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| RESEARCH ARTICLE

Knowledge, Attitude, and Barriers of Seasonal Influenza Vaccination among Pregnant Women Visiting Primary Healthcare Centers in Qassim, Saudi Arabia

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| ABSTRACT

Seasonal influenza presents a heightened risk to pregnant women, emphasizing the importance of vaccination. Yet, the influenza vaccination rate among this group is low. This study explores the knowledge, attitudes, and barriers towards seasonal influenza vaccination among pregnant women in Qassim, Saudi Arabia. In this cross-sectional study, 276 pregnant women from primary healthcare centers in Qassim were surveyed using a self-administered questionnaire. The instrument gathered information regarding socio-demographic details, knowledge about, attitudes towards, and barriers against influenza vaccination. Data was analyzed using SPSS Software. Although a high level of vaccine awareness (95.7%) was observed among participants, the vaccination uptake (34%) was low. There were considerable variations in the median knowledge and attitude scores across different socio-demographic groups. Individuals with higher education, living in urban areas, and working in healthcare showed better levels of knowledge and more positive attitudes towards vaccination. The primary barriers to immunization included concerns regarding potential side effects and uncertainties regarding the importance of vaccines. The study demonstrates a significant disparity between awareness and actual vaccination among pregnant women in Qassim. Bridging this gap requires public health education to address misconceptions and implement communication strategies customized to socio-demographic characteristics. Training healthcare professionals in communication skills could also play a vital role in increasing vaccine uptake. Further research is recommended to devise effective interventions for increasing influenza vaccine uptake.

| KEYWORDS

Flu vaccine, pregnancy, awareness, knowledge, attitudes, barriers.

| ARTICLE INFORMATION

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1. Introduction

Influenza viruses are ribonucleic acid (RNA) viruses categorized under the virus family named Orthomyxoviridae (Hutchinson & Yamauchi, 2018). The Influenza viruses are divided into four genera, namely Influenza A viruses (IAVs), Influenza B viruses (IBVs), Influenza C viruses (ICVs) and Influenza D viruses (IDVs) (Flerlage et al., 2021). Both IAVs and IBVs majorly affect human health, while ICVs can lead to mild disease in humans. IBVs are primarily restricted to human hosts, while IAVs can transmit infections in various host species from different animal classes, including mammals and birds (Wille & Holmes, 2019).

Influenza viruses cause respiratory infections by invading epithelial cells, leading to inflammation. In severe cases, inflammation may spread, causing multiorgan failure and death. Globally, influenza affects 10% of the population annually, causing 0.5 million deaths. Effective vaccine development and utilization are crucial for mitigating this burden (Javanian et al., 2021; Kalil & Thomas, 2019).

Influenza vaccines are crucial for prevention and control, but universal coverage is limited due to the virus's high mutation rate. WHO predicts annual strains to aid targeted vaccine development (Grech & Borg, 2020). Licensed vaccines are either live attenuated or inactivated (Wei et al., 2020). These vaccines work by initiating the production of virus specific antibodies in the body using the natural immune system of the human body. These antibodies are utilized to control viral spread when the body is exposed to the specific strains against which the antibodies were produced (Kalarikkal et al., 2024; Wei et al., 2020). Vaccines can be administered by various methods, including intramuscular injections, intradermal injections, jet injectors, and nasal sprays (Kalarikkal et al., 2024). Healthcare professionals determine dosage and administration based on age. Influenza vaccination challenges include a lack of universal vaccines due to antigenic shifts and low public acceptance. Healthcare providers must educate patients, particularly pregnant women, about influenza risks and vaccines (Kalarikkal et al., 2024; Vousden et al., 2021).

Existing literature demonstrates that seasonal influenza poses greater risks to pregnant women, often resulting in increased hospitalizations (Mertz et al., 2017; Vousden et al., 2021). WHO recommends prioritizing pregnant women for influenza vaccination, yet uptake remains low. Healthcare providers' knowledge and attitudes significantly influence vaccination rates (Morales et al., 2020). Studies show the effectiveness of influenza vaccines in pregnant women, protecting against laboratory-confirmed influenza and influenza-like illness (Quach et al., 2019). However, vaccine hesitancy persists due to psychological factors, including fear of side effects and misconceptions about vaccine efficacy (Adeyanju et al., 2021). Cross-sectional studies in various regions reveal low vaccination rates among pregnant women, with inadequate knowledge and recommendations from healthcare providers cited as major barriers (Albattat et al., 2021; AlMusailhi et al., 2019; Mayet et al., 2017). Some studies in Saudi Arabia assessed influenza vaccination among pregnant women. AlMusailhi et al. surveyed over 400 pregnant women in Dammam and Al-Khobar, revealing that 57.1% had good awareness, but only 19.8% were vaccinated, with 36.6% recommended by healthcare professionals (AlMusailhi et al., 2019). Albattat et al. found that 60.6% of 410 pregnant women in Al-Ahsa had insufficient knowledge, and 66.1% were not recommended vaccination, citing fear of side effects as a major barrier (Albattat et al., 2021). Mayet et al. reported low uptake (18.1%) in Riyadh, with only 3% recommended vaccination (Mayet et al., 2017). Alqahtani et al. found 9.48% believed the vaccine was safe for pregnant women (Alqahtani et al., 2017). National policies and immunization programs vary, with Saudi Arabia making efforts to improve vaccination awareness and uptake (Alqahtani et al., 2017; Attia et al., 2023).

Understanding the level of knowledge among pregnant women regarding influenza vaccination is essential for identifying gaps in awareness and education. This information can guide healthcare providers in tailoring educational interventions to improve vaccination rates. Furthermore, assessing attitudes towards influenza vaccination can reveal misconceptions or concerns that may hinder uptake, allowing for targeted interventions to address these issues. Moreover, identifying barriers to vaccination is crucial for designing effective strategies to overcome these obstacles and increase vaccination coverage among pregnant women. Given the potential severe outcomes of influenza infection during pregnancy and the importance of vaccination in preventing these complications, this study was conducted with the objectives of investigating the knowledge, attitudes, and barriers towards seasonal influenza vaccination among pregnant women in Qassim, Saudi Arabia, and to examine the association of socio-demographic factors with these elements.

2. Methodology

2.1 Study Design and Setting

The research was a cross sectional study conducted among pregnant females in eight primary healthcare centers (PHCCs) in Buraidah, Qassim, Saudi Arabia. The inclusion criteria for this study encompass pregnant females residing in Qassim, Saudi Arabia, who consented to participate. Conversely, females who were not pregnant or declined participation were excluded from the study.

2.2 Sample size and sampling technique

The sample size was calculated using the OpenEpi program. Based on a 95% confidence interval, 5% margin of error and the criteria of the proportion of vaccinated women as 19.8% (AlMusailhi et al., 2019), the estimated sample size was 244 and was adjusted to 250 to compensate for data collection errors. A convenience non-probability sampling technique was employed to collect the data from the participants. Data were collected from May 2023 to July 2023.

2.3 Study Instrument

The study was conducted at antenatal care clinics in PHCCs using an online self-administered questionnaire via Google Forms. The aim of the study was stated in the interface. The questionnaire was adapted from previous similar studies (Albattat et al., 2021; AlMusailhi et al., 2019; Mayet et al., 2017). The questionnaire contained socio-demographic characteristics of the participants, such as age, occupation, and residence. The questionnaire also included questions about awareness regarding the influenza vaccine as well as knowledge, attitude, and barriers to seasonal influenza vaccination among pregnant women visiting PHCCs in Qassim, Saudi Arabia. Thirteen questions were asked to assess the knowledge regarding the effects of contracting influenza during

pregnancy and the influenza vaccine. The questionnaire was pretested in a pilot study over a sample of 20 participants. Some modifications were made accordingly to ensure clarity and easy understanding of the questions.

2.4 Statistical analysis

The study involved a comprehensive statistical analysis of the collected data, utilizing both descriptive and inferential statistics. Analyzing data involved numerical and graphical presentations. Correct answers were coded as (1), whereas wrong or "not sure" ones were coded as (0). Due to variables not meeting parametric conditions (p-value <0.05), non-parametric tests were used for comparisons. To explore variations in total knowledge scores based on sociodemographic factors, statistical tests such as the Mann-Whitney U test, the Kruskal-Wallis Test, and Spearman's rank test were applied. Statistical significance was established at a p-value of 0.05. IBM's SPSS Software, version 27.0.0, was used for all statistical analyses.

2.5 Ethical considerations

Ethical approval of the study was obtained from the Qassim Regional Research Ethics Committee (Reference number: 607-45-4118). All data was kept confidential and used only for research purposes.

3. Results

Our study encompassed 276 pregnant women who visited PHCCs in Qassim, Saudi Arabia. Table 1 shows the sociodemographic characteristics of the participants. The median age of participants was 32 years old. Most had a university degree (n=181, 65.6%) and lived in cities (n=230, 83.3%). Regarding their employment status, a significant proportion (n=111, 40.2%) were housewives, while more women were working either within or outside the health sector (n=116, 42%). The vast majority of women had heard about **the** Flu vaccine before (n=264, 95.7%).

Table 1: - Sociodemographic Characteristics of Participants (n=276)

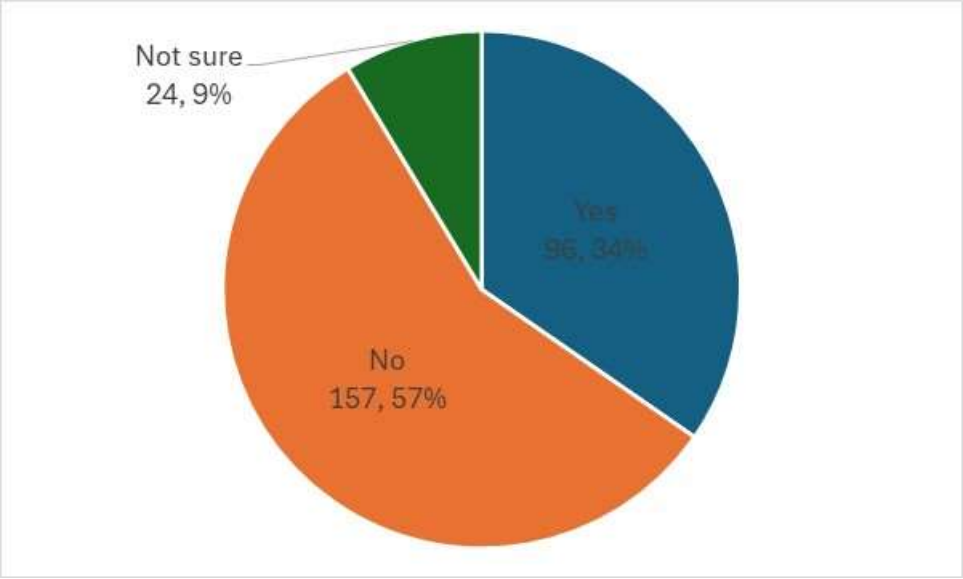
Variable:		**Median (IQR)**
Age (Years)		32 (27-37)
		n (%)
Gender	Female	276 (100.0)
Education	Uneducated	2 (0.7)
	Primary/intermediate/secondary	38 (13.8)
	Bachelor/Diploma	181 (65.6)
	Post-graduate degree	55 (19.9)
Residence	Urban	230 (83.3)
	Rural	46 (16.7)
Occupation	Student	46 (16.7)
	housewife	111 (40.2)
	Seeking a job	1 (0.4)
	Employee	101 (36.6)
	Employee in healthcare sector	15 (5.4)
	Resigned	2 (0.7)
No. of children	No children	30 (10.9)
	1-3	174 (63.0)
	4-6	70 (25.4)
	More than 6	2 (0.6)
Previous Knowledge of influenza vaccine	Yes	264 (95.7)
	No	5 (1.8)
	I'm not sure	7 (2.5)

n: *Frequency,* ***%:*** *percentage,* ***IQR:*** *interquartile range*

To assess awareness about the influenza vaccine, the study participants were asked if they had ever heard of the vaccine. A total of 265 (95.7%) study participants had heard of **the** influenza vaccine**,** while 5 (1.8%) had never heard of it, and 7 (2.5%) were not sure about it.

Figure 1 displays the influenza vaccine uptake as reported by the study participants. A total of 157 (57%) respondents had not received **the** influenza vaccine, while 24 (9%) were not sure about it.

Figure 1: Self-reported Influenza Vaccine uptake among study participants (n=277)



Concerning the source (s) of information women relied on to learn about the influenza vaccine, the majority obtained information from multiple sources, including social media, internet, family, friends, TV, electronic, and printed materials. Very few participants (n=28) got information from healthcare providers.

Women expressed various factors that hindered them from getting a flu vaccination. The majority of participants mentioned more than one barrier against vaccination. Barriers included fear of side effects, fear of injection, previous bad experiences with flu vaccination, and scepticism about the necessity of vaccination. Only 52 women reported that they would not reject having the vaccine.

Median knowledge scores were significantly different among subgroups of education (p-value=0.001), residence (p-value= 0.002), occupation (p-value= 0.001), number of children (p-value= 0.005), and previous information about influenza vaccine (p-value= 0.001). Women with post-graduate education (median score=8), having only one child (median score=8), residing in urban areas (median score=7), employed in the healthcare sector (median score=11), and having previous information about influenza vaccine (median score=7), reflected higher knowledge level of the vaccine compared to their counterparts (Table 2).

Table 2: - Differences in knowledge scores based on sociodemographic characteristics (13 Questions)

Variable:			***p-value***
Age (Years)	**Correlation Coefficient**= -0.063		0.301[S]
		Median (IQR)	
Education	Uneducated	4 (1-7)	**0.001[K]**
	Primary/intermediate/secondary	6 (5-7)	
	Bachelor/Diploma	6 (5-8)	
	Post-graduate degree	8 (7-10)	
Residence	Urban	7 (6-8)	**0.002[M]**
	Rural	6 (4.75-7)	
Occupation	Student	6.5 (5-8)	**0.001[K]**
	housewife	6 (5-8)	
	Employee	7 (6-8)	
	Employee in healthcare sector	11 (8.50-12)	
	Resigned	6 (6-6)	
No. of children	No children	6 (5-8)	**0.005[K]**
	1	8 (6-10)	
	2	6 (6-8)	
	3	7 (6-8)	
	4	6 (5-7)	
	5	6 (5-7)	
	6	6.5 (6-8)	
	7	2.5 (2-3)	
Previous Knowledge of influenza vaccine	Yes	7 (6-8)	**0.001[K]**
	No	3 (3-4)	
	I'm not sure	6 (4-6)	

S: *Spearman's test,* ***M:*** *Mann Whitney test,* ***K:*** *Kruskal Wallis test*

The median attitude scores were significantly different among subgroups of education (p-value=0.019), occupation (p-value= 0.002), number of children (p-value= 0.021), and previous information about influenza vaccine (p-value= 0.009). Women with post-graduate education (median score=4), having 1-6 children (median score=3), employed in the healthcare sector (median score=5), and having previous information about influenza vaccine (median score=3) exhibited more positive attitudes towards flu vaccination compared to their counterparts (Table 3).

Table 3: Differences of attitude scores based on sociodemographic characteristics. (8 Questions)

Variable:			***p-value***
Age (Years)	**Correlation Coefficient**= 0.096		0.111[S]
		Median (IQR)	
Education	Uneducated	3.5 (2-5)	**0.019[K]**
	Primary/intermediate/secondary	3 (0-4)	
	Bachelor/Diploma	3 (1-4)	
	Post-graduate degree	4 (2-5)	
Residence	Urban	3 (2-5)	0.307[M]
	Rural	3 (1-4)	
Occupation	Student	2 (1-3)	**0.002[K]**
	housewife	3 (1-4)	
	Employee	3 (2-5)	
	Employee in healthcare sector	5 (3-6)	
	Resigned	2 (2-2)	
No. of children	No children	2 (0-3)	**0.021[K]**
	1	3 (2-4)	
	2	3 (2-5)	
	3	3 (1-5)	
	4	3 (1-5)	
	5	3 (2-4)	
	6	3 (3-5)	
	7	1 (0-2)	
Previous Knowledge of influenza vaccine	Yes	3 (2-5)	**0.009[K]**
	No	0 (0-1)	
	I'm not sure	2 (1-3)	

S: *Spearman's test,* ***M:*** *Mann Whitney test,* ***K:*** *Kruskal Wallis test*

Age showed a non-significant correlation with median knowledge and attitude scores. Notably, age was found to be inversely correlated with knowledge score (Correlation Coefficient= -0.063), indicating that older women tend to be less knowledgeable about flu vaccination. Conversely, a positive correlation between age and attitude score (Correlation Coefficient= 0.096) suggests that older women generally had a more positive attitude towards the flu vaccination (Table 2&3).

4. Discussion

In 2012, the World Health Organization (WHO) advised that it is crucial for all pregnant women to receive immunization against influenza. The Strategic Advisory Group of Experts on Immunization issued this recommendation. Pregnant women are regarded as the most vulnerable population to seasonal influenza in comparison to other at-risk populations. They are expected to receive major benefits from obtaining the immunization. Our study found a promising self-reported level of awareness about influenza vaccines among pregnant women in Qassim (95.7%). However, the self-reported vaccination uptake (34%) was considerably lower as compared to the level of awareness. A similar trend is observed in the study by AlMusailhi et al. (2019), where a significant awareness does not equate to a high vaccination rate among pregnant women in the Dammam and Al-Khobar regions of Saudi Arabia. The difference suggests that although awareness is a crucial factor in enhancing immunization rates, it is not enough on its own. When the distinct barriers are not tackled, it becomes difficult to put awareness into action. The use of various sources, including family, friends, social networks, online information, and health-professionals, illustrates the complexity and multi-dimensional nature of health communication regarding the influenza vaccine. This observation is in agreement with the published literature, which focuses on the importance of multidimensional and comprehensive methods to facilitate education about vaccines, as discussed by Buchy et al. (2020). A wide array of information sources can certainly increase awareness, but it also poses challenges to ensuring that the information shared is factual and unified, which may impact public perceptions of vaccination.

The findings of our research indicate that although such awareness is common, there still are several barriers against influenza vaccination. The primary barriers include concerns over potential adverse effects and doubts about the importance of vaccination. Other studies have also reported psychological barriers to vaccine acceptability (Adeyanju et al., 2021). Shahid et al. (2023) and

Arriola et al. (2018) further showed that the pregnant population's shared concerns about the cost of the vaccine and limited awareness are universal barriers that exist in many cultures and socio-economic settings.

This study establishes a distinct association between socio-demographic characteristics, such as education, residence, occupation, and vaccine knowledge and attitudes. Women who have attained higher levels of education, live in urban areas, and work in the healthcare sector demonstrate more knowledge and hold more favorable attitudes about vaccination. These findings are in accordance with Wang et al. (2021) and D. Ditsungnoen et al. (2016), who found that socio-demographic characteristics played a critical role in determining the rate of vaccine uptake among pregnant women in China and Thailand, respectively. The correlation between previous information about the influenza vaccination and the increased knowledge and favorable attitudes reaffirms the importance of consistent and accurate information about health. This association suggests that, in addition to just the presence of information, its quality and reliability are important factors that shape long-term health behavior and decisions (Erazo et al., 2021).

Our study revealed low vaccine uptake despite a high level of vaccination awareness. This implies that the decision-making process regarding vaccines is a complex balance of knowledge, attitudes, and barriers. Healthcare professionals play a leading role in shaping the acceptability of the vaccine, as suggested by King et al. (2020) and Morales et al. 2020), among others, where a substantial proportion of vaccinated pregnant women in the U.S reported to have decided because of advice of healthcare provider (King et al., 2020; Morales et al., 2020). There is a higher likelihood that pregnant women having counseling from healthcare professionals would accept immunizations, and therefore extensive training in communication skills for healthcare providers is crucial (Barry et al., 2020).

Vaccine uptake and awareness vary across the regions, as reported by various studies (Albattat et al., 2021; AlMusailhi et al., 2019). These variations reveal the importance of developing specific health promotion strategies based on areas that take local culture, socio-economic, and health care aspects into consideration (Mayet et al., 2017). Other research has also highlighted similar barriers to vaccination, pointing to a global challenge in vaccine consumption. This, however, calls for an effective global strategy to overcome these barriers, as proposed by Attia et al. (2023) in their assessment of the Eastern Mediterranean Region (Attia et al., 2023).

Our study has certain limitations. The cross-sectional design makes it more difficult to understand changes in time and establish causality. Self-reported data may create biases related to response and recall. The implementation of convenience sampling and voluntary participation can lead to selection bias and limit the generalizability of the findings to the overall population of pregnant women in the region. Finally, the questionnaire used in this study did not inquire about the trimester levels of pregnancy. The degree of vaccine acceptability among pregnant women can significantly differ based on the specific trimester of their pregnancy.

5. Conclusion

Despite widespread awareness, there is still a low vaccination rate because of concerns about side effects and vaccine necessity. The socio-demographic factors play a significant role in vaccine attitudes, highlighting the importance of personalized and culturally relevant health education. Healthcare practitioners play a great role in bridging the gap between awareness and action, which notifies that there is a significant need for better communication and counseling strategies. Several recommendations include the intensification of public health educational activities, including debunking myths and the improvement of the training of healthcare providers regarding the promotion of vaccination. Future studies need to be conducted using qualitative and longitudinal approaches to explore changing perceptions and attitudes towards influenza vaccination. It is possible to achieve a more holistic approach to these points, which will also increase vaccination rates and produce better health outcomes for mothers and newborns.

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Informed consent: All participants were informed about the study's purpose, and informed consent was obtained.

References

[1] Adeyanju, G. C., Engel, E., Koch, L., Ranzinger, T., Shahid, I. B. M., Head, M. G., Eitze, S., & Betsch, C. (2021). Determinants of influenza vaccine hesitancy among pregnant women in Europe: a systematic review. *European Journal of Medical Research*, *26*(1). https://doi.org/10.1186/s40001-021-00584-w

[2] Albattat, H., Alahmed, A., Alkadi, F., & Aldrees, O. (2021). Knowledge, attitude, and barriers of seasonal influenza vaccination among pregnant women visiting primary healthcare centers in Al-Ahsa, Saudi Arabia. 2019/2020. *Journal of Family Medicine and Primary Care*, *10*(2), 783. https://doi.org/10.4103/jfmpc.jfmpc_2183_20

[3] AlMusailhi, S. A., AlShehri, N. M., & AlHarbi, W. M. (2019). Knowledge, utilization and barriers of pregnant women to Influenza vaccine in primary health care centers in Dammam and Al Khobar, Saudi Arabia, 2017–2018. *International Journal of Women's Health*, *11*, 207–211. https://doi.org/10.2147/ijwh.s194061

[4] Alqahtani, A. S., Althobaity, H. M., Al Aboud, D., & Abdel-Moneim, A. S. (2017). Knowledge and attitudes of Saudi populations regarding seasonal influenza vaccination. *Journal of Infection and Public Health*, *10*(6), 897–900. https://doi.org/10.1016/j.jiph.2017.03.011

[5] Arriola, C. S., Vasconez, N., Bresee, J., & Ropero, A. M. (2018). Knowledge, attitudes and practices about influenza vaccination among pregnant women and healthcare providers serving pregnant women in Managua, Nicaragua. *Vaccine*, *36*(25), 3686–3693. https://doi.org/10.1016/j.vaccine.2018.05.013

[6] Attia, R., Abubakar, A., Bresee, J. S., Mere, O., & Khan, W. (2023). A review of policies and coverage of seasonal influenza vaccination programs in the WHO Eastern Mediterranean Region. *Influenza and Other Respiratory Viruses*, *17*(3). https://doi.org/10.1111/irv.13126

[7] Barry, M. A., Aljammaz, K. I., & Alrashed, A. A. (2020). Knowledge, Attitude, and Barriers Influencing Seasonal Influenza Vaccination Uptake. *Canadian Journal of Infectious Diseases and Medical Microbiology*, *2020*, 1–6. https://doi.org/10.1155/2020/7653745

[8] Buchy, P., Badur, S., Kassianos, G., Preiss, S., & Tam, J. S. (2020). Vaccinating pregnant women against influenza needs to be a priority for all countries: An expert commentary. *International Journal of Infectious Diseases*, *92*, 1–12. https://doi.org/10.1016/j.ijid.2019.12.019

[9] Ditsungnoen, D., Greenbaum, A., Praphasiri, P., Dawood, F. S., Thompson, M. G., Yoocharoen, P., Lindblade, K. A., Olsen, S. J., & Muangchana, C. (2016). Knowledge, attitudes and beliefs related to seasonal influenza vaccine among pregnant women in Thailand. *Vaccine*, *34*(18), 2141–2146. https://doi.org/10.1016/j.vaccine.2016.01.056

[10] Erazo, C. E., Erazo, C. V., Grijalva, M. J., & Moncayo, A. L. (2021). Knowledge, attitudes and practices on influenza vaccination during pregnancy in Quito, Ecuador. *BMC Public Health*, *21*, 72. https://doi.org/10.1186/s12889-020-10061-4.

[11] Flerlage, T., Boyd, D. F., Meliopoulos, V., Thomas, P. G., & Schultz-Cherry, S. (2021). Influenza virus and SARS-CoV-2: pathogenesis and host responses in the respiratory tract. Nature Reviews Microbiology, 19, 1–17. https://doi.org/10.1038/s41579-021-00542-7

[12] Grech, V., & Borg, M. (2020). Influenza vaccination in the COVID-19 era. *Early Human Development*, *148*, 105116. https://doi.org/10.1016/j.earlhumdev.2020.105116

[13] Hutchinson, E. C., & Yamauchi, Y. (2018). Understanding Influenza. *Methods in Molecular Biology*, 1–21. https://doi.org/10.1007/978-1-4939-8678-1_1

[14] Javanian, M., Barary, M., Ghebrehewet, S., Koppolu, V., Vasigala, V., & Ebrahimpour, S. (2021). A brief review of influenza virus infection. *Journal of Medical Virology*, *93*(8), 4638–4646. https://doi.org/10.1002/jmv.26990

[15] Kalarikkal, S. M., Swinkels, H. M., & Jaishankar, G. B. (2024). Influenza Vaccine. In StatPearls. StatPearls Publishing. http://www.ncbi.nlm.nih.gov/books/NBK537197/

[16] Kalil, A. C., & Thomas, P. G. (2019). Influenza virus-related critical illness: pathophysiology and epidemiology. *Critical Care*, *23*(1). BMC. https://doi.org/10.1186/s13054-019-2539-x

[17] King, J. P., Hanson, K. E., Donahue, J. G., Glanz, J. M., Klein, N. P., Naleway, A. L., DeStefano, F., Weintraub, E., & Belongia, E. A. (2020). Survey of influenza vaccine knowledge, attitudes, and beliefs among pregnant women in the 2016–17 season. *Vaccine*, *38*(9), 2202–2208. https://doi.org/10.1016/j.vaccine.2020.01.039

[18] Mayet, A. Y., Al-Shaikh, G. K., Al-Mandeel, H. M., Alsaleh, N. A., & Hamad, A. F. (2017). Knowledge, attitudes, beliefs, and barriers associated with the uptake of influenza vaccine among pregnant women. *Saudi Pharmaceutical Journal*, *25*(1), 76–82. https://doi.org/10.1016/j.jsps.2015.12.001

[19] Mertz, D., Geraci, J., Winkup, J., Gessner, B. D., Ortiz, J. R., & Loeb, M. (2017). Pregnancy as a risk factor for severe outcomes from influenza virus infection: A systematic review and meta-analysis of observational studies. *Vaccine*, *35*(4), 521–528. https://doi.org/10.1016/j.vaccine.2016.12.012

[20] Morales, K. F., Menning, L., & Lambach, P. (2020). The faces of influenza vaccine recommendation: A Literature review of the determinants and barriers to health providers' recommendation of influenza vaccine in pregnancy. *Vaccine*, *38*(31), 4805–4815. https://doi.org/10.1016/j.vaccine.2020.04.033

[21] Quach, T. H. T., Mallis, N. A., & Cordero, J. F. (2019). Influenza Vaccine Efficacy and Effectiveness in Pregnant Women: Systematic Review and Meta-analysis. *Maternal and Child Health Journal*, *24*(2), 229–240. https://doi.org/10.1007/s10995-019-02844-y

[22] Shahid, S., Kalhoro, S., Khwaja, H., Hussainyar, M. A., Mehmood, J., Qazi, M. F., Abubakar, A., Mohamed, S., Khan, W., Jehan, F., & Nisar, M. I. (2023). Knowledge, attitudes, and practices towards seasonal influenza vaccination among pregnant women and healthcare workers: A cross-sectional survey in Afghanistan. *Influenza and Other Respiratory Viruses*, *17*(3). https://doi.org/10.1111/irv.13101

[23] Vousden, N., Bunch, K., & Knight, M. (2021). Incidence, risk factors and impact of seasonal influenza in pregnancy: A national cohort study. *PLOS ONE*, *16*(1), e0244986. https://doi.org/10.1371/journal.pone.0244986

[24] Wang, R., Tao, L., Han, N., Liu, J., Yuan, C., Deng, L., Han, C., Sun, F., Chi, L., Liu, M., & Liu, J. (2021). Acceptance of seasonal influenza vaccination and associated factors among pregnant women in the context of COVID-19 pandemic in China: a multi-center cross-sectional study based on health belief model. *BMC Pregnancy and Childbirth*, *21*(1). https://doi.org/10.1186/s12884-021-04224-3

[25] Wei, C.J., Crank, M. C., Shiver, J., Graham, B. S., Mascola, J. R., & Nabel, G. J. (2020). Next-generation influenza vaccines: opportunities and challenges. *Nature Reviews Drug Discovery*, *19*(4), 239–252. https://doi.org/10.1038/s41573-019-0056-x

[26] Wille, M., & Holmes, E. C. (2019). The Ecology and Evolution of Influenza Viruses. *Cold Spring Harbor Perspectives in Medicine*, a038489. https://doi.org/10.1101/cshperspect.a038489