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ORIGINAL RESEARCH

Effects of Direct and Indirect Factors on Attitude toward the COVID-19 Vaccine in Pregnant Women

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Article Info	Abstract
	Background: The administration of the COVID-19 vaccine is facing resistance from pregnant women, leading to a lower attitude toward vaccination uptake. Previous studies have explored several factors that contributed to the issue. However, no studies have investigated further the direct and indirect effects of factors that simultaneously influence attitudes toward the COVID-19 vaccine in pregnant women. **Purpose:** This study aimed to investigate the direct and indirect effects of factors that influence attitudes toward the COVID-19 vaccine (ACV) in pregnant women, particularly hesitancy, motivation, and history of COVID-19 infection (HCI), and to describe a pathway model that represents the effects. **Methods:** This cross-sectional study recruited 440 pregnant women living in Bekasi and Pandeglang, Indonesia, in May–June 2022 using consecutive sampling methods. This study employed the Motivations of Vaccination Questionnaire, the Reasons for Hesitation Questionnaire, and the Attitudes toward COVID-19 Vaccine Questionnaire. A path analysis was performed to calculate the data. **Results:** Hesitancy had a more indirect effect (β=-0.270; p=0.00) than the direct effect (β=-0.193; p=0.00) on ACV, whereas motivation had a more direct effect (β=0.092; p=0.04) than the indirect effect (β=0.074; p=0.00). HCI acted as the mediation variable because it could intercede with the effect of hesitancy on ACV (β=-0.449; p=0.00). It indicated that HCI in pregnant women would lead to a different approach to increasing ACV. **Conclusions:** All studied factors had significant impacts on ACV, both directly and indirectly. It is recommended that interventions be adjusted according to the program's purpose, with the aim of increasing motivation or reducing hesitancy.

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1. Introduction

The COVID-19 outbreak has affected Indonesia since March 2020. Various efforts have been made to implement health protocols to prevent its worsening. These efforts have included washing hands, using masks, maintaining physical distance, and applying large-scale social restrictions (Djalante et al., 2020; Rhatomy & Prasetyo, 2020; World Health Organization & United Nations Children's Fund, 2020). The rapidly spreading global pandemic triggered the urgency to develop other innovative efforts, particularly the research and development of COVID-19 vaccines to prevent morbidity and reduce mortality due to COVID-19 (Joubert et al., 2022). Through vaccines, the expectation of controlling the pandemic can be achieved as they effectively maintain the body's immunity (Mahmud et al., 2021). Even so, the vaccine's effectiveness in controlling the pandemic situation can only be attained if the public acceptance of the vaccines is quite high (Alamer et al., 2021).

Pregnant women are a vulnerable group with a high risk of exposure to COVID-19, so protection efforts are needed to administer safe vaccinations based on existing evidence (Fakari & Simbar, 2020). The government has legalized COVID-19 immunization for pregnant women by announcing the Circular Letter of HK.02.01/I/2007/2021 concerning COVID-19 vaccination for pregnant women and screening adjustments in the implementation of COVID-19 vaccination (Halu et al., 2022). This announcement is a milestone of trust in COVID-19 vaccination, especially for pregnant women. The vaccine also helps to ensure that the fetus has antibodies to COVID-19, which are transmitted vertically from the mother. This mechanism makes the fetus

resistant to the SARS-CoV-2 virus, reducing the risk of mortality and morbidity for the mother and fetus (Skjefte et al., 2021). However, pregnant women's uptake of the COVID-19 vaccination is still relatively low in Indonesia and worldwide (Galanis et al., 2022; Goncu Ayhan et al., 2021; Halu et al., 2022; Skirrow et al., 2022). Considering that the government has developed a free vaccination program for pregnant women, this problem of low acceptance of the COVID-19 vaccination has created an issue. Therefore, the target of vaccination coverage cannot be achieved.

Several factors affected the public acceptance of vaccines, as previous studies reported (Alamer et al., 2021; Galanis et al., 2022). A prior study reported that 34.1% of participants rated their motivation to receive the COVID-19 vaccination as low. More than a third were hesitant to accept the COVID-19 vaccination (Lin et al., 2021). Pregnant women have a higher risk of COVID-19 transmission, so their history of COVID-19 infection (HCI) might be considered when determining strategies for vaccine uptake during pregnancy. Furthermore, previous studies have reported diverse findings regarding the HCI among pregnant women and whether it interfered with their willingness to accept the vaccine (Galanis et al., 2022; Simmons et al., 2022). Hence, it was necessary to inquire about these factors to find such evidence in the population.

The main factors influencing a person's attitude toward receiving a vaccine are the supporting and inhibiting factors. Supporting factors could be in the form of motivation to get the vaccine while inhibiting factors would be in the form of hesitancy. These two factors can have different effects on someone with or without a history of being infected with COVID-19, both directly or indirectly affecting a person's attitude toward the COVID-19 vaccine. A previous study found a relationship between motivation and hesitation in receiving the COVID-19 vaccine in pregnant women (Puspaningrum & Samaria, 2023). However, to the best of the researcher's knowledge, no studies have investigated further the direct and indirect effects of motivation, hesitation, and history of COVID-19 infection simultaneously on attitude toward the COVID-19 vaccine in pregnant women. Therefore, this study aimed to investigate the direct and indirect effects of factors influencing attitudes toward the COVID-19 vaccine (ACV) in pregnant women, particularly hesitancy, motivation, and history of COVID-19 infection (HCI), and to describe a pathway model that represented the effects.

2. Methods

2.1 Research design

This study employed a cross-sectional design using offline questionnaires. The study design was selected to examine the direct and indirect effects of factors influencing attitudes towards COVID-19 vaccination at one time simultaneously. The factors, including motivation, hesitancy, and HCI in pregnant women, were observed concurrently in their effects on ACV.

2.2 Setting and samples

The participants were pregnant women who visited the Public Health Centers (PHCs) or independent midwife clinics in Bekasi and Pandeglang regencies, Indonesia. Pregnant women in Bekasi and Pandeglang who met the criteria for the consecutive sampling method were recruited as respondents. The inclusion criteria were pregnant women who lived in Bekasi or Pandeglang and had functional reading and writing abilities in Indonesian. The exclusion criteria were those positively confirmed for COVID-19 transmission and undergoing isolation. The Lwanga and Lemeshow equation was utilized to calculate the sample size due to the unknown population by setting an anticipated population proportion(P) of 0.8, a confidence level of 95%, and desired precision(E) of 5% (Lwanga & Lemeshow, 1991). A minimum sample size of as many as 384 subjects was required. To avoid the risk of bias regarding non-probability method sampling, the researchers added the number of participants (Baktash & Aziz, 2023; Gray et al., 2017). As many as 476 pregnant women were asked to join this study to minimize the risk of bias. However, only 440 subjects fit the inclusion and exclusion criteria. Therefore, 440 pregnant women participated in this study.

2.3 Measurement and data collection

This study was conducted on pregnant women from May to June 2022 in Bekasi and Pandeglang. This study employed a demographic questionnaire including the mother's age,

gestation age, level of education, working status, gravid status, and history of COVID-19 infection (HCI). Other instruments were the Motivations for Vaccination Questionnaire (MVQ) developed by Tavolacci et al. (2021) to measure respondent's motivation for the COVID-19 vaccine, the Reasons for Hesitation Questionnaire (RHQ), also set by Tavolacci et al. (2021) to investigate respondent's hesitation in receiving COVID-19 vaccine, and the Attitudes Toward COVID-19 Vaccine Questionnaire (ACVQ) developed by El-Elimat et al. (2021). The Indonesian version of the MVQ and RHQ had been used in Indonesia and reported as valid and reliable in the earlier study (Puspaningrum & Samaria, 2023). The ACVQ was translated into Bahasa Indonesia and analyzed using face validity by three academic members, one health professional, and two language translators. The questionnaire's readability, clarity of wording, and relevancy of the items were qualitatively evaluated.

The MVQ consisted of 8 questions regarding the content of the vaccine, how it works, and its benefits, safety, and efficacy. All items were favorable, with scores ranging from 0-8. The MVQ was valid with r items counting from 0.379 to 0.746, which were more than r table (0.361), and reliable with a Cronbach alpha of 0.660 after delivering validity and reliability test to 30 subjects (Puspaningrum & Samaria, 2023). The RHQ involved 13 statements. Each statement item was positive (favorable), with responses using a Guttman scale of 0=no and 1=yes. The scores ranged from 0-13. The RHQ was tested for validity and reliability on 30 participants. It was valid with an r item ranging from 0.367 to 0.720 and reliable with a Cronbach alpha of 0.770 (Puspaningrum & Samaria, 2023). The ACVQ comprised of 9 questions. The questionnaire was measured using a Likert scale with scores ranging from 1=strongly disagree to 5=strongly agree. Item numbers 1-5 and 8-9 were favorable; meanwhile, items 6-7 were unfavorable. The score ranged from 1-45. The ACVQ was tested for validity and reliability on 30 subjects. The ACQV was valid with an r item ranging from 0.379 to 0.582 and reliable with a Cronbach alpha of 0.691.

The data was collected offline as the pregnant women visited the Public Health Centers (PHCs) or independent midwife clinics in Bekasi and Pandeglang for antenatal examination. Candidates of participants who met the inclusion criteria were recruited to enroll in the study. They were explained about the study protocol, and if they agreed to participate voluntarily in this study, they were asked to sign the informed consent. They then spent about 25 minutes to complete the questionnaires. The subjects and researchers applied health protocols such as wearing masks and keeping their distance when mining the data during the pandemic (Samaria et al., 2023).

2.4 Data analysis

Univariate analysis was performed to identify the characteristics of participants, including age, gestational age, level of education, working status, and gravid status. In the bivariate analysis, variables that yielded significant values ($p<0.01$) were further analyzed using Path Analysis in a multivariate approach. A path analysis investigated the direct and indirect effects of hesitancy, motivation, and history of COVID-19 infection (HCI) on attitude toward the COVID-19 vaccine (ACV).

2.5 Ethical considerations

This study was held according to research ethics principles by implementing the rules of anonymity and voluntary participation when collecting the data. The researchers explained to each respondent candidate about the study protocol, objectives, expected outcomes, and benefits for them before agreeing to participate and signing the informed consent form. This study obtained the ethical approval letter number 233/V/2022/KEP from the Research Ethics Commission of the Faculty of Medicine, Universitas Pembangunan Nasional "Veteran" Jakarta, Indonesia.

3. Results
3.1 Characteristics of the participants

A total of 440 participants were involved in this study. Their average age was 28.5 years (see Table 1). Of the participants, 21 subjects were at high risk due to pregnancy at a younger age (<20 years), and 59 subjects (13.4%) were older (>35 years). Most participants had higher education levels, namely senior high school and university. In addition, more than half of the

participants were unemployed (275 participants, 62.5%) and multigravid (303 participants, 68.9%).

Table 1. Characteristics of participants (n=440)

Characteristics	Mean	SD	Min	Max	f	%
Age (years)	28.5	5.555	16	44		
Age (category)						
Younger age (<20 years old)					21	4.8
Normal age (20-35 years old)					360	81.8
Older age (>35 years old)					59	13.4
Gestation age (weeks)	22.8	1.345	5	40		
Level of education						
Uneducated					2	5
Elementary school					42	9.5
Junior high school					78	17.7
Senior high school					198	45
Higher education (college)					120	27.3
Working status						
Not working					275	62.5
Working					165	37.5
Gravid Status						
Primigravid					137	31.1
Multigravid					303	68.9
Hesitancy [a]	5.30	2.536	1	12		
Motivation [b]	5.95	1.543	2	8		
HCI (category) [c]						
Never					356	80.9
Once					78	17.7
Twice					6	1.4
HCI (frequency of being infected with COVID-19)	0.2	0.436	0	2		
ACV [d]	30.66	4.351	19	41		

Note. [a]Reasons of Hesitation Questionnaire (RHQ), [b]Motivations of Vaccination Questionnaire (MVQ), [c]History of COVID-19 Infection (HCI), [d]Attitudes toward the COVID-19 Vaccine (ACV)

3.2 Path analysis

The result of the bivariate analysis got a significant value ($p<0.01$), so the statistical analysis was continued to a path analysis to identify the direct and indirect effects of all factors studied on ACV (See Table 2).

Table 2. Relationship between hesitancy, motivation, HCI, and ACV using Pearson correlation

Variables	Attitudes toward COVID-19 Vaccine			
	Mean(SD)	*Mean(SD)*	r	*p*
Hesitancy	5.30(2.536)		-0.559	<0.001[a]
Motivation	5.95(1.543)	30.66(4.351)	0.435	<0.001[a]
HCI	0.2(0.436)		-0.631	<0.001[a]

Note. [a]Pearson Correlation

All studied factors had significant impacts on ACV, both directly and indirectly. As shown in Table 3, hesitancy, motivation, and HCI significantly affected ACV. Hesitancy had a negative effect, whereas motivation positively impacted ACV. The level of hesitancy had a more indirect effect ($\beta=-0.270$; $p<0.001$) than a direct effect ($\beta=-0.193$; $p<0.001$) on ACV. Motivation had a more direct ($\beta=0.092$; $p=0.044$) than an indirect effect ($\beta=0.074$; $p=0.044$) on ACV. In addition, HCI acted as the mediation variable because it could intercede the effect of hesitancy on ACV ($\beta=-0.449$; $p<0.001$).

Table 3. Path analysis of the direct and indirect effect of hesitancy and motivation on ACV via HCI

| Variables	Direct Effects β	Indirect Effect β	Total Effect β	p
Hesitancy (Total Effect)			-0.463	
Hesitancy →ACV	-0.193			<0.001
Hesitancy →HCI →ACV		-0.270		<0.001
Motivation (Total Effect)			0.166	
Motivation →ACV	0.092			0.044
Motivation →HCI →ACV		0.074		0.044
Hesitancy ➔ HCI (mediation) ➔ ACV			0.449	<0.001

3.3 Pathway model of the factors

The further results of path analysis are shown in Table 4. The results of Model I (Table 4) revealed the effect of the independent variable on the dependent variable with a *p*-value of <0.001. This result supported that HCI, hesitancy, and motivation had a direct effect on ACV. The R^2 value of 0.505 indicated a contribution of the direct effect of 50.5%, and the remaining 49.5% was the influence of other contributing variables that were not implicated in the study.

Table 4. Model factors on ACV in pregnant women

Dependent Variables	Independent Variables	b*	SE	p	β**	R^2	e
Model I							
HCI	←Hesitancy	0.104	0.007	<0.001	0.602	0.505	0.704
HCI	←Motivation	-0.047	0.012	<0.001	-0.165		
Model II							
ACV	←Hesitancy	-0.331	0.093	<0.001	-0.193	0.431	0.754
ACV	←Motivation	0.258	0.128	0.044	0.092		
ACV	←HCI	-4.476	0.512	<0.001	-0.449		

Note. b*=unstandardized path coefficient, β**=standardized path coefficient, SE=standart error, R^2=coefficient of determination, e=error term

The results of Model II represented a significant effect of the independent variables on the dependent with *p*<0.001 and 0.044. This result highlighted that hesitancy and motivation affected ACV utilizing HCI. The value of R^2 was 0.431, revealing that the effect of hesitation and motivation via HCI on ACV was 43.1%. In comparison, 56.9% contributed to other variables that were not encompassed in the study. Model I and II test results are integrated into the following path analysis structure model (Figure 1).
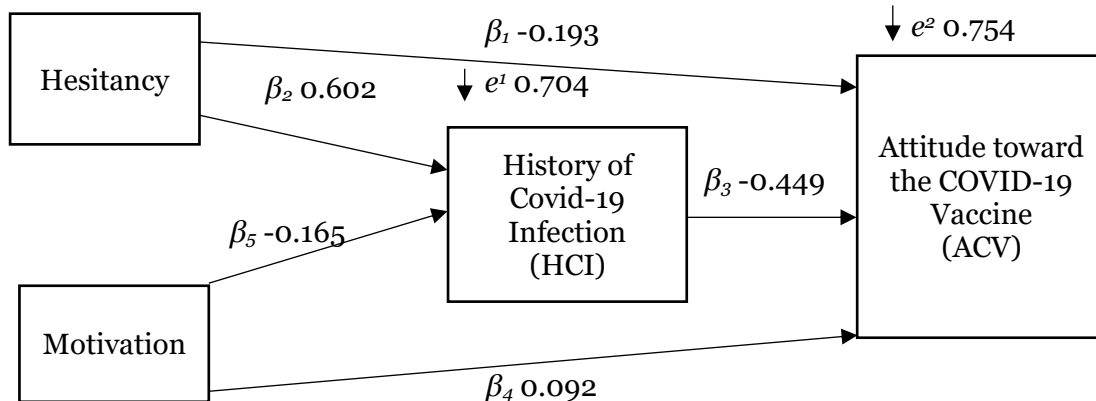
Figure 1. Model of path analysis of factors related to ACV in pregnant women

4. Discussion

This study investigated the direct and indirect effects of factors influencing ACV in pregnant women, particularly hesitancy, motivation, and HCI, and described a pathway model that represents these effects. The main findings showed that both the direct and indirect effects of motivation, hesitancy, and HCI on ACV were significant. Moreover, the indirect effect of hesitancy and HCI on ACV was more pronounced than the direct effect of hesitancy on ACV. Therefore, HCI played a facilitating role in the effect of motivation on ACV and acted as the intervening variable that modified the effect of hesitancy on ACV. On the other hand, the results revealed that the direct effect of motivation on ACV was more significant than the indirect effect of motivation on ACV through HCI. Thus, HCI did not facilitate the effect of motivation on ACV, as observed in the pathway model.

Regarding the results of hesitancy effects on the path analysis, HCI was found to be the intervening variable that influence the indirect effect of hesitancy on ACV. A previous study reported similar findings, proving that a history of being infected by COVID-19 could predict hesitancy in receiving the COVID-19 vaccine (Ghaznavi et al., 2022). A prior study also found that having a history of severe COVID-19 infection could increase hesitancy about the COVID-19 vaccine by up to 46% (Olanipekun et al., 2021). Therefore, a robust indirect effect of hesitancy on ACV through HCI was indicated. This effect may arise from the belief that being exposed to COVID-19 leads to feeling immune to COVID-19, so that a person no longer needs protection from vaccines. However, another study reported that someone who has transmitted COVID-19 infection and has never been hospitalized likely plans to accept the vaccine (aOR: 1.2), but is unlikely to get the vaccine if they are ever hospitalized (aOR: 0.62) (Wirawan et al., 2022). So, the effect may vary depending on the severity of the COVID-19 infection.

An intervention program that paid attention to the HCI factor was recommended to reduce hesitancy by separating the two groups of pregnant women (with and without HCI), such as the provision of health education, peer group sharing, or another form of social support (Galanis et al., 2022). The two groups may have different perceptions of ACV. The group with HCI may be hesitant to receive the vaccine because they did not experience severe symptoms of COVID-19; they might only have experienced flu-like symptoms. They might also assume that they already have automatic immunity and pass this to the fetus after recovering from a COVID-19 infection (Cui et al., 2022). They may not perceive the pandemic seriously, seeing no urgent need for the vaccine (Samannodi, 2021). However, other pregnant women in the group with HCI might have a different assumption and receive the vaccine confidently after experiencing severe COVID-19 symptoms. By accepting the vaccine, they expect milder symptoms if reinfected. The perceived severity of COVID-19 symptoms is positively related to the motivation to receive COVID-19 vaccines (Wang et al., 2021). In contrast, pregnant women without HCI might be more concerned about the vaccine's side effects. This perception could raise hesitancy in accepting it (Galanis et al., 2022). On the other hand, some pregnant women in the group with no HCI might confidently receive the COVID-19 vaccine for its efficacy and have optimal health status during pregnancy. The key for nurses is to educate themselves and proactively initiate discussions about vaccines with patients and colleagues, to build trust with patients and peers, to help motivate them to receive the COVID-19 vaccine, and to make appointments to receive vaccinations (Rittle, 2022). Addressing the impact of low vaccination rates due to vaccine indecision is the first step toward closing the gap and achieving universal vaccination for all adults, including pregnant women.

Evidence-based practice has identified measures to minimize COVID-19 vaccine hesitancy, such as adequate education about vaccines, clear and consistent communication to build public trust and confidence, health education about vaccination and its social benefits, program outreach, and targeted messaging (Anakpo & Mishi, 2022). The intervention program suggested increasing ACV by providing health education regarding the criteria, indications, and safety of the COVID-19 vaccine for pregnant women (Galanis et al., 2022). In addition, sharing testimonials regarding the perceived benefits of the vaccine from pregnant women who have previously received it can increase the confidence of pregnant women to receive it. Since the information comes from pregnant women who have experienced vaccination programs, it tends to be more highly regarded for accepting the vaccine. The intervention program must target pregnant women by looking at their HCI. The program provided can be of the same design but must be delivered separately to each group.

Furthermore, regarding the results of motivation effects on the path analysis, HCI was found not to be the intervening variable that influenced the indirect effect of motivation on ACV. As seen in the pathway model, HCI did not facilitate the effect of motivation on ACV. Furthermore, regarding the results of the influence of motivation on the path analysis, it was found that HCI was not an intervening variable that influences the indirect effect of motivation on ACV. So, HCI does not facilitate motivational effects. The results of this study are different from previous findings. Qualitative research reported the statement from participants infected with COVID-19 that they were motivated to get the vaccine to prevent reinfection (Moore et al., 2022). However, another qualitative study reported the results of content analysis that the factors shaping the motivations to get the COVID-19 vaccine are attitudes and perceptions about the COVID-19 vaccine, strong emotions about the COVID-19 vaccine, values and beliefs, and confidence and trust (Liu & Liu, 2021). So, HCI was not found to influence a person's motivation to get the COVID-19 vaccine. This finding was similar to this study's results.

Based on the results of the respondents' characteristics, most subjects were at a safe age for pregnancy, had higher education, did not work, and were multigravida. A previous study reported that subjects who were of safe age for pregnancy and had a higher level of education were associated with higher motivation to get the vaccine (Puspaningrum & Samaria, 2023). Likewise, pregnant women who are not working experience less stress than working mothers, making them more likely to get the vaccine. For the gravida status, a study reported that there was no significant difference between primigravida and multigravida mothers in their desire to get the COVID-19 vaccine (Geoghegan et al., 2021). These findings indicated that most of the characteristics of the respondents in the current study tended to have good motivation to receive the COVID-19 vaccine, except for the participant's pregnancy status, which referred to the previous study results that there was no difference in their desire to receive the COVID-19 vaccine (Geoghegan et al., 2021).

Providing interventions to increase motivation to receive the COVID-19 vaccine regardless of HCI is recommended. The provision of rewards or penalties can provide interventions to improve motivation under the theory of motivation (Böhm et al., 2019; Brewer et al., 2017; Wu et al., 2022). As an example of its implementation in Indonesia, individuals who had not received the vaccine were prohibited from accessing public places such as working offices and malls or traveling by airplane without a COVID-19 vaccine booster (Wirawan et al., 2022). Previous studies have declared several strategies to increase motivation to accept the COVID-19 vaccine. For example, a study in Zambia concluded that the motivating factors for vaccine uptake included increased cases of COVID-19, accessibility and availability of vaccines, vaccine certificates required for travel, and credible sources of information (Matenga et al., 2022). In addition, communication strategies can improve attitudes toward COVID-19 vaccine acceptance (Merkley & Loewen, 2021). For example, health providers could extend a vaccine campaign through routine activities during prenatal visits for all pregnant women, regardless of HCI. The movement should emphasize the benefits of the COVID-19 vaccine and repeat it intensely. If only one message is delivered, it will not be enough to increase vaccination intention (Burger et al., 2022). Placing banners or posters about COVID-19 vaccination in public spaces can also raise awareness and motivate pregnant women to accept the COVID-19 vaccine.

5. Implication and limitation

This study impacts nursing practice, especially maternal health services during the COVID-19 pandemic, to enhance protection from viral infections. Nurses should empower pregnant women eligible for COVID-19 vaccination to reduce hesitancy through health education, particularly concerning their history of COVID-19 infection. Additionally, to increase motivation to vaccinate, nurses should provide education during antenatal visits and work with governments to encourage people to access public places or travel by air without the COVID-19 virus. Rewards or sanctions can generally be offered to those who cannot do so. Apart from its implications, this study also has limitations. Many factors influence the attitude of pregnant women to receive vaccines, yet in this study, researchers focused on aspects of hesitancy, motivation, and history of COVID-19 infection only. As explained in the study results, the attitude of pregnant women in receiving the COVID-19 vaccine was also influenced by factors that were not examined in this study.

6. Conclusion

Hesitancy, motivation, and HCI have direct and indirect effects on ACV. HCI acted as the mediation variable concerning the effect of hesitancy on ACV, yet no evidence was proven for HCI as an intervening variable between motivation and ACV. Consequently, adjusting interventions based on the program's purpose is recommended, such as delivering health education and campaigns to increase motivation or reduce hesitancy. Each goal will have a different approach according to HCI in pregnant women. The study recommends a quasi-experimental design for future studies by adding other factors, such as social support and other factors, to be investigated by including randomization in sampling. The interventions are also recommended to be adjusted based on the program's purpose for increasing motivation or reducing hesitancy.

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Author contribution

DS: Conceptualization, methodology, investigation, data curation, writing review, and editing. DD: Conceptualization, process, review, and data curation. LF: Investigation and data curation.

Conflict of interest

None of conflict of interest is declared.

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