

Knowledge, Attitudes, and Self-Care Practices of Pregnant Women for COVID-19 Prevention: Implications for Sustainable Development Goals (SDG 3 & SDG 5)

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Abstract

Background: The COVID-19 pandemic has placed an unprecedented burden on global health systems, disproportionately affecting maternal and child health outcomes, particularly in low- and middle-income countries. Pregnant women are biologically and socially vulnerable to both the direct consequences of infection and the indirect effects of disrupted health services. Understanding the knowledge, attitudes, and self-care practices (KAP) of pregnant women is crucial for informing antenatal counseling, shaping community health interventions, and addressing inequities. In alignment with the Sustainable Development Goals (SDG 3: Good Health and Well-being; SDG 5: Gender Equality), evidence-based insights can guide the development of gender-sensitive and context-specific preventive strategies to strengthen maternal and child health resilience.

Objective: This study aimed to examine the levels of knowledge, attitudes, and self-care practices of pregnant women regarding COVID-19 prevention, and to identify significant predictors of preventive behaviors within antenatal care settings.

Methods: A cross-sectional analytical study was conducted among 219 pregnant women attending antenatal clinics in public hospitals across Health Region 8, Thailand (Udon Thani, Nong Khai, Nong Bua Lamphu, and Sakon Nakhon Provinces), between June and December 2024. Data were collected using a structured and validated questionnaire covering three domains: knowledge, attitudes, and practices. Instrument validity and reliability were established through expert review and pilot testing. Data were analyzed using descriptive statistics, Pearson correlation, and multiple regression to identify factors associated with preventive self-care practices.

Results: Participants demonstrated moderate (51.15%) to high (49.77%) levels of knowledge. Attitudes toward prevention were predominantly positive ($M = 3.70$, $SD = 0.54$), and self-care practices were frequently performed ($M = 4.28$, $SD = 0.54$). Attitudes were positively correlated with practices ($r = 0.457$, $p < 0.01$). Predictors of preventive practices included having a family member infected with COVID-19 ($\beta = .15$, $p = .014$), receiving information from health professionals ($\beta = -.12$, $p = .046$), receiving information from the internet ($\beta = -.13$, $p = .036$), and positive attitudes ($\beta = .45$, $p < .001$). Collectively, these predictors explained 26.3% of the variance in self-care practices ($p < 0.001$).

Conclusion:

The findings underscore the importance of strengthening maternal health systems by promoting positive attitudes, enhancing access to credible health information, and integrating family experiences into health education. Policy implications include the need for gender-sensitive, community-based, and digitally supported interventions that address inequalities in access to information and services. This study contributes to the global evidence base by highlighting the role of psychosocial and contextual factors in shaping preventive practices among pregnant women. Strengthening antenatal education and community

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linkages in line with SDG 3 and SDG 5 can enhance resilience and improve maternal and child health outcomes in the ongoing and post-pandemic era.

Keywords: Knowledge; Attitudes; Practices; Self-care; COVID-19; Pregnant women; Sustainable Development Goals

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Background and Significance

Since its emergence in Wuhan, China, in late December 2019, the novel coronavirus disease (COVID-19) has spread globally, resulting in more than 770 million confirmed cases and over six million deaths worldwide as of September 2023. In Thailand, the Department of Disease Control, Ministry of Public Health, designated COVID-19 as a notifiable disease under the Communicable Disease Act B.E. 2558 (2015), with mandatory weekly reporting beginning on October 1, 2022. As of May 2024, Thailand reported a cumulative total of 4,769,209 confirmed cases and 34,614 deaths, with the majority of mortality occurring among older adults aged 70 years and above (Department of Disease Control, 2024). This trend underscores the continuing threat of COVID-19 across all population groups, particularly among vulnerable populations such as the elderly, children, and pregnant women.

Pregnant women and their fetuses constitute a high-risk group during pandemics due to physiological and immunological changes that increase susceptibility to infection. Alterations in cardiovascular and respiratory function, alongside immune modulation favoring a Th2 response to protect the fetus, render pregnant women more vulnerable to viral infections such as SARS-CoV-2 (Dashraath et al., 2020). Clinical evidence indicates that pregnant women with COVID-19 face a higher risk of severe respiratory failure, intensive care unit admission, and obstetric complications, including preterm birth, low birth weight, and stillbirth (Allotey et al., 2020). Comorbidities such as chronic hypertension, diabetes, and obesity further elevate the risk of maternal mortality and adverse neonatal outcomes (Supiya & Pimlada, 2021).

Knowledge, attitudes, and practices (KAP) play a pivotal role in determining the effectiveness of preventive behaviors. International studies show wide variability in knowledge levels across regions. For example, a cross-sectional study in Iran reported mean COVID-19 knowledge scores of 13.2 ± 1.1 out of 14 among pregnant women (Naveh Ebrahim et al., 2020),

while research in Ethiopia found knowledge levels of 60.24%, substantially lower than in countries such as India, Saudi Arabia, and Egypt (Sisay et al., 2022). Higher knowledge is consistently linked to appropriate preventive practices, including mask use, hand hygiene, and social distancing (Isaree et al., 2022). Attitudes are equally influential; positive attitudes toward prevention and vaccination correlate with greater adherence to health recommendations, whereas negative perceptions may foster hesitancy and distrust in health systems (Kuptarak & Phupong, 2024). Thai evidence similarly highlights the importance of KAP in shaping maternal health behaviors. (Kunno et al., 2022) found that pregnant women with higher knowledge scores demonstrated significantly better self-care practices, and (Pothisa et al., 2022) reported that education level was associated with both attitudes and vaccination uptake. These findings align with the Health Belief Model, emphasizing perceived risk, self-efficacy, and cues to action as determinants of preventive behavior (Bayrami et al., 2024).

Institutional research from the Faculty of Nursing, Shinawatra University, further reinforces this evidence base. (Pitsachart and Saenprasarn., 2023) demonstrated the effectiveness of a virtual living laboratory model in strengthening community self-care capacity. Highlighted nursing students' preparedness and resilience in implementing infection prevention protocols during the pandemic. (Kitsomporn and Rueangthataworn., 2021) reported that community-driven maternal health interventions significantly improved self-care behaviors among pregnant women. These contributions underscore the role of nursing education and community engagement in shaping effective, context-sensitive responses to public health crises.

Despite this growing body of literature, limited research has examined pregnant women's KAP regarding COVID-19 in Thailand's Health Region 8, particularly in rural northeastern provinces such as Udon Thani, Nong Khai, Nong Bua Lamphu, and Sakon Nakhon. Most

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existing studies focus on general populations or metropolitan settings, leaving a critical evidence gap in understanding maternal vulnerability and protective behaviors in rural antenatal contexts. This study therefore seeks to address that gap by examining KAP and identifying predictors of preventive practices among pregnant women in Health Region 8. Findings are expected to inform targeted maternal health interventions consistent with SDG 3 (Good Health and Well-being) and SDG 5 (Gender Equality), thereby contributing to sustainable improvements in maternal and child health outcomes.

Research Objectives

1. To examine the levels of knowledge, attitudes, and self-care behaviors for COVID-19 prevention among pregnant women in Health Region 8, Udon Thani.
2. To identify predictors of self-care behaviors for COVID-19 prevention among pregnant women in Health Region 8, Udon Thani.

Conceptual Framework and Related Literature

This study investigates pregnant women's knowledge regarding COVID-19 prevention. Those with higher levels of COVID-19 knowledge are expected to demonstrate better self-care behaviors to prevent infection. Positive attitudes toward disease prevention encourage willingness and awareness to practice self-care. Individual factors considered include age, education level, occupation, having family members who contracted COVID-19, and sources of self-care information about COVID-19 (e.g., health personnel—physicians and nurses—Internet, television, radio, and hospital leaflets). The study examines how these factors collectively predict pregnant women's self-care behaviors to prevent COVID-19 infection.

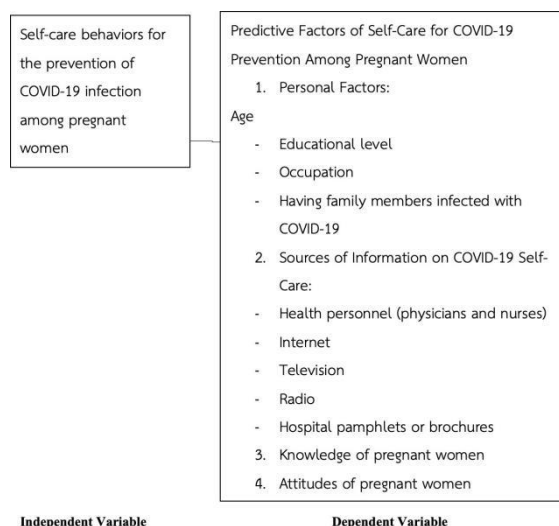


Figure 1. Conceptual Framework of the Research

Research Methodology

This study employed a cross-sectional descriptive research design aimed at examining the levels of knowledge, attitudes, and self-care behaviors for COVID-19 prevention among pregnant women, as well as identifying the predictive factors influencing such self-care behaviors.

The study population consisted of pregnant women who attended antenatal care (ANC) services at government hospitals in Health Region 8, Northeastern Thailand, covering four provinces: Somdet Phra Yupparat Sawang Daen Din Hospital in Sakon Nakhon Province, Udon Thani Hospital, Nong Khai Hospital, and Nong Bua Lamphu Hospital.

Data were collected from pregnant women receiving antenatal care between June and December 2024. The sampling method used was non-probability sampling, specifically accidental sampling, with a total of 219 participants.

The sample size was calculated using the G*Power program for multiple regression analysis, aiming to test factors influencing the dependent variable measured on an interval or ratio scale, while the independent variables were also measured on interval or ratio scales. The sample size estimation was based on the study by Kunno et al. (2022), which analyzed the correlation between pregnant women's knowledge and preventive practices ($r = 0.210$, $p = 0.01$).

The statistical test selected was Linear Multiple Regression: Fixed Model, R^2 deviation from zero, with the following parameters: a medium effect size ($f^2 = 0.15$), 11 predictor

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variables, power $(1-\beta) = 0.90$, and a significance level $(\alpha) = 0.01$.

According to these parameters, the required minimum sample size was 198 participants. Considering a possible 11% data loss, the total sample size was adjusted to 219 participants for this study.

Research Instruments

The research instruments used in this study consisted of a questionnaire developed by the researchers based on a review of relevant documents, textbooks, and previous research studies. The questionnaire was divided into four parts as follows:

Part 1: General Information of the Respondents
This section included questions related to demographic and personal background such as age, educational level, occupation, number of family members, relationship with family members, presence of illness among family members, existing chronic diseases, and sources of information regarding self-care during pregnancy, among others.

Part 2: Knowledge of Self-Care to Prevent COVID-19 Infection among Pregnant Women
This section consisted of 18 items measured on a nominal scale, with two possible responses: "Yes" and "No." Respondents were instructed to select only one answer per item. A correct answer received a score of 1 point, while an incorrect answer received 0 points.

The total scores were summed and classified into three levels of knowledge using the class interval formula. The interpretation criteria were as follows:

- 13–18 points = High level of knowledge
- 7–12 points = Moderate level of knowledge
- 0–6 points = Low level of knowledge

Part 3: Attitudes toward Self-Care to Prevent COVID-19 Infection among Pregnant Women
This part consisted of items measured on a five-point Likert scale, with response options as follows:

- 5 = Strongly agree
- 4 = Agree
- 3 = Somewhat agree
- 2 = Disagree
- 1 = Strongly disagree

The interpretation of the mean scores followed the criteria of Boonchom Srisa-ard (2017) as follows:

- 0.00–1.50 = Strongly disagree
- 1.51–2.50 = Disagree

- 2.51–3.50 = Somewhat agree
- 3.51–4.50 = Agree
- 4.51–5.00 = Strongly agree

Part 4: Self-Care Behaviors to Prevent COVID-19 Infection among Pregnant Women

This section also used a five-point Likert scale with the following response options:

- 5 = Regularly perform
- 4 = Often perform
- 3 = Occasionally perform
- 2 = Seldom perform
- 1 = Never perform

The interpretation of behavioral scores was based on the average score criteria of Boonchom Srisa-ard (2017) using the full score range of 1–5, categorized as follows:

- 0.00–1.50 = Never perform
- 1.51–2.50 = Seldom perform
- 2.51–3.50 = Occasionally perform
- 3.51–4.50 = Often perform
- 4.51–5.00 = Regularly perform

Instrument Quality Verification

1) Content Validity

The questionnaire was evaluated for content validity by three experts: one obstetrician responsible for prenatal care, one nursing instructor specializing in midwifery, and one nursing instructor specializing in internal medicine. They reviewed the questionnaire to assess the accuracy, relevance, and clarity of the content and provided feedback for improvement. The questionnaire was then revised based on their suggestions to ensure clarity, language appropriateness, and comprehensive coverage of the intended content. The Index of Item-Objective Congruence (IOC) values ranged from 0.67 to 1.00, indicating acceptable content validity.

2) Reliability

The reliability of the questionnaire was tested with 30 pregnant women who shared similar characteristics to the actual sample group at the antenatal clinic of Somdej Phra Yupparaj Sawang Daen Din Hospital, Sakon Nakhon Province. The reliability was analyzed using Cronbach's alpha coefficient. The results showed that:

The questionnaire on knowledge of self-care for COVID-19 prevention among pregnant women had a reliability coefficient greater than 0.70.

The questionnaire on attitudes toward self-care for COVID-19 prevention had a reliability coefficient greater than 0.785.

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The questionnaire on self-care behaviors for COVID-19 prevention had a reliability coefficient greater than 0.869.

These results indicate that all parts of the questionnaire had high internal consistency and were suitable for use with the actual sample of pregnant women.

Data Collection

The researcher submitted a request for ethical review and approval to the Research Ethics Committee of Shinawatra University (Certification No. IRB 24/10), which was approved on May 17, 2024. In addition, the researcher sought ethical approval from the Research Ethics Committees of government hospitals located in Health Region 8, Udon Thani (Upper Northeastern Region). Ethical approval for human research was granted as follows:

- Nong Bua Lamphu Hospital (Certification No. EC [External] 011/2567), approved on May 29, 2024
- Nong Khai Hospital, approved on August 28, 2024
- Udon Thani Hospital (Certification No. UDH REC 148/2567), approved on October 7, 2024
- Somdej Phra Yupparat Sawang Daen Din Hospital, Sakon Nakhon Province

After receiving approval from all relevant provincial ethics committees, the researcher proceeded with the data collection process as follows:

- 1) Sample Selection:
Participants were selected based on the inclusion criteria. The researcher explained the objectives, benefits, and possible risks of the study to ensure participants fully understood and voluntarily signed the informed consent form prior to participation.
- 2) Permission for Data Collection:
The researcher obtained official permission to collect data from four provinces within Health Region 8 (Udon Thani). Formal request letters were sent to the directors of Somdej Phra Yupparat Sawang Daen Din Hospital (Sakon Nakhon Province), Nong Bua Lamphu Hospital, Nong Khai Hospital, and Udon Thani Hospital, seeking approval and cooperation for conducting the data collection throughout the research period.
- 3) Data Collection Process:
The researcher prepared and trained research assistants, selecting one

registered nurse from each hospital who had more than five years of experience in antenatal care. The training ensured that all assistants followed standardized procedures and consistent interview techniques using structured questionnaires. The training continued until the assistants demonstrated full understanding of the research objectives and could conduct interviews appropriately.

The data were collected using a four-part questionnaire:

1. General information of the participants
 2. Knowledge regarding self-care to prevent COVID-19 infection
 3. Attitudes toward self-care in preventing COVID-19 infection
 4. Self-care behaviors to prevent COVID-19 infection among pregnant women
 5. Each interview and questionnaire session took approximately 15–20 minutes to complete.
- 4) Data Verification:

After data collection, the researcher reviewed all questionnaires for accuracy and completeness before proceeding to data analysis.

Data Analysis

The researcher employed quantitative data analysis as follows:

- 1) General information analysis — The general characteristics of the participants were analyzed using descriptive statistics, including frequency, percentage, mean, and standard deviation.
- 2) Knowledge, attitude, and self-care behavior analysis — The levels of knowledge, attitudes, and self-care behaviors for the prevention of COVID-19 infection among pregnant women were analyzed using descriptive statistics, such as frequency, percentage, mean, and standard deviation.
- 3) Correlation analysis — The relationships among knowledge, attitudes, and self-care behaviors regarding the prevention of COVID-19 infection among pregnant women were examined using Pearson's correlation coefficient.
- 4) Predictor variable analysis — The variables jointly predicting self-care behaviors for the prevention of COVID-19 infection among pregnant women were analyzed using multiple

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linear regression analysis, with the level of statistical significance set at 0.05.

Protection of Participants' Rights

This research study was reviewed and approved by the Research Ethics Committee of Shinawatra University (Approval No. IRB 24/10), certified on May 17, 2024. In addition, ethical clearance was sought from the research ethics committees of government hospitals in Health Region 8 (Upper Northeastern Thailand). Ethical approvals were granted by the following institutions:

- Nongbua Lamphu Hospital (External Nongbua Approval No. EC 011/2567), certified on May 29, 2024
- Nong Khai Hospital, approved on August 28, 2024
- Udon Thani Hospital (UDH REC No. 148/2567), certified on October 7, 2024
- Somdej Phra Yupparat Sawang Daen Din Hospital, Sakon Nakhon Province

The researcher clearly explained the study's objectives, procedures, potential benefits, and possible risks to all participants. Participation in this study was entirely voluntary, and participants had the right to withdraw at any time without any effect on their medical care or treatment plans. All participants continued to receive normal antenatal care according to their healthcare rights.

Research Findings

1. Personal Information

A total of 217 pregnant women participated in the study. The participants' mean age was 26.68 years ($SD = 6.16$), with the youngest being 15 years and the oldest 43 years. The majority were aged 20–30 years (59.36%), followed by 30–40 years (23.74%). Most participants had not been infected with COVID-19 during previous pregnancies (77.63%).

Regarding education level, most participants had completed secondary education (56.62%), followed by vocational education (23.29%). The majority were housewives or farmers (77.88%), followed by traders or vendors who had frequent contact with people (20.28%).

In terms of family composition, most households had five members (29.68%), followed by four members (23.29%). The majority lived in single houses (98.16%). Most families had at least one member who had been infected with COVID-19 (83.87%).

For COVID-19 vaccination, most participants had received three doses (62.10%), followed by four doses (33.33%).

Regarding sources of information about self-care during pregnancy in the context of COVID-19, participants were allowed to select more than one source. The majority received information from online platforms such as Google and LINE (52.50%), followed by healthcare personnel (45.16%) and television (41.01%).

2. Level of Knowledge on Self-Care for COVID-19 Prevention

Most pregnant women demonstrated a moderate level of knowledge regarding self-care for COVID-19 prevention (51.15%), while 49.77% had a high level of knowledge. The mean score was 12.42 ($S.D. = 1.387$), with the highest score being 16 and the lowest 9.

3. Attitudes of Pregnant Women Toward Self-Care for COVID-19 Prevention

The majority of participants expressed a highly positive attitude toward self-care for COVID-19 prevention, with a mean score of 3.70 ($S.D. = 0.538$).

4. Self-Care Behaviors of Pregnant Women for COVID-19 Prevention

Most participants exhibited frequent self-care behaviors for COVID-19 prevention, with a mean score of 4.28 ($S.D. = 0.543$).

2. The Relationship Between Predictive Factors and Self-Care Behaviors for COVID-19 Prevention Among Pregnant Women

The majority of participants demonstrated a high level of self-care behavior for preventing COVID-19 infection ($M = 4.28$, $SD = 0.543$). The correlation analysis revealed that attitude toward COVID-19 prevention among pregnant women showed a low positive correlation with their self-care behaviors for COVID-19 prevention, which was statistically significant ($r = .457$, $p < 0.01$).

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Table 1
Correlation Coefficients (r) Between the Variables and Self-Care

ตัวแปร	1	2	3	4	5	6	7	8	9	10	11	12
1. Self-care behaviors	1.000											
2. Age	.052	1.000										
3. Education level	-.098	-.119*	1.000									
4. Occupation	-.071	.065	.031	1.000								
5. Family members infected with COVID-19	.089	.006	.034	-.075	1.000							
6. Information from public health personnel	-.057	.137*	.009	-.034	.131*	1.000						
7. Information from the Internet	-.077	.151*	-.180*	-.016	.101	-.111	1.000					
8. Information from television	-.100	.037	.018	.029	.072	-.023	.038	1.000				
9. Information from family members	-.014	-.188*	.073	.101	.010	.011	-.069	.075	1.000			
10. History of COVID-19 vaccination	.030	.038	.049	.059	.030	.076	.019	-.019	.008	1.000		
11. Pregnant women's knowledge	.109	.018	.083	-.098	-.008	.026	.027	.055	.065	.059	1.000	
12. Pregnant women's attitude	.457**	.132*	-.081	-.140*	-.055	.053	.017	-.077	-.065	.003	.132	1.000

Behaviors for COVID-19 Prevention Among Pregnant Women

* $p < .05$, ** $p < .01$, *Sig.* (one-tailed)

When the multiple regression analysis using the Enter method was conducted, it was found that the factors jointly predicting self-care behaviors for COVID-19 prevention among pregnant women included: having family members infected with COVID-19 ($\beta = .15, t = 2.475, p = .014$), receiving information from healthcare personnel ($\beta = -.12, t = -2.005, p = .046$), receiving information from the internet ($\beta = .13, t = -2.105, p = .036$), and attitudes of pregnant women ($\beta = .45, t = 7.284, p < .001$).

These variables together significantly predicted 26.3% of the variance in self-care behaviors for COVID-19 prevention among pregnant women at the 0.001 level of statistical significance ($F(11, 218) = 6.704, R^2 = .263, p < .001$).

The standardized prediction equation can be expressed as follows:

$$Z = 1.713 + .213(\text{Family members infected with COVID-19}) - .135(\text{Information from healthcare personnel}) - .107(\text{Information from the internet}) + .645(\text{Attitudes of pregnant women})$$

Table 1.6 Multiple Regression Analysis of Predictive Factors Associated with Self-Care Behaviors for COVID-19 Prevention among Pregnant Women Using the Enter Method

Predictor Variables	b	SE
1. Family member infected with COVID-19	.213	.086
2. Information obtained from health personnel	-.135	.067
3. Information obtained from the Internet	-.107	.051
4. Pregnant women's attitude	.645	.088

Constant (b) = 1.713, multiple $R = .513, R^2 = .263, R^2_{adj} = .223, SEE = 475.60$
 $F(11, 218) = 6.704, p < 0.001$

* $p < .05$, ** $p < .01$, Sig. (one-tailed)

Discussion

Knowledge level. Most pregnant women demonstrated a moderate level of knowledge about COVID-19. Key reasons for this moderate knowledge include limitations in information access, educational attainment, and socioeconomic factors. This finding is consistent with studies from multiple countries. Although government agencies and mass media have continuously disseminated information, some individuals—especially those in rural areas—may lack access to accurate or easily understandable information. In this study, data were collected from district-level general hospitals, where

pregnant women with lower educational levels or rural residence typically had lower knowledge. This pattern aligns with reports indicating that approximately 47% of pregnant women in Iran had a moderate level of knowledge, and with syntheses across countries suggesting that pregnant women's knowledge of COVID-19 infection prevention worldwide was slightly below "good," at around 59%. Similarly, studies in India reported that 32.1% of pregnant women had a moderate level of knowledge. Pregnant women and postpartum mothers often lacked sufficient knowledge about the COVID-19 pandemic and the WHO-recommended preventive measures. Given that knowledge, practices, and attitudes toward COVID-19 are interrelated, it is imperative to provide accurate information to pregnant and postpartum women to prevent infection.

These results contradict Kunno et al. (2022), who found that most pregnant women in Thailand had high or very high knowledge, and also differ from Phutong and Thaitae (2023), who reported high levels of health knowledge related to COVID-19 and pregnancy among pregnant women. Notably, both of those studies were conducted in urban settings, which likely explains the divergence from the present findings. In groups with high knowledge, participants could articulate the basic principles of infection prevention—mask-wearing, hand hygiene, and social distancing—along with the sources of information on vaccines and the potential effects of infection on pregnancy and the fetus. Such groups also tended to behave appropriately and comply with recommended preventive measures (Gunawardhana et al., 2024). Attitudes toward self-care to prevent COVID-19 infection were generally strongly agreeable and positive, reflecting awareness and readiness to comply with prevention measures to protect their own health and that of the fetus. This can be explained by concerns over

potentially severe consequences for both mother and child in the event of infection, heightened risk perception, perceived benefits of prevention, and exposure to accurate information about COVID-19. Access to information from healthcare personnel, mass media, and health applications fostered understanding of the importance of prevention measures, thereby strengthening motivation and positive attitudes toward self-care during the pandemic. These findings are consistent with Kunno et al. (2022), who reported high attitude scores among pregnant women, and with Gunawardhana et al. (2024), who found that 90.1% of women had "more positive attitudes toward COVID-19 testing,"

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and that adequate knowledge of COVID-19 was associated with reporting positive attitudes toward testing and prioritizing personal and fetal health. Increases in knowledge were related to more positive attitudes and behaviours that led to the adoption of self-protective measures, such as acceptance of vaccination—consistent with Kuptarak and Phupong (2024), who found that most pregnant women with positive attitudes toward vaccines, and prior knowledge about vaccination, were more likely to accept vaccination during pregnancy.

Practices. Most pregnant women reported that they practiced self-care to prevent COVID-19 infection, a finding consistent with Kuptarak and Phupong (2024) and with Kijssomporn et al. (2024). Pregnant women with higher levels of understanding and positive attitudes toward COVID-19 vaccines generally adhered well to preventive measures—mask-wearing, handwashing, avoiding high-risk areas and showed higher uptake of vaccination. Likewise, studies among pregnant women in Bangladesh indicated that increased knowledge was associated with more positive attitudes and behaviours, leading to the adoption of preventive measures; women with adequate COVID-19 knowledge were more likely to report positive attitudes toward testing and sufficient adherence to prevention. Educational level and employment status influenced knowledge, attitudes, and behaviours related to COVID-19. Only 14.9% reported satisfaction with their knowledge about COVID-19 (Gunawardhana et al., 2024).

Predictors of self-care behaviour. Having a family member ill with COVID-19, receiving information from public health officers, receiving information from the internet, and pregnant women's attitudes collectively predicted self-care behaviours to prevent COVID-19 infection. Having an infected family member strongly heightened motivation and awareness of the importance of prevention, prompting diligent action. Pregnant women with such firsthand experience were stricter and more consistent in preventive behaviours—handwashing, mask-wearing, and social distancing—than those without direct exposure. This is consistent with findings by Chionuma and colleagues in Nigeria, who reported that only 8.4% of pregnant and lactating women were willing to receive a COVID-19 vaccine; however, the loss of a family member or infection within the household increased vaccine acceptance and adherence to preventive measures.

Role of healthcare providers. Information from healthcare personnel exerted a positive influence on self-care behaviour by increasing knowledge and confidence in prevention measures—fostering accurate attitudes and a sense of efficacy in applying them. This aligns with research showing that pregnant women's behaviours during the COVID-19 outbreak in villages within Bogor Regency were influenced by the availability of healthcare facilities, the role of medical personnel, pregnant women's attitudes, and facility readiness; fewer facilities in Cibinong Hospital were associated with poorer behaviours. These findings underscore the need to provide adequate facilities for pregnant women, support postnatal home visits, and ensure access to counselling rooms. They also align with studies indicating that pregnant women who received information and guidance from healthcare professionals were more likely to follow recommendations than those who did not—especially when guidance came from general practitioners or obstetrician-gynecologists. A desire for more information about maternal vaccination improved prevention practices, including distancing, health check-ups, and vaccination. Conversely, prior experiences of inadequate information and limited health-media literacy could heighten anxiety and impede preventive action. This is consistent with Phutong and Thaitae (2023) and with Kulip et al. (2022), who found that predictors of anxiety among pregnant women during the COVID-19 pandemic in Thailand included COVID-19-related health literacy and social support. Anxiety related to COVID-19 can either reduce or increase motivation for prevention (e.g., vaccine uptake).

Internet as an information source. The internet was an important source shaping pregnant women's self-care decisions and promoting health literacy. Consistent with Mo et al. (2021), perceived self-efficacy functioned as a protective factor, and perceived susceptibility was associated with consistent mask-wearing. Online information facilitates rapid access to news, preventive guidelines, and emerging recommendations; however, it must be paired with media literacy, as misinformation or conflicting messages can generate anxiety and lead to inappropriate behaviours if not adequately filtered. In contrast to the present findings, Gunawardhana et al. (2024) reported that television was the primary source of COVID-19 information.

Mediating role of attitudes and the HBM. Attitudes are a key mediator linking knowledge to behaviour. When individuals hold positive attitudes toward preventive measures—confidence in the

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effectiveness of mask-wearing, distancing, or vaccination—they are more motivated to comply. Conversely, negative attitudes or doubts about effectiveness inhibit cooperation. This is consistent with Kuptarak and Phupong (2024), who found that pregnant women with positive vaccine attitudes and prior vaccine knowledge were more likely to accept vaccination during pregnancy, whereas those recently infected with COVID-19 were more hesitant—also in line with Phutong and Thaitae (2023). Positive attitudes strongly predicted appropriate behaviours among pregnant women: those with favourable attitudes toward prevention and vaccination consistently adhered to protective practices such as mask-wearing, distancing, and vaccination. Consistent with Mo et al. (2021), among Chinese pregnant women, self-efficacy was protective and perceived susceptibility correlated with consistent mask use. Pregnant women experienced high psychological stress but low levels of self-protective behaviour during the pandemic; self-care was essential to promoting preventive behaviours, and women with higher self-efficacy were more likely to engage in such behaviours. Studies in Iran applying the Health Belief Model further indicated that knowledge, self-efficacy, and perceived barriers were the strongest predictors of self-care behaviours among pregnant women (Bayrami et al., 2024).

Limitations of the Study

Data collection was conducted by research assistants who administered questionnaires to participants across four provinces. This may have led to some degree of bias or error due to variations in the way the questionnaires were used, differences in the interpretation of questions, or inconsistencies in how the questionnaire content was explained. Consequently, the data obtained from participants in different areas might have contained certain discrepancies or inconsistencies.

Recommendations

Recommendations for Applying the Research Findings

Reliable and easily accessible health communication channels should be enhanced to provide pregnant women with accurate information and clear responses to their concerns.

Multiple communication platforms should be promoted to disseminate information about the benefits and safety of vaccines, as well as other preventive measures against COVID-19.

Social support networks and psychological well-being programs should be strengthened to reduce

anxiety among pregnant women, fostering resilience and confidence during the pandemic.

The research findings should be applied in the development of policies or programs that support self-care behaviors among pregnant women in communities and hospitals.

The development and application of health technologies, including community-level support networks, should be encouraged to promote sustainable maternal health practices.

Recommendations for Future Research

Examine the influence of information sources—such as healthcare personnel, the internet, and family experiences with COVID-19 infection—on pregnant women's attitudes and preventive behaviors.

Investigate supportive and obstructive factors, such as misinformation about COVID-19 vaccines, family support, and the mental health status of pregnant women during the pandemic, to develop effective policy recommendations or intervention programs.

Explore levels of stress and psychological anxiety among pregnant women during the COVID-19 pandemic and design intervention programs aimed at promoting mental health and positive health behaviors during outbreak situations.

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