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Psychological Determinants of COVID-19 Vaccination Uptake among Pregnant Women in Kenya: A Comprehensive Model Integrating Health Belief Model Constructs, Anticipated Regret, and Trust in Health Authorities

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Abstract: Pregnant women, considered at risk of COVID-19 complications because of the immunosuppressive and physiological changes in pregnancy, were initially hesitant to receive COVID-19 vaccination. This study assessed the association between COVID-19 vaccination uptake, psychological determinants (health belief model (HBM) constructs, anticipated regret, trust in health authorities), and provider recommendation among pregnant women in Kenya. Using data from a cross-sectional study, we conducted correlations, binary and multivariable logistic regressions, and moderation analysis to explore relationships between COVID-19 vaccination and psychological variables. Of the 115 pregnant women, 64% reported receiving provider recommendations for COVID-19 vaccination. There were weak positive correlations between the variables. Participants with high anticipated regret scores were more likely to receive COVID-19 vaccination compared to their peers (AOR = 4.27; 95% CI, 1.23–14.85), while provider recommendation increased the odds of COVID-19 vaccination (OR = 3.70; 95% CI, 1.53–8.92). None of the HBM constructs were significantly associated with COVID-19 vaccination. The findings related to psychological variables require the reconceptualization of theory-informed interventions to streamline healthcare provision. The critical role of healthcare providers in COVID-19 vaccination recommendations suggests a need to empower health practitioners with effective communication skills to improve maternal health outcomes.

Keywords: vaccine hesitancy; COVID-19 vaccination; health belief model; anticipated regret; provider recommendation; trust; pregnant women; Kenya

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1. Introduction

In March 2020, the World Health Organization (WHO) declared the coronavirus disease 2019 (COVID-19) a global pandemic [1]. By December 2020, regulatory agencies in the United States and the United Kingdom granted emergency use authorization for the first COVID-19 vaccine following safety, quality, and efficacy data from clinical trials [2–4]. Compared to other COVID-19 prevention and mitigation strategies, COVID-19 vaccination is among the most effective strategies in protecting against COVID-19-related respiratory complications and controlling the spread of COVID-19 [5–7].

Although studies have shown that pregnant women have a higher risk of COVID-19-related complications compared to non-pregnant women [8], delayed recommendations for COVID-19 vaccine uptake during pregnancy by WHO and other regulatory bodies due

to insufficient safety data led many pregnant women to avoid COVID-19 vaccines [9–11]. Clinical studies revealed that COVID-19 vaccination during pregnancy was safe and effective [12,13] and minimized the risk of COVID-19-related intensive care unit admissions, respiratory intubations, preterm births, or deaths among vaccinated pregnant women [8].

COVID-19 vaccines became available in Kenya in 2021 through the COVID-19 Vaccines Global Access Facility (COVAX) initiative and are currently approved for all individuals 12 years and older [14,15]. The Kenya Obstetrical Gynecological Society (KOGS) also recommends COVID-19 vaccination among pregnant women regardless of gestational age [16]. Similar to other upper-middle-class countries, Kenya utilized digital communication strategies to disseminate information about COVID-19 and COVID-19 vaccination [17]. Communication about COVID-19 was conducted via daily situation reports from the Ministry of Health through their website [14] and daily press briefings via television and radio. The shift to more virtual communication was due to restrictions on public gatherings to mitigate the spread of COVID-19 [14]. However, misinformation through social media channels and reduced community engagements influenced the rollout of COVID-19 vaccination and vaccine uptake among some populations [10].

While several health agencies across the globe recommended and approved vaccination [2–4], COVID-19 vaccine hesitancy during pregnancy was observed in various countries. Specifically, pregnant women in Ethiopia (60%) [18] and Thailand (39.2%) [19] were initially unwilling to receive COVID-19 vaccination, while in Cameroon, less than one-third of pregnant women in one study expressed willingness to accept the COVID-19 vaccination [20].

Few studies, however, have reported determining factors associated with COVID-19 vaccine behaviors among pregnant women [18,20–22]. The deterrents to COVID-19 vaccination ranged from perceptions to pragmatic limitations in countries and health facilities. One multi-country study reported that pregnant women with vaccine safety concerns and a lack of trust in COVID-19 vaccines had a higher likelihood of vaccine refusal [23]. Pregnant women in Qatar reported the unavailability of COVID-19 vaccines as a barrier to COVID-19 vaccination [21].

The Health Belief Model (HBM) has been utilized in international studies as a parsimonious theoretical framework for understanding COVID-19 vaccination [24,25]. Having been developed in the early 1950s, HBM assumes that decision-making around health behaviors is based on the individual perceptions of vulnerability, the severity of an illness, and the combined costs and benefits of engaging in the behavior [26]. Anticipated regret of inaction towards a healthy behavior is likely to encourage vaccination, and trust in health authorities is likely to influence vaccination behaviors [26]. Several studies have identified specific HBM constructs, including perceived susceptibility, perceived barriers, perceived benefits, and self-efficacy, as significant factors associated with the uptake and intention to receive COVID-19 vaccination [27,28]. However, few studies have examined how the specific HBM constructs, anticipated regret, and trust in health authorities are associated with COVID-19 vaccination during pregnancy.

Prior comprehensive research on vaccination suggests that even though low perceived susceptibility could influence vaccine hesitancy, healthcare professionals played a critical role in boosting vaccine confidence and uptake [29]. While healthcare providers in Kenya influence COVID-19 vaccination behaviors [30], it is unclear whether healthcare provider recommendations influence the strength of association between HBM constructs, anticipated regret and trust in health authorities, and COVID-19 vaccination uptake among pregnant women in Kenya. The aim of this study is to examine how HBM constructs, anticipated regret, and trust in health authorities as psychological factors are associated with COVID-19 vaccination among pregnant women in Kenya. A secondary objective is to assess if healthcare provider recommendation moderated the relationship between COVID-19 vaccination status and the psychological constructs included in the study.

2. Materials and Methods

2.1. Study Design

This study utilizes data from a cross-sectional online survey on COVID-19 vaccination conducted in Kenya between May and October 2022 [31]. The study participants were pregnant women who reported their vaccination status, perceptions about COVID-19 vaccination, and behaviors related to COVID-19 prevention using a self-administered online questionnaire adapted from the Centers for Disease Control and Prevention (CDC) National Immunization Survey—Adult COVID-19 module (NIS-ACM) (CDC, 2021). The study used the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) as the reporting guidelines [32].

2.2. Study Sample

Pregnant women at Kenyatta National Hospital (Nairobi) and Moi Teaching and Referral Hospital (Uasin Gishu) were recruited for the study. The inclusion criteria for eligible participants were (a) any adult pregnant woman (18–49 years old) living in Kenya, (b) an individual with access to a mobile device and WhatsApp, and (c) those who provided consent to participate in the study. The analytic sample included 115 pregnant women in Kenya. Specific study details are outlined in a prior study [24,31].

2.3. Measures

2.3.1. Dependent Variable

The primary outcome variable was COVID-19 vaccination status. This was measured by the question, "Have you received at least one dose of a COVID-19 vaccine?". The response options to this variable—"Yes", "No", or "Not sure"—were then coded as a dichotomous outcome (Y/N). We assigned the "Not sure" response to Y/N based on follow-up responses to the questions addressing vaccine brand, number of doses, and date of vaccination.

2.3.2. Independent Variables

Primary exposure variables included HBM constructs (perceived susceptibility, perceived barriers, perceived benefits, and self-efficacy), anticipated regret, and trust in health authorities. Most independent variables were scored on a four-point Likert scale, such as (very strongly disagree—1) to (very strongly agree—4). Perceived susceptibility was measured by self-report to the following question: "How concerned are/were you about getting COVID-19?". Perceived barriers were measured by self-report to the following question: "How difficult would it be /was it for you] to get a COVID-19 vaccine?". Anticipated regret was measured by self-report to the following question: "If I do not get/had not gotten a COVID-19 vaccine, I will regret/would have regretted it". Trust was measured by self-report to the following question: "How much do you trust the public health agencies (Ministry of Health) that recommend COVID-19 vaccines?". Single-item variables had scores ranging from 1 to 4, while multi-item variables had scores ranging from 1–8 based on the cumulative scores.

2.3.3. Covariates

Based on previous studies [24,33], the following sociodemographic factors were included as covariates: age (categorized as 18–24 years, 24–29 years, 30–39 years, and 40–49 years); education level completed (primary school, secondary school, and college); region (Nairobi and Uasin Gishu), and insurance status (insured and uninsured).

2.3.4. Effect Modification

Provider recommendation for COVID-19 vaccines was considered an effect modifier in the final analysis. Participants were asked, "Has/did a doctor, nurse, or another health professional ever recommend that you get a COVID-19 vaccine?". The answers were coded as 0 for "No" and 1 for "Yes".

2.4. Ethics

Ethical approval to conduct the study was obtained from the University of Texas Health Science Center Houston Institutional Review Board (IRB)-(HSC-SPH-21-0997). Approval for the parent study was also granted by the Moi University/Moi Teaching and Referral Hospital Institutional Research (MTRH/MU IREC/092/2022) and Ethics Committee and the University of Nairobi/Kenyatta National Hospital Ethics Review Board (KNH-UoN P98/02/2022). Permission was also granted by the National Commission for Science, Technology, and Innovation (NACOSTI), Nairobi and Uasin Gishu counties in Kenya.

2.5. Statistical Analysis

Descriptive analyses summarized all demographic, dependent, and independent variables. Categorical and binary variables were expressed as frequencies and percentages, while means ± standard deviations were used to express continuous variables. T-tests determined differences in independent variables by vaccination status. To ensure that the independent variables were not correlated, we tested for collinearity using variance inflation factor (VIF), where values of less than one indicated no correlation.

Each independent variable was re-categorized for logistic regression analyses as a binary variable (high/low). For example, Likert scale scores were recoded as dichotomous variables such that lower scores (1 and 2) were recoded as 0 and higher scores (3 and 4) as 1. Bivariate and multivariable analyses were performed using logistic regression to determine the factors associated with COVID-19 vaccination. Associations were expressed as odds ratio (OR) or adjusted odds ratio (AOR) and included 95% confidence intervals (CI). Covariates (age, education) were dummy-coded and included in the analyses to control for potential confounding. Using a 95% CI, a two-tailed p-value of <0.05 was considered statistically significant. Moderation analyses determined the effect of the provider recommendation of each independent variable on COVID-19 vaccination uptake. Figure 1 depicts the conceptual model of provider recommendation as a moderating role in the relationship between psychological factors and COVID-19 vaccination. All statistical analyses were performed using STATA SE 18 [34].

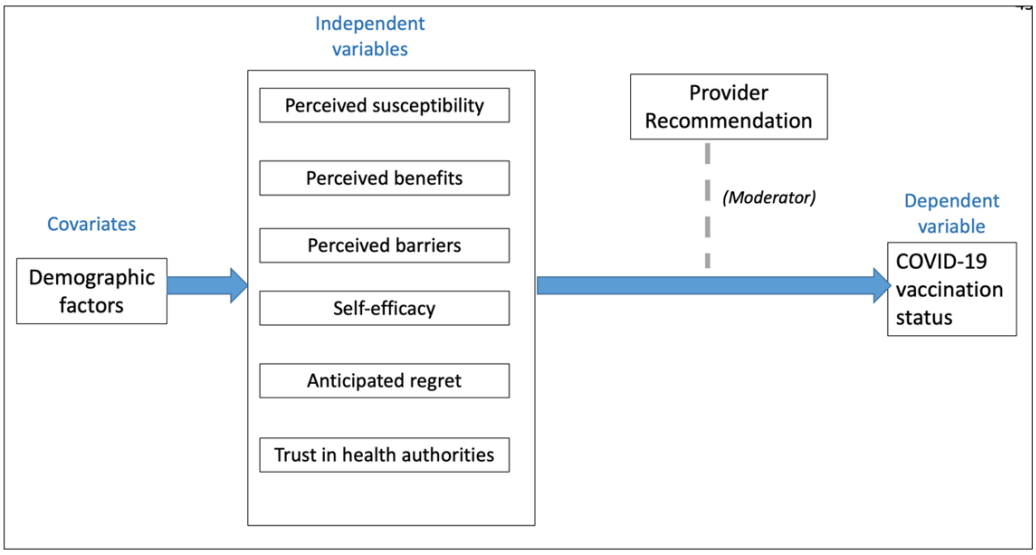

Figure 1. Conceptual model depicting provider recommendation as a moderator between the independent variables and COVID-19 vaccination.

3. Results

3.1. Descriptive Characteristics

Among the 115 pregnant women, most were vaccinated (73%) and were aged 25–29 years (39%) and 30–39 years (39%). All study participants had some formal education, with 68% (n = 78) having a college- or university-level education. A total of 85 study participants (74%) had health insurance. Almost two-thirds (64%) of the pregnant women reported receiving recommendations for COVID-19 vaccination from a healthcare provider. The sociodemographic characteristics of the participants are displayed in Table 1.

Table 1. Demographic characteristics of pregnant women in Kenya.

Variable	N (%)
Vaccination Status	
Vaccinated	31 (27)
Unvaccinated	84 (73)
Age	
18–24 years	19 (17)
25–29 years	45 (39)
30–39 years	45 (39)
40–49 years	6 (5)
Education level	
Primary school	3 (3)
Secondary School	34 (29)
College/University	78 (68)
Region	
Nairobi	59 (51)
Uasin Gishu	56 (49)
Insurance Status	
Insured	85 (74)
Uninsured	30 (26)
Health Provider Recommendation	
Yes	72 (64)
No	40 (36)

3.2. Socio-Psychological Factors among Pregnant Women in Kenya

Vaccinated study participants had slightly higher mean scores in perceived susceptibility (mean = 3.64; Std. dev. = 0.72) to COVID-19 infections compared to unvaccinated respondents (mean = 3.52; Std. dev. = 0.93), though the difference was not statistically significant. There were significant differences in anticipated regret mean scores between the vaccinated (2.65 $\pm$ 1.01) and unvaccinated groups (1.76 $\pm$ 0.91). Vaccinated pregnant women had higher mean scores in trust (6.61 $\pm$ 1.60, $p < 0.01$) compared to the unvaccinated group (5.13 $\pm$ 2.40, $p < 0.01$). Table 2 presents the mean scores of the psychological variable and the differences between vaccination groups.

Table 2. The mean ± SD of psychological factors influencing COVID-19 vaccination.

Variable	Mean (SD)				
	Vaccinated	Unvaccinated	t	Mean Difference	*p*-Value
Perceived susceptibility	3.64 ± 0.72	3.52 ± 0.93	−0.77	−0.13	0.44
Perceived barriers	5.19 ± 2.50	5.03 ± 3.36	−0.27	−0.16	0.78
Perceived benefits	2.67 ± 0.55	2.45 ± 0.81	−1.63	−0.22	0.11
Self-efficacy	3.02 ± 0.80	2.86 ± 0.83	−0.93	−0.16	0.35
Anticipated regret	2.65 ± 1.01	1.76 ± 0.91	−4.21	−0.89	0.01 *
Trust	6.61 ± 1.60	5.13 ± 2.40	−3.81	−1.48	0.01 *

* Statistically significant: p < 0.05.

3.3. Correlation Analyses

Correlation analysis indicated that most psychological factors were positively correlated, though the magnitude was minimal. While there was a negative correlation between self-efficacy and the HBM constructs, the correlations were very weak and not statistically significant. There were weak positive correlations between self-efficacy, anticipated regret, and trust. See Table 3 for more information.

Table 3. Correlation between psychosocial variables.

	Perceived Susceptibility	Perceived Barriers	Perceived Benefits	Self-Efficacy	Anticipated Regret	Trust
Perceived Susceptibility	1					
Perceived barriers	0.01	1				
Perceived benefits	0.13	0.10	1			
Self-efficacy	−0.11	−0.15	−0.01	1		
Anticipated regret	0.05	0.17	0.17	0.24	1	
Trust	0.06	0.13	0.01	0.36 *	0.34 *	1

* Correlation significant at 0.01 level.

3.4. Associations between Psychological Factors Associated with COVID-19 Vaccination and Vaccination Status among Pregnant Women in Kenya

Logistic regression results are presented in Table 4. HBM constructs (perceived susceptibility, perceived barriers, perceived benefits, and self-efficacy) were not associated with COVID-19 vaccination. Pregnant women who had higher scores of anticipated regret were 4.46 times more likely than their unvaccinated peers to be vaccinated (OR = 4.46; 95% CI 1.55–12.83), while those who trusted health authorities were 4.19 times more likely to be vaccinated against COVID-19 (OR = 4.19; 95% CI 1.60–10.96). HBM constructs were not significantly associated with COVID-19 vaccination. We then included all psychological variables for the adjusted model while controlling for demographic characteristics. None of the HBM constructs or trust in authorities were significant. Anticipated regret was associated with COVID-19 vaccination, where those with high anticipated regret scores were 4.27 times more likely to receive COVID-19 vaccination compared to those with lower anticipated regret scores (AOR = 4.27; 95% CI, 1.23–14.85, $p = 0.02$).

In the adjusted model, those with higher self-efficacy scores had 5% lower odds of receiving COVID-19 vaccination, although this association was not statistically significant. All other variables were not significant. Vaccinated pregnant women were 3.7 times more likely to have received provider recommendation (OR = 3.70; 95% CI, 1.53–8.92; $p > 0.01$).

Table 4. Psychological factors associated with COVID-19 vaccination among pregnant women in Kenya.

Variable	OR (95% CI)	aOR (95% CI)
Perceived susceptibility	1.42 (0.44–4.55)	1.54 (0.38–6.30)
Perceived barriers	2.12 (0.88–5.09)	1.58 (0.53–4.75)
Perceived benefits	1.30 (0.54–3.10)	1.14 (0.40–3.23)
Self-efficacy	1.77 (0.71–4.45)	0.96 (0.28–3.29)
Anticipated regret	4.46 (1.55–12.83) *	4.27 (1.23–14.85) *
Trust	4.19 (1.60–10.96) *	2.27 (0.61–8.41)
Age		
18–24 years	2.5 (0.71–8.75)	4.87 (0.99–23.86)
25–29 years	Ref	Ref
30–39 years	3.08 (1.17–8.13) *	2.84 (0.96–8.42)
40–49 years	3.33 (0.36–30.95)	**
Education level		
Primary school	0.17 (0.01–2.01)	0.68 (0.22–2.13)
Secondary School	0.96 (0.38–2.39)	1.02 (0.02–66.83)
College/University	Ref	Ref
Region		
Nairobi	Ref	Ref
Uasin Gishu	1.17 (0.51–2.68)	1.06 (0.38–2.94)
Insurance Status		
Insured	1.22 (0.49–3.08)	1.89 (0.54–6.62)
Uninsured	Ref	Ref
Health Provider Recommendation		
Yes	3.70 (1.53–8.92) *	3.22 (1.27–8.16) [a]
No	Ref	Ref

* Statistically significant (p-value < 0.05). ** Missing data due to successful predictions. [a] Only with demographic variables.

3.5. Effect of Provider Recommendation on COVID-19 Vaccination by Psychological Factors

Moderation analysis confirmed that provider recommendation moderated the relationship between COVID-19 vaccination and higher trust in health authorities ($\beta = 2.66$; $p < 0.02$). With provider recommendation, high levels of trust in health authorities had a positive effect on COVID-19 vaccine uptake. For the other psychological variables, no interaction effects were significant.

4. Discussion

This study explored the relationship between constructs from the health belief model—HBM (perceived susceptibility, perceived barriers, perceived benefits, and self-efficacy), including anticipated regret and trust in health authorities with COVID-19 vaccination. Our study findings indicated that none of the HBM constructs were associated with COVID-19 vaccination uptake. Anticipated regret was significantly associated with COVID-19 vaccination during pregnancy. Provider recommendation influenced the strength of the association between COVID-19 vaccination uptake and trust in health authorities, suggesting the critical role of healthcare providers in vaccine decision-making.

Consistent with prior research, we found that perceived susceptibility to COVID-19 was not associated with COVID-19 vaccination [27]. Although the vaccinated group had slightly higher scores of perceived risk of COVID-19 infections, the difference was not significant. The realization that one could recover from COVID-19 may have likely impacted the reluctance to get vaccinated, especially with novel vaccinations that underwent fast-track development [35]. Participants in the present study were concerned about getting infected with COVID-19, results that were similar to prior studies [36,37]. However, perceived susceptibility in this study was not associated with COVID-19 vaccination, which perhaps underscores other factors in the lives of pregnant women in Kenya. Perhaps pregnant women felt that COVID-19 vaccines were unsafe, as reported in prior research [31], and were unwilling to be vaccinated despite having higher perceived risk of COVID-19 infections. It is also likely that individual perceptions about COVID-19 such as relatively lower mortality rates in Kenya compared to COVID-19-related fatalities in the United States, Europe, and India [1] might have contributed to low COVID-19 vaccination rates among pregnant women in Kenya.

According to the Health Belief Model, perceived barriers such as negative information, cost, or transportation issues can minimize the chances of engaging in a behavior [38,39]. In this study, although the pregnant women articulated barriers such as receiving negative information about COVID-19 vaccines, there were no significant differences between the vaccinated and unvaccinated groups. It was also unusual that the vaccinated group had higher perceived barrier scores than the unvaccinated group. Unlike previous studies that showed that COVID-19 vaccination was associated with perceived benefits [27] and perceived barriers [40], our results did not show any significant relationship between perceived barriers/benefits and COVID-19 vaccination uptake. The lack of association could be due to agency among pregnant women, who may have felt a responsibility to protect themselves and their unborn children despite various obstacles they faced. It is also possible that though a few women acknowledged vaccine benefits, skepticism about the novel vaccine [30] or the vaccine unavailability of preferred brands [14] may have contributed to low vaccine uptake.

Vaccine hesitancy, a global public health threat [41], has arisen due to diminishing trust in health authorities. Past medical malpractices among certain vulnerable populations have led to speculations around novel health interventions including vaccination [42]. However, pregnant women in this study with higher trust in health authorities had 400% higher odds of COVID-19 vaccination than those with lower trust, suggesting the critical role public authorities such as the Ministry of Health play in advocating, recommending and providing vaccination. Our results confirmed prior research showing that trust in healthcare providers can influence COVID-19 vaccination [43] and that healthcare professionals are the most trusted information source for vaccination [29].

Anticipated regret was the only determinant significantly associated with COVID-19 vaccination in the bivariate and multivariable logistic regression models, as pregnant women with high anticipated regret had four times higher odds of being vaccinated than those with low anticipated regret. Additional research showed that pregnant respondents with lower anticipated regret towards maternal vaccinations had lower vaccine intention [43,44]. A recent scoping review on the role of anticipated regret in vaccine decision-making [45] showed that anticipated regret plays a role in vaccination behaviors and should be included in interventions. Prior studies demonstrated that trust in health authorities [29,46,47] and anticipated regret [44] can influence vaccination uptake.

Excluding pregnant women from initial vaccine trials prompted patient–provider decision-making on COVID-19 vaccination based on individual risk during pregnancy [9,48]. Results from a systematic review examining vaccination decision-making indicated that pregnant women were 10 to 12 times more likely to receive a vaccine following healthcare provider recommendations [49]. Our results showed the impact of healthcare providers in recommending COVID-19 vaccination to pregnant women, as those who received recommendations were three times more likely to be vaccinated. Prior studies showed

that pregnant women received little to no information about COVID-19 vaccines from their physicians or other medical professionals, even though some women might have needed advice to make informed decisions [30,50]. Though public health entities urged pregnant women to discuss COVID-19 vaccination with their respective healthcare providers, many did not receive that information.

The findings accentuate the need for medical providers to spend time with their pregnant patients to discuss other preventative measures beyond regular prenatal checkups, such as vaccinations [49]. While providers have expressed concern about short visits with their pregnant patients due to high demand, health facilities could implement other strategies for effectively engaging with pregnant women in health-promotive behaviors. The results of this study highlight the gaps in public health interventions that target specific aspects, such as increasing knowledge or supplies, but fail to acknowledge the critical role of empowering providers to communicate effectively with their patients. The successful implementation of maternal healthcare policies requires collaborative efforts with all stakeholders.

Study outcomes showed that pregnant women who received recommendations for COVID-19 vaccination appeared to have more trust in health authorities, thus increasing their uptake of COVID-19 vaccines. The effect of provider recommendation on trust in health authorities is essential, especially among vulnerable populations, to help buffer poor health outcomes resulting from medical malpractices or institutional distrust [42].

Strengths and Limitations

The study demonstrated that determinants associated with COVID-19 vaccination behaviors, such as trust and anticipated regret among pregnant women, can be used to develop future interventions that target these psychological factors related to preventive behaviors during pregnancy. These research findings provide insight into the role of provider recommendations for vaccination during pregnancy. The high vaccination rates from this study sample do not reflect rates among pregnant women who do not seek treatment in hospitals, live in areas with limited access to COVID-19 vaccines, or have lower education levels; therefore, the study outcomes should be applied cautiously. Further, the convenience sampling method and the use of online surveys likely led to selection bias, as those without access to the Internet were excluded. The study used single items to assess some determinants that may not reflect the psychological factor accurately. Future studies should consider using a larger cohort and include multiple-item scales to examine if there would be any trends in psychological determinants, especially with new vaccines.

5. Conclusions

Anticipated regret and trust in health authorities can influence vaccination. Future studies should explore and include more items and validated scales to examine the HBM constructs appropriately. The findings accentuate the critical role of healthcare providers in vaccination decision-making and can be utilized as significant advocates in championing preventive behaviors in the prenatal and postpartum periods with their obstetric patients. The effect of provider recommendation on trust in health authorities suggests that appropriate and effective communication, especially among vulnerable populations, can attenuate vaccine hesitancy.

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Informed Consent Statement: Written informed consent was obtained from the patient(s) to publish this paper.

Data Availability Statement: Raw data used in this study, including de-identified participant data and survey results, are available upon request.

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