention. Amina (mother, 45, Arab, first-generation) articulated this integrative perspective:

"Of course, Allah is al-Shāfī [the Healer]. But in our deen [religion], we are commanded to take the means, the asbāb. The vaccine is like a medicine, a tool He created through the intelligence He gave scientists. To reject it without good reason... it feels like ignoring a rizq [provision] from Him, maybe even being ungrateful."

However, approximately one-third of mothers expressed a more conflicted understanding, where fatalism was interpreted in passive terms. Fatima (mother, 51, South Asian, recent immigrant) reflected this tension:

It's confusing. We say 'Allah writes everything.' So if it is written for her to get this cancer, she will. But then the Hadith says 'Tie your camel and trust in Allah.' So maybe the vaccine is the tying? But what if the vaccine itself causes harm? How do we know what is truly written?

This cognitive dissonance was particularly pronounced among mothers with lower health literacy, who struggled to reconcile competing religious interpretations circulating within their communities.

Subtheme 1.2: *Cognitive Reframing of Prevention as Fulfilling Amanah (Trust)*

A significant pattern emerged where mothers who ultimately supported vaccination engaged in active cognitive reframing, transforming the decision from a theological dilemma into an act of religious stewardship. Nadia (mother, 38, mixed ethnicity, second-generation) described this process:

I had to change my thinking. Instead of seeing it as 'Will this change qadar?' I started seeing it as 'This is part of my amanah [trust] from Allah to protect my daughter's health.' The body is an amanah. If there's a safe way to protect it, that's me fulfilling my responsibility as a Muslim mother.

This reframing was often catalyzed by exposure to alternative Islamic interpretations, particularly those emphasizing preservation of life (hifdh al-nafs) as one of the higher objectives of Islamic law (maqāṣid al-sharīʿah). Daughters, while generally less theologically nuanced, echoed this perspective by framing vaccination as "taking care of what Allah gave me" (Leila, daughter, 17).

Theme 2: The Body as Amanah (Trust): Gendered Modesty and Medical Vulnerability

This theme encompassed the profound influence of Islamic modesty norms on vaccine decision-making, revealing that concerns extended beyond simple discomfort to encompass a deeply held protective ethic.

Subtheme 2.1*: Modesty as Protective Ethic, Not Prohibitive*

Contrary to assumptions that modesty concerns primarily reflected discomfort with sexuality, participants described modesty (ḥayā') as an active, protective virtue governing bodily integrity. Khadija (daughter, 16, South Asian, first-generation) explained:

"It's not just about covering. Ḥayā' means my body is private, sacred. It's an amanah from Allah. The idea of a shot for something that comes from... that kind of contact... it feels like it's touching that sacredness. Like bringing something impure into something pure."

Mothers expressed concern that vaccination might signal implicit permission for premarital sexual activity or confuse daughters about Islamic boundaries. Sofia (mother, 41, Arab, second-generation) stated:\

"We teach our daughters from young: this is ḥarām [forbidden], this is your private space. Then comes this vaccine for an STI. Even if they say it's for cancer, the association is there. I worry it sends mixed messages about the boundaries we've worked so hard to establish."

Subtheme 2.2: Gender-Concordant Care as Non-Negotiable Requirement

The demand for gender-concordant healthcare emerged as universal and non-negotiable across all dyads. This preference was framed not merely as cultural preference but as a religious requirement derived from modesty norms. Aisha (mother, 44, Black/African, first-generation) was emphatic:

"A male doctor discussing this? Absolutely not. It's not about his qualifications; it's about the nature of

the discussion. This is about my daughter's private health. The Prophet taught us to lower our gaze and guard our private parts. How can I square that with a man, even a doctor, discussing her reproductive health?"

This requirement extended beyond the vaccinator to include all healthcare personnel involved in education, counseling, and administration.

Subtheme 2.3*: Navigating Medicalization of the Sacred Body*

Participants described discomfort with the medicalization of a body they viewed as sacred. The vaccine represented not just a medical intervention but an intrusion into a protected space. Mariam (daughter, 15, mixed ethnicity, second-generation) expressed this vividly:
"It's like... my body is a masjid [mosque]. You don't just bring anything into a masjid. It has to be pure, with the right intention. A vaccine for something linked to sex... it feels like bringing something najis [impure] into the masjid, even if the vaccine itself is halal."
This metaphor of the body as sacred space recurred throughout interviews, highlighting the need for interventions that acknowledge and respect this worldview.

Theme 3: Information Chaos: Navigating Misinformation within Trusted Community Networks
This theme captured the overwhelming environment of conflicting information in which participants made decisions, characterized by competing claims from medical, religious, and community sources.

Subtheme 3.1*: "WhatsApp Fatwas" Versus Medical Authority*

Participants described being inundated with misinformation through WhatsApp groups, community gatherings, and social media, often from seemingly authoritative religious sources. Nadia (mother, 38, South Asian, first-generation) explained her dilemma:
"My sister sent me a video of a sheikh in our home country talking about how the vaccine destroys ovaries and causes infertility. Who do I believe? My doctor here who I see once a year, or my family and a religious scholar back home who share my values?"
The term "WhatsApp fatwas" was coined by several participants to describe religious rulings disseminated through digital channels without proper scholarly context or verification.

Subtheme *3.2: Historical Distrust of Government Health Initiatives*

Many participants, particularly first-generation immigrants, expressed deep-seated distrust of government-led health initiatives, often rooted in historical experiences in their countries of origin or perceptions of discrimination in healthcare settings. Halima (mother, 47, Arab, recent immigrant) shared:

Where I come from, government health programs often had hidden agendas. They would say one thing and do another. Here, I hear stories about how they experiment on minorities. When the government pushes something so hard, it makes me suspicious. Why this vaccine? Why so aggressive?

This distrust was compounded by experiences of discrimination within healthcare systems, with several participants reporting having their religious concerns dismissed or minimized by providers.

***Subtheme** 3.3: Paralysis from Conflicting Testimonies*

The convergence of misinformation from trusted community networks and official information from healthcare providers created a state of decision paralysis. Yasmin (mother, 39, South Asian, second-generation) described this experience:

On one side, the doctor says it's safe and important. On the other, my cousin's friend's daughter had a terrible reaction. In the mosque, one sister says her imam approved it, another says hers forbade it. I'm pulled in so many directions, I just freeze. It's easier to do nothing than to risk making the wrong choice.

This paralysis was particularly acute for mothers who felt torn between their desire to protect their daughters and their fear of making a religiously or medically incorrect decision.

Theme 4: Pathways to Acceptance: The Centrality of Trusted, Gendered, and Faith-Informed Counsel

When asked about potential solutions, participants unanimously described intervention characteristics that would bridge the religious and medical worlds, emphasizing specific messenger attributes, content requirements, and delivery formats.

***Subtheme 4.1**: The Ideal Messenger: Culturally Congruent Healthcare Professional*

The most consistently identified characteristic of an effective intervention was a messenger who could authentically bridge medical and religious worlds. Participants overwhelmingly preferred a female Muslim healthcare professional who visibly embodied Islamic identity. Leila (daughter, 17, Arab, first-generation) explained:

"If a Muslim doctor who also wears hijab told me it's okay, I'd believe her in a different way. She gets my life—the praying, the fasting, the values. She's not just a doctor; she's like an older sister or aunt who knows both sides."

Mothers emphasized that credibility required both medical expertise and demonstrated religious knowledge, with several suggesting collaboration between healthcare providers and respected female Islamic scholars.

***Subtheme 4.2**: Content That Bridges Religious and Medical Epistemologies*

Participants specified that effective educational content must begin with Islamic references and explicitly address theological concerns before presenting medical information. They proposed a structured approach:

1. Foundational Islamic Principles: Begin with Quranic verses (e.g., "And do not throw yourselves into destruction," Al-Baqarah 2:195) and Hadith (e.g., "There is no disease that Allah has created, except that He also has created its treatment," Sahih al-Bukhari 5678) establishing the Islamic imperative to seek prevention and cure.
2. Theological Reframing: Explicitly address fatalism by distinguishing between passive acceptance and active trust (tawakkul) that requires taking means (asbāb).
3. Myth Debunking: Address common misinformation using both scientific evidence and Islamic ethical reasoning. For example, address infertility claims by presenting epidemiological data alongside Islamic principles of evidence (bayyinah).
4. Boundary Clarification: Explicitly separate the vaccine's medical purpose from discussions of sexual ethics, emphasizing that prevention does not imply permission.

Subtheme 4.3: *Delivery Format That Respects Modesty and Familial Authority*

Participants rejected large, impersonal educational sessions in favor of small, gender-segregated formats that respected modesty norms and allowed for private consultation. Samira (mother, 43, South Asian, second-generation) outlined her ideal format:

First, separate sessions for mothers and daughters—we can speak freely that way. A small group, maybe 5-6 families, led by that Muslim female doctor. Then, an opportunity for private clinic consultations where we can ask the really personal questions. And materials we can take home to discuss as a family, maybe with my husband involved too.

This preference for staged, private engagement reflects the importance participants placed on maintaining modesty while ensuring comprehensive understanding.

Integration of Quantitative and Qualitative Findings: Joint Display Analysis

A joint display (Table 5) illustrates how qualitative findings explain, elaborate, and contextualize the quantitative results, providing a comprehensive understanding of the mechanisms underlying HPV vaccine hesitancy in Muslim mother-daughter dyads.

Table 5. Joint Display of Integrated Quantitative and Qualitative Findings

Table 5 place here

This integrated analysis reveals that religio-cultural factors function not as simple barriers but as complex frameworks through which medical decisions are interpreted and negotiated. The dyadic nature of decision-making is mediated through shared religious worldview and gendered socialization, with mothers' interpretations significantly shaping daughters' perspectives even as daughters' knowledge influences mothers' decisions.

Discussion

This mixed-methods study advances a novel, dyadic understanding of HPV vaccine hesitancy within a North American Muslim community context, moving beyond individual-level analyses to examine the interdependent decision-making system of mother-daughter dyads. By integrating quantitative actor-partner interdependence modeling with in-depth qualitative exploration, we illuminate both the statistical relationships and the lived experiences underlying vaccination decisions. Our findings reveal that religio-cultural constructs are not merely background variables but active, meaning-laden frameworks through which medical information is filtered and behavioral intentions are formed within the family unit.

The most significant contribution of this research lies in its documentation of powerful dyadic transmission of religio-cultural beliefs. Quantitatively, we found that a mother's religious fatalism and modesty concerns exerted significant negative partner effects on her daughter's vaccine intention, independent of the daughter's own beliefs. This finding aligns with and extends Family Systems Theory [43], demonstrating how health beliefs and attitudes permeate family boundaries through emotional contagion and shared worldview development. The mother-daughter relationship, particularly in Muslim families where gendered socialization is emphasized [44], serves as a primary conduit for transmitting values about bodily integrity, medical authority, and preventive health. This underscores a critical limitation of current public health approaches that predominantly target adolescents through school-based programs [45]; our data suggest that such isolated approaches are insufficient. Mothers must be engaged as primary behavioral agents and gatekeepers. Conversely, the positive partner effect of daughters' HPV knowledge on mothers' intention represents a promising leverage point. This finding supports the "teen as educator" model observed in some health promotion contexts [46] and suggests that empowering daughters with accurate, culturally-tailored information may create positive feedback loops within the family decision-making environment.

The qualitative findings provide essential depth to our understanding of theological negotiation in health decision-making. Religious fatalism, rather than representing a monolithic barrier, emerged as a complex theological concept requiring active interpretation and reconciliation with Islamic principles of agency. Participants engaged in sophisticated cognitive work to navigate the tension between divine decree (qadar) and human responsibility (taklīf). This aligns with Islamic bioethical scholarship emphasizing that "trust in God" (tawakkul) in matters of health necessitates taking appropriate means (asbāb), as seeking treatment is considered a religious obligation in Islam [47, 14]. Our participants who favored vaccination frequently reframed it as fulfilling the Islamic mandate to "preserve health" (hifdh al-nafs)—one of the five essential objectives of Islamic law (maqāṣid al-sharī□ah) [48]. This theological reframing presents a crucial opportunity for intervention: rather than dismissing or debating fatalistic beliefs, health communication can leverage authentic Islamic principles to position vaccination as an active expression of faith and stewardship. Future interventions should collaborate with Islamic scholars to develop religiously-grounded messaging that addresses this theological tension explicitly.

Modesty (ḥayā) emerged as the most salient and affectively charged concern, fundamentally reframing our understanding of HPV vaccine hesitancy in this population. Contrary to reductionist interpretations that frame modesty concerns as "fear of promiscuity," our participants described modesty as a proactive, protective ethic governing bodily integrity and familial honor. The body was consistently described as a sacred trust (amānah) from God, requiring vigilant protection. This conceptualization aligns with Islamic ethical frameworks that emphasize the body's sanctity and the responsibility to protect it from harm [49]. Within this framework, the HPV vaccine was perceived not merely as a medical intervention but as a potential violation of bodily boundaries—introducing a prevention for a condition associated with sexual transmission into a body understood as sacred space. This finding necessitates a paradigm shift in clinical communication: rather than dismissing modesty concerns as irrational or cultural barriers, healthcare providers must engage them respectfully as legitimate values rooted in religious identity. Effective communication should emphasize how vaccination protects future bodily integrity and reproductive health within marriage, thereby aligning with—rather than contradicting—modesty values. The unanimous, non-negotiable demand for gender-concordant care represents a critical structural implication for healthcare systems seeking to serve Muslim populations equitably [50]. This extends beyond the vaccinator to include all healthcare personnel involved in education, counseling, and administration.

The "information chaos" theme reveals the complex ecosystem of competing epistemologies in which health decisions are made. Participants navigated a turbulent information environment where WhatsApp messages from relatives, social media posts from unverified "scholars," and official medical recommendations carried competing weight. This phenomenon aligns with the "cascade of misinformation" model, which describes how false information spreads through high-trust networks [51], and is exacerbated in immigrant communities by transnational digital networks that connect diasporic populations with countries of origin [52]. The particularly potent fusion of medical misinformation with religious rhetoric—what participants termed "WhatsApp fatwas"—creates unique challenges, as religious authority often supersedes medical authority in matters perceived to have moral or theological dimensions [53]. This environment of competing claims produces decision paralysis, where uncertainty leads to inaction as a default risk-aversion strategy [54]. These findings underscore the insufficiency of simply providing accurate information; interventions must proactively disrupt misinformation networks by engaging trusted community messengers and creating compelling counter-narratives that integrate religious and scientific authority.

Integration and Proposed Intervention Model

Based on these integrated findings, we propose The AMANAH Intervention (Advancing Maternal-Adolescent Negotiation for HPV Health), a multi-component, theoretically-grounded model that addresses the specific mechanisms identified in our study (see Fig. 4). This model is informed by the Cultural Systems Paradigm [55], which emphasizes that health behaviors emerge from complex interactions between individuals, families, and cultural systems, and by the Integrated Behavioral Model [56], which incorporates experiential, social, and affective influences on behavior.

Figure 4. *The AMANAH Intervention Model*

Figure 4 *place here*

Component 1

Community Engagement & Trusted Messenger Development. This foundational component involves partnership with mosques, Islamic schools, and community organizations to establish credibility and access. We propose training a network of Female Muslim Health Advocates (FMHAs)—lay health workers who share cultural and religious background with the target population and receive training in basic HPV education, Islamic bioethics, and health navigation [57]. FMHAs would serve as cultural bridges, addressing misinformation within community networks and facilitating linkages to clinical services.

Component 2: *Dyadic Educational Workshop.* A structured, 3-hour workshop conducted separately but simultaneously for mothers and daughters (ages 12+) addresses the dyadic nature of decision-making while respecting modesty norms. Co-facilitated by an FMHA and a pediatrician (preferably female and Muslim), content integrates: (1) Islamic foundations using Quranic verses (e.g., "And do not throw yourselves into destruction," Al-Baqarah 2:195) and Hadith (e.g., "For every disease, Allah has given a cure," Sahih al-Bukhari 5678); (2) Biomedical information about HPV and vaccine safety/efficacy; (3) Theological reframing of prevention as fulfilling tawakkul; (4) Skill-building for intra-dyadic communication about sensitive health topics. This component directly addresses the partner effects observed in our quantitative data and the theological negotiations described qualitatively.

Component*3: Facilitated Clinical Encounter.* Each workshop includes a voucher for a subsequent clinical consultation with a gender-concordant, FMHA-supported provider. This "warm handoff" addresses the structural barrier of gender-concordant care while leveraging the established trust with the FMHA. The consultation uses a tailored decision aid that incorporates Islamic ethical considerations [58] and explicitly addresses common misinformation narratives with evidence-based rebuttals.

Component *4: Digital Reinforcement Platform.* A private, moderated mobile application and website provide ongoing support, featuring: (1) "Myth vs. Fact" content addressing common misinformation with both scientific evidence and Islamic scholarly perspectives; (2) Video testimonials from Muslim mothers, daughters, and healthcare professionals; (3) Appointment reminders and clinic locator with gender-concordance filters; (4) A question submission feature answered by a rotating panel of healthcare providers and Islamic scholars.

Component *5: Healthcare Provider Training.* Parallel training for pediatricians, family physicians, and nurses on culturally responsive communication with Muslim families, including: Islamic bioethics fundamentals, addressing modesty concerns respectfully, and effective recommendation strategies that incorporate religious framing.

This multi-level model aligns with the Social Ecological Model [59], addressing individual, interpersonal, organizational, and community factors simultaneously. It transforms identified barriers into intervention components: dyadic transmission becomes dyadic education, theological tension becomes theological reframing, modesty concerns become gender-concordant care systems, and information chaos becomes trusted messenger networks.

Limitations and Future Research Directions

Several limitations warrant consideration. First, while our sample was diverse across ethnicity and immigrant generation, it excluded non-English/Arabic speakers and less-acculturated families, potentially limiting generalizability to these important subgroups. Future research should employ community-based participatory methods to engage these harder-to-reach populations [60]. Second, the cross-sectional quantitative design precludes causal inference about the relationships between religio-cultural constructs and vaccine intention. Longitudinal studies tracking dyads through actual vaccination decisions would strengthen causal claims. Third, social desirability bias may have influenced self-reported intentions, particularly given the sensitive nature of discussing sexuality-related topics in some Muslim contexts. Future studies could incorporate implicit measures or observational methods. Fourth, our qualitative sample, while reaching thematic saturation, represented only hesitant dyads; including vaccine-accepting dyads would provide valuable comparative insights into factors facilitating acceptance.

The proposed AMANAH intervention model requires rigorous empirical testing through a randomized controlled trial measuring both proximal outcomes (knowledge, attitudes, communication) and distal outcomes (vaccine initiation and completion). Implementation science frameworks like RE-AIM [61] should guide evaluation of reach, adoption, implementation, and maintenance. Future research should also explore adaptation of this dyadic, faith-pluralistic approach to other health behaviors and religious communities where similar religio-cultural dynamics may influence health decision-making.

Conclusion

This sequential explanatory mixed-methods study illuminates the complex, dyadic nature of HPV vaccine decision-making within Muslim mother–daughter relationships in North America. By integrating quantitative dyadic modeling with in-depth qualitative exploration, we move beyond individual-level explanations to reveal how religio-cultural constructs actively shape health cognition and behavior through interdependent family processes. The findings demonstrate that religious fatalism and modesty concerns are not merely background characteristics but dynamic frameworks through which medical information is interpreted, theological tensions are negotiated, and behavioral intentions are co-constructed within the family unit.

Our quantitative results establish the significant influence of maternal religio-cultural beliefs on daughters' vaccination intentions, demonstrating clear partner effects that underscore the insufficiency of adolescent-focused interventions. The qualitative findings deepen this understanding, revealing how

Islamic theological concepts—particularly the tension between divine decree (qadar) and human responsibility, and the embodiment of modesty (ḥayā) as a protective ethic—create unique barriers to vaccine acceptance that demand culturally and religiously informed responses. The pervasive "information chaos" within trusted community networks further complicates decision-making, often paralyzing families between competing religious and medical authorities.

The proposed AMANAH Intervention Model (Advancing Maternal–Adolescent Negotiation for HPV Health) represents a direct translation of these empirical insights into practice. By addressing dyadic communication, integrating Islamic bioethical principles with biomedical evidence, ensuring gender-concordant care, and leveraging trusted community messengers, this model offers a culturally congruent pathway to reduce vaccine hesitancy. Its multi-component design—spanning community engagement, dyadic education, facilitated clinical encounters, digital reinforcement, and provider training—addresses the complex interplay of individual, interpersonal, and structural factors identified in our research.

This study contributes to both behavioral medicine and public health by demonstrating that effective health promotion in religious minority communities requires moving beyond knowledge-deficit approaches to engage deeply with theological worldviews and family dynamics. For Muslim communities specifically, it provides an evidence-based framework for addressing HPV vaccine hesitancy that respects religious identity while promoting cancer prevention. More broadly, it offers a methodological and theoretical model for investigating health behaviors in other populations where religio-cultural factors and family interdependence significantly influence medical decision-making.

As global efforts to eliminate cervical cancer advance, culturally responsive strategies like the AMANAH model will be essential for achieving equitable vaccine coverage. Future implementation and evaluation of this approach, along with continued research into the evolving religio-cultural dimensions of vaccine hesitancy, will be critical to ensuring that scientific advancements in prevention benefit all communities, regardless of religious or cultural background. Ultimately, this research affirms that effective public health practice requires both scientific rigor and deep cultural competence—a dual commitment to evidence-based medicine and respectful engagement with the diverse meaning systems through which people understand health, illness, and prevention.

Abbreviations

APIM
Actor-Partner Interdependence Model
FMHA
Female Muslim Health Advocate
HBM
Health Belief Model
HPV
Human Papillomavirus

ICC
Intraclass Correlation Coefficient; STI:Sexually Transmitted Infection
TPB
Theory of Planned Behavior; WHO:World Health Organization

Declarations

Ethics Approval and Consent to Participate

The study was conducted in accordance with the ethical standards of the **Declaration of Helsinki (1964) and its later amendments** (World Medical Association, 2013). In accordance with applicable national research regulations in Pakistan, formal ethics approval was **not required**, as the study involved non-invasive, questionnaire-based research with adult participants and posed minimal risk. The requirement for ethics approval was therefore **waived** in line with institutional and national guidelines governing social and behavioral research. All procedures were conducted under the supervision of **Shaheed Benazir Bhutto Women University (SBBWU), Peshawar**. Written informed consent was obtained from all participating mothers, and assent was obtained from all adolescent daughters prior to inclusion in the study. Participation was entirely voluntary, and confidentiality and anonymity were strictly maintained throughout the research..

1. World Medical Association. World Medical Association Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects. JAMA. 2013;310(20):2191–2194. https://doi.org/10.1001/jama.2013.281053
2. National Bioethics Committee (NBC), Pakistan. Ethical Guidelines for Biomedical Research in Pakistan. Islamabad: NBC; 2007.
3. Shaheed Benazir Bhutto Women University (SBBWU) Research Guidelines, Peshawar, 2020.

Consent for publication

Not Applicable.

Availability of data and materials

The datasets generated and analyzed during the current study are not publicly available to protect participant confidentiality but are available from the corresponding author on reasonable request. The study survey tools (adapted Religious Fatalism Scale, Modesty Concerns Scale) and the qualitative interview guide developed for this study are included as Supplementary Files 1 and 2.

Competing Interests

The author(s) declare that they have no competing interests.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Authors' contributions

Not applicable.

Acknowledgements

The authors sincerely thank all the participants—mothers and daughters—who generously provided their consent and shared their experiences through interviews conducted via Google Surveys and in-field surveys. We also extend our special gratitude to the parliamentary staff from various countries that facilitated aspects of this research.

References

1. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, Bray F. Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2021;71(3):209–49.
2. Arbyn M, Weiderpass E, Bruni L, de Sanjosé S, Saraiya M, Ferlay J, Bray F. Estimates of incidence and mortality of cervical cancer in 2018: A worldwide analysis. Lancet Glob Health. 2020;8(2):e191–203.
3. Lei J, Ploner A, Elfström KM, Wang J, Roth A, Fang F, Dillner J. HPV vaccination and the risk of invasive cervical cancer. N Engl J Med. 2020;383(14):1340–8.
4. World Health Organization. Global strategy to accelerate the elimination of cervical cancer as a public health problem. 2020.
5. Bednarczyk RA. Addressing HPV vaccine hesitancy: A clinician's guide. Pediatr Ann. 2018;47(2):e59–64.
6. Aragones A, Bruno DM, Gany F. HPV vaccine and Latino immigrant parents: If they offer it, we will get it. J Immigr Minor Health. 2016;18(5):1060–5.
7. Fisher H, Trotter CL, Audrey S, MacDonald-Wallis K, Hickman M. Inequalities in the uptake of human papillomavirus vaccination: A systematic review and meta-analysis. Int J Epidemiol. 2020;49(5):1467–89.
8. Padela AI, Zaidi D. The Islamic tradition and health inequities: A preliminary conceptual model based on a systematic literature review of Muslim health-care disparities. Avicenna J Med. 2018;8(1):1–13.
9. MacDonald NE, SAGE Working Group on Vaccine Hesitancy. Vaccine hesitancy: Definition, scope and determinants. Vaccine. 2015;33(34):4161–4.
10. Katz IT, Bogart LM, Fu CM, Liu Y, Cox JE, Samuels RC, Block CJ. Barriers to HPV vaccination among low-income, Black adolescent girls and young women. J Health Care Poor Underserved. 2021;32(1):428–45.

11. Abdullahi LH, Kagina BM, Ndze VN, Hussey GD, Wiysonge CS. Improving vaccination uptake among adolescents. Cochrane Database Syst Rev. 2019;1(1):CD011895.
12. Khan MS, Ali SA, Adelaine A. The role of religiosity in HPV vaccine uptake among Muslim communities in Europe: A scoping review. J Relig Health. 2021;60(4):2347–64.
13. Franklin MD, Schlundt DG, Wallston KA. Development and validation of a religious health fatalism measure for the African-American faith community. J Health Psychol. 2008;13(3):323–35.
14. Padela AI, Mohiuddin A. Ethical obligations and clinical goals in end-of-life care: Deriving a quality-of-life construct based on the Islamic concept of accountability before God (taklīf). Am J Bioeth. 2015;15(1):3–13.
15. Padela AI. Islamic medical ethics: A primer. Bioethics. 2013;27(3):131–5.
16. Razzaghi H, Masalovich S, Srivastav A. Parental attitudes and beliefs associated with child HPV vaccination. Am J Prev Med. 2021;60(5):679–87.
17. Gilkey MB, Calo WA, Moss JL, Shah PD, Marciniak MW, Brewer NT. Provider communication and HPV vaccination: The impact of recommendation quality. Vaccine. 2016;34(9):1187–92.
18. Reiter PL, Gerend MA, Gilkey MB, Perkins RB, Saslow D, Stokley S, Brewer NT. Advancing human papillomavirus vaccine delivery: 12 priority research gaps. Acad Pediatr. 2020;20(1):14–20.
19. Kenny DA, Kashy DA, Cook WL. Dyadic data analysis. New York: Guilford Press; 2006.
20. Kenny DA, Ledermann T. Detecting, measuring, and testing dyadic patterns in the actor-partner interdependence model. J Fam Psychol. 2010;24(3):359–66.
21. Creswell JW, Plano Clark VL. Designing and conducting mixed methods research. 3rd ed. Sage Publications; 2017.
22. Fetters MD, Curry LA, Creswell JW. Achieving integration in mixed methods designs—principles and practices. Health Serv Res. 2013;48(6 Pt 2):2134–56.
23. Rosenstock IM. The health belief model and preventive health behavior. Health Educ Monogr. 1974;2(4):354–86.
24. Ajzen I. The theory of planned behavior. Organ Behav Hum Decis Process. 1991;50(2):179–211.
25. Pew Research Center. U.S. Muslims concerned about their place in society, but continue to believe in the American dream. 2017.
26. Ackerman RA, Kenny DA. APIMPower: An interactive tool for actor-partner interdependence model power analysis. Behav Res Methods. 2016;48(3):1209–18.
27. Meites E, Szilagyi PG, Chesson HW, Unger ER, Romero JR, Markowitz LE. Human papillomavirus vaccination for adults: Updated recommendations of the Advisory Committee on Immunization Practices. MMWR Morb Mortal Wkly Rep. 2019;68(32):698–702.
28. Israel BA, Schulz AJ, Parker EA, Becker AB, Allen AJ, Guzman JR. Critical issues in developing and following community-based participatory research principles. In: Wallerstein N, Duran B, Oetzel JG, Minkler M, editors. Community-based participatory research for health: Advancing social and health equity. 3rd ed. Jossey-Bass; 2018. p. 31–46.

29. Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the process of cross-cultural adaptation of self-report measures. Spine. 2000;25(24):3186–91.
30. Ryder AG, Alden LE, Paulhus DL. Is acculturation unidimensional or bidimensional? A head-to-head comparison in the prediction of personality, self-identity, and adjustment. J Pers Soc Psychol. 2000;79(1):49–65.
31. Koenig HG, Büssing A. The Duke University Religion Index (DUREL): A five-item measure for use in epidemiological studies. Religions. 2010;1(1):78–85.
32. McRee AL, Gilkey MB, Dempsey AF. HPV vaccine hesitancy: Findings from a statewide survey of health care providers. J Pediatr Health Care. 2014;28(6):541–9.
33. Shapiro GK, Tatar O, Dube E, Amsel R, Knauper B, Naz A, Zimet G. The vaccine hesitancy scale: Psychometric properties and validation. Vaccine. 2018;36(5):660–7.
34. Brewer NT, Chapman GB, Rothman AJ, Leask J, Kempe A. Increasing vaccination: Putting psychological science into action. Psychol Sci Public Interest. 2017;18(3):149–207.
35. Muthén LK, Muthén BO. Mplus user's guide. 8th ed. Muthén & Muthén; 2017.
36. Enders CK. Applied missing data analysis. Guilford Press; 2010.
37. Hu LT, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. Struct Equ Modeling. 1999;6(1):1–55.
38. Patton MQ. Qualitative research & evaluation methods. 4th ed. Sage Publications; 2015.
39. Hennink MM, Kaiser BN, Marconi VC. Code saturation versus meaning saturation: How many interviews are enough? Qual Health Res. 2017;27(4):591–608.
40. Braun V, Clarke V. Thematic analysis: A practical guide. Sage Publications; 2022.
41. Lincoln YS, Guba EG. Naturalistic inquiry. Sage Publications; 1985.
42. Guetterman TC, Fetters MD, Creswell JW. Integrating quantitative and qualitative results in health science mixed methods research through joint displays. Ann Fam Med. 2015;13(6):554–61.
43. Bowen M. Family therapy in clinical practice. Jason Aronson; 1978.
44. Ajrouch KJ. Resources and well-being among Arab-American elders. J Cross Cult Gerontol. 2007;22(2):167–82.
45. Orenstein WA, Hinman AR. The immunization system in the United States—The role of school immunization laws. Vaccine. 2017;35(Suppl 3):S19–24.
46. Bogart LM, Cowgill BO, Elliott MN, Klein DJ, Hawes-Dawson J, Uyeda K, Schuster MA. A randomized controlled trial of students for nutrition and exercise: A community-based participatory research study. J Adolesc Health. 2013;53(3):415–22.
47. Rispler-Chaim V. Islamic medical ethics in the twentieth century. Brill; 1993.
48. Auda J. Maqasid al-Shariah as philosophy of Islamic law: A systems approach. International Institute of Islamic Thought; 2007.
49. Sachedina A. Islamic biomedical ethics: Principles and application. Oxford University Press; 2009.

50. Hasnain M, Connell KJ, Menon U, Tranmer PA. Patient-centered care for Muslim women: Provider and patient perspectives. J Womens Health. 2011;20(1):73–83.
51. Puri N, Coomes EA, Haghbayan H, Gunaratne K. Social media and vaccine hesitancy: New updates for the era of COVID-19 and globalized infectious diseases. Hum Vaccin Immunother. 2020;16(11):2586–93.
52. Matsaganis MD, Katz VS, Ball-Rokeach SJ. Understanding ethnic media: Producers, consumers, and societies. Sage Publications; 2010.
53. Padela AI, Gunter K, Killawi A. Meeting the healthcare needs of American Muslims: Challenges and strategies for healthcare settings. Institute for Social Policy and Understanding; 2015.
54. Han PK, Moser RP, Klein WM. Perceived ambiguity about cancer prevention recommendations: Associations with cancer-related perceptions and behaviours in a US population survey. Health Expect. 2015;20(1):92–105.
55. Kirmayer LJ. Cultural competence and evidence-based practice in mental health: Epistemic communities and the politics of pluralism. Soc Sci Med. 2012;75(2):249–56.
56. Montaño DE, Kasprzyk D. Theory of reasoned action, theory of planned behavior, and the integrated behavioral model. In: Glanz K, Rimer BK, Viswanath K, editors. Health behavior: Theory, research, and practice. 5th ed. Jossey-Bass; 2015. p. 95–124.
57. Peretz PJ, Matiz LA, Findley S, Lizardo M, Evans D, McCord M. Community health workers as drivers of a successful community-based disease management initiative. Am J Public Health. 2012;102(8):1443–6.
58. Durand MA, Carpenter L, Dolan H, Bravo P, Mann M, Bunn F, Elwyn G. Do interventions designed to support shared decision-making reduce health inequalities? A systematic review and meta-analysis. PLoS One. 2014;9(4):e94670.
59. McLeroy KR, Bibeau D, Steckler A, Glanz K. An ecological perspective on health promotion programs. Health Educ Q. 1988;15(4):351–77.
60. Wallerstein NB, Duran B. Community-based participatory research contributions to intervention research: The intersection of science and practice to improve health equity. Am J Public Health. 2010;100(Suppl 1):S40–6.
61. Glasgow RE, Harden SM, Gaglio B, Rabin B, Smith ML, Porter GC, Estabrooks PA. RE-AIM planning and evaluation framework: Adapting to new science and practice with a 20-year review. Front Public Health. 2019;7:64.

Tables

Tables 1 to 5 are available in the supplementary files section

Figures

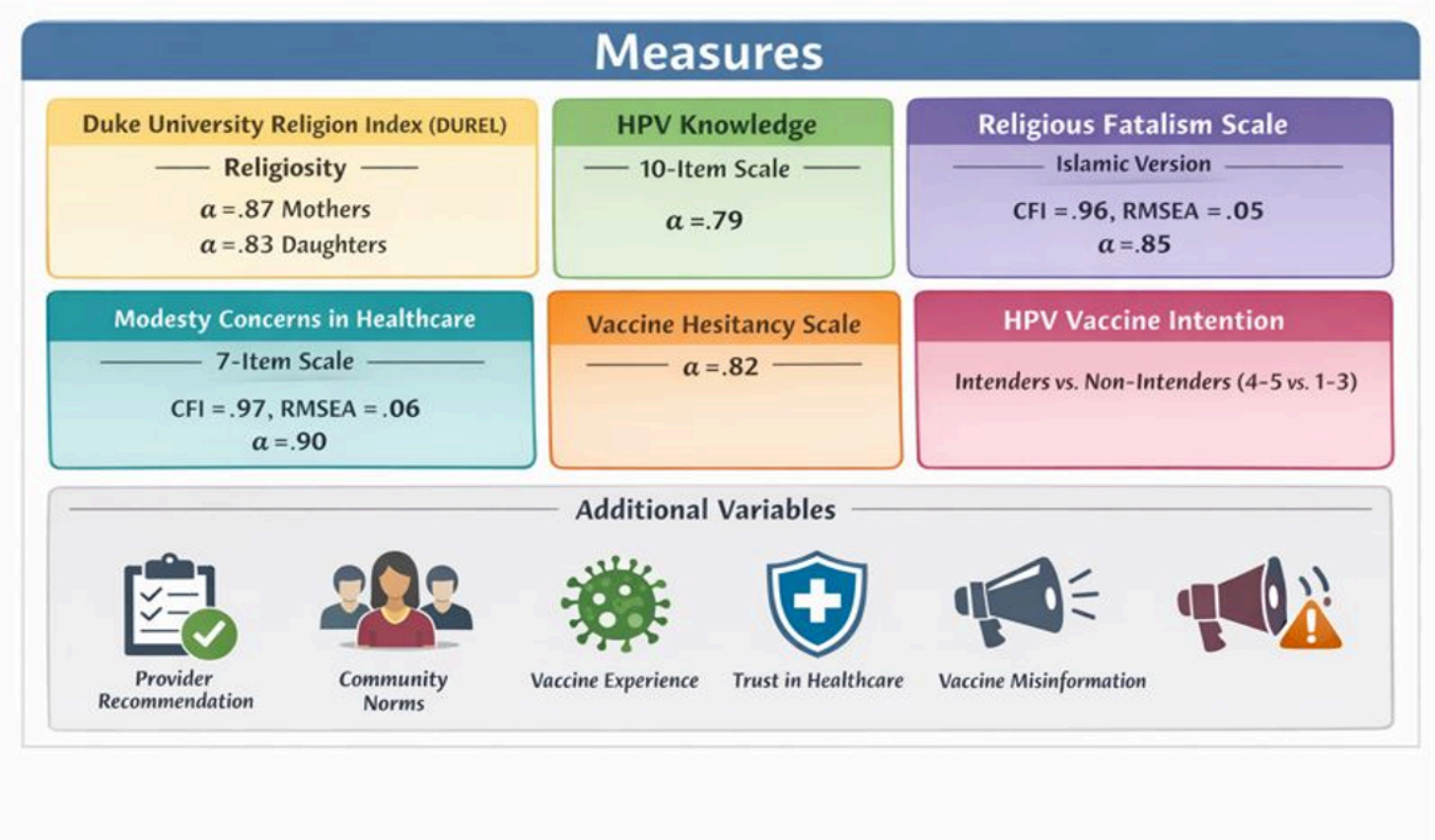


Figure 1

Measures

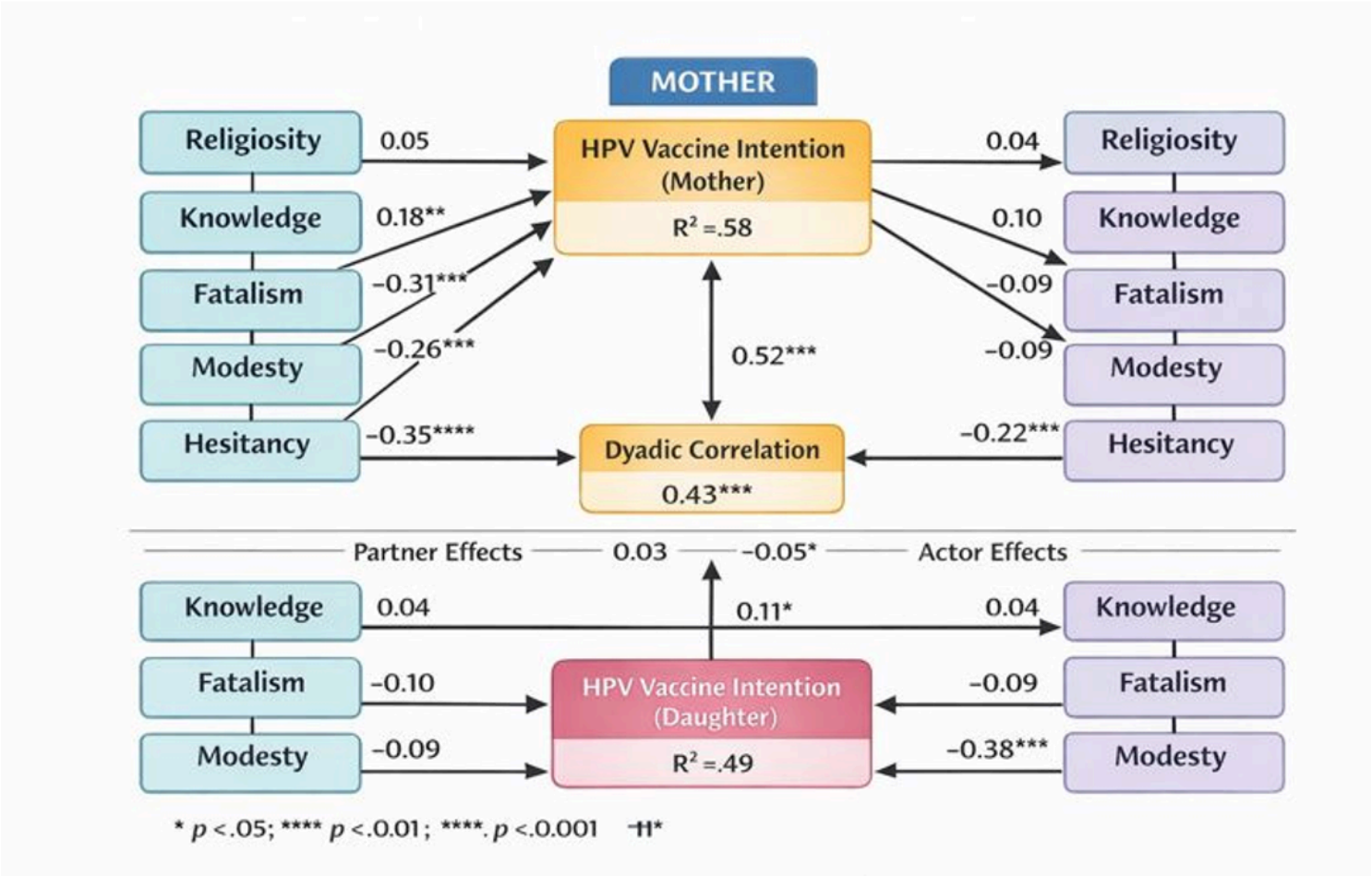


Figure 2

APIM Path Diagram with Standardized Coefficients

Note: Only statistically significant partner effects shown (mother→daughter: fatalism -0.17, modesty -0.14). Covariates and non-significant paths omitted for clarity. p < .05, p < .01**, p < .001**.



Figure 3

Thematic Map of Qualitative Findings

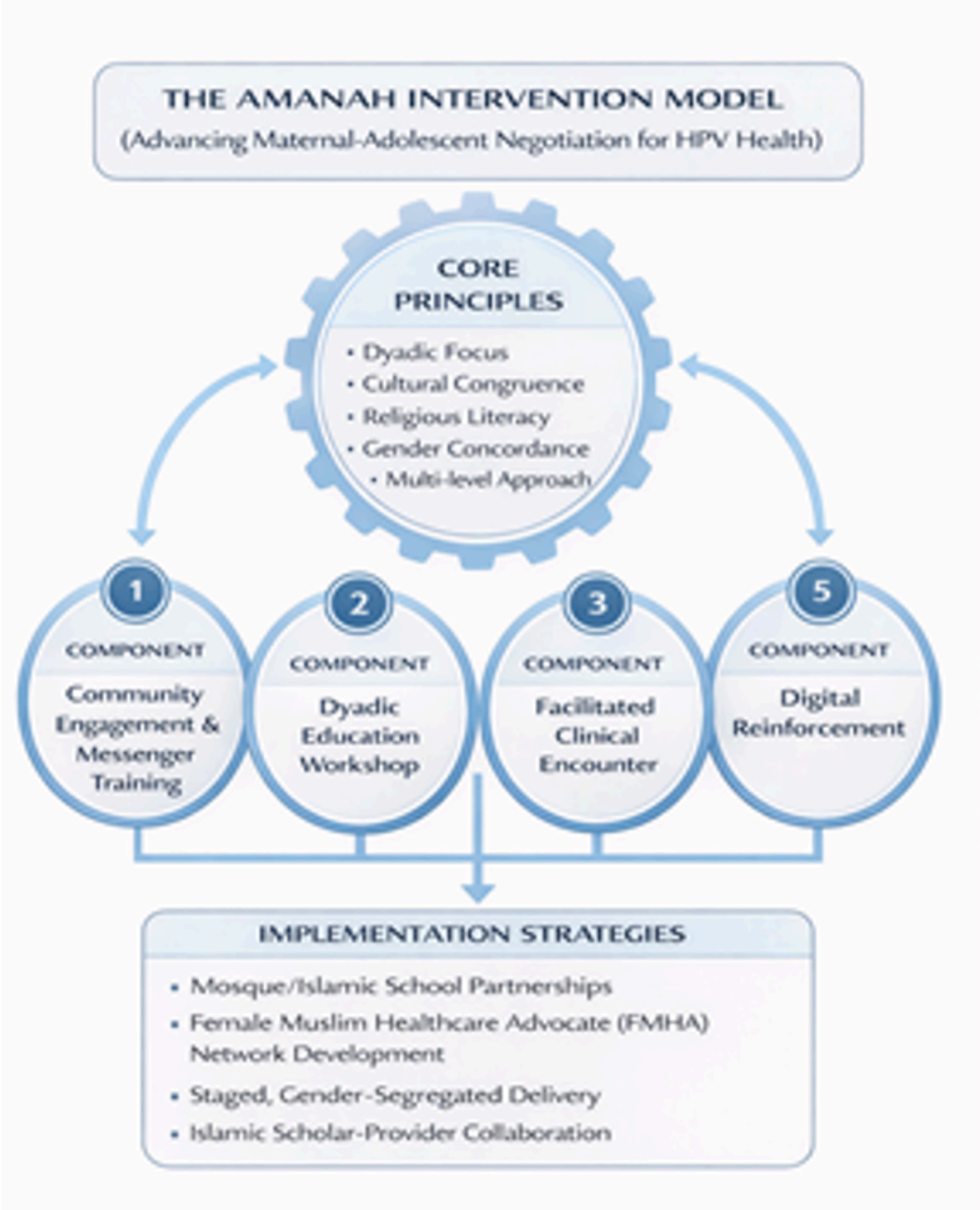


Figure 4

The AMANAH Intervention Model

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Tables.docx

- SupplementaryFile1.pdf
- SupplementaryFile2.pdf