Case Study

Knowledge, Attitudes, and Practices among Pregnant Saudi Women during the COVID-19 Pandemic: A Cross-Sectional Analysis

Radi Alsafi[1], Lama Ziyad Farsi[2], Ahmad Alharbi[3], Faisal Minshawi[1], Hadi Alsafi[4], Fadi Qashqari[5], Fawaz Edeeb Edris[6], Mazin Adnan Altuwrqi[1], Abdulelah Aljuaid[3], Hamza Assaggaf[1]*

[1]Department of Laboratory Medicine, Faculty of Applied Medical Sciences, Umm Al-Qura University, Makkah, Saudi Arabia.
[2]Microbiology Laboratory, East Jeddah Hospital, Ministry of Health, Saudi Arabia.
[3]Department of Clinical Laboratories Sciences, College of Applied Medical Sciences, Taif University, Taif 21944, Saudi Arabia.
[4]Internal Medicine Consultant, King Abdul Aziz Hospital, Ministry of Health, Saudi Arabia.
[5]Department of Microbiology, Medicine College, Umm Al-Qura University, Makkah 24381, Saudi Arabia.
[6]Associate Professor, Umm Al-Qura University, Makkah 24381, Saudi Arabia.

***Email:** hmsaggaf@uqu.edu.sa*

ABSTRACT

Emerging global infections, such as coronavirus disease (COVID-19), pose serious public health threats, especially for vulnerable groups, including pregnant women. Knowledge about the disease, attitudes toward disease prevention, and preventative practices can help curb the spread of disease and limit mortality as well. To determine knowledge, attitudes, and practices (KAP) among a cohort of Saudi women who were either pregnant during the pandemic or pregnant at the time of data collection. A cross-sectional, prospective observational study using data collected via an online self-reported questionnaire was carried out between February 3 and March 14, 2021. The questionnaire ascertained the levels of knowledge, attitude, and practice of pregnant women. An ANOVA and t-test were used to determine significant associations between levels of KAP and sociodemographic variables. The average knowledge score was 10.4 ± 2.85 out of 19 (54.7%); for attitudes, the average score was 3.4 ± 1.61 out of 5 (68%); and for practices, the average score was 5.9 ± 1.21 out of 7 (84.2%). Higher educational status and healthcare as a profession were significantly associated with improved KAP scores among pregnant women. Participants from the Western region of Saudi Arabia were heavily represented in our study. Pregnant women, especially those subgroups with low KAP scores, should be provided with adequate and updated information regarding COVID-19. This can help prevent the spread of disease and increase their knowledge, especially regarding breastfeeding practices during infection.

Key words: *COVID-19/prevention & control, Health knowledge, Attitudes, Practice, Risk assessment, Pregnancy*

INTRODUCTION

The disease caused by SARS-CoV-2, COVID-19, has created a pandemic that has ravaged the healthcare systems of the entire world, with vast socioeconomic repercussions [1, 2]. Pregnant women constitute a vulnerable group, one at a greater risk of contracting COVID-19 due to physical and physiological stressors and a weakened immune system [3, 4]; unsurprisingly, they are at a greater risk of complications resulting from severe disease caused by other coronaviruses [5]. While the reported incidence of vertical transmission of the virus is low, at 3.2%, during

the third trimester [6, 7], nevertheless, COVID-19 infection during pregnancy can lead to significant maternal and neonatal morbidity in terms of preeclampsia, preterm and low-birth-weight births, and fetal distress [8-10].

Even with the advent of vaccinations for COVID-19, public health measures to avoid the transmission of the virus are still an important mainstay for preventing disease spread, as well as the emergence of new variants [11, 12]. Knowledge about the disease is essential to modifying attitudes and practices, which is an important step in curtailing the spread of infection [13, 14]. A recent cross-sectional analysis of psychological distress among mothers and expectant women in Saudi Arabia showed significantly high levels of psychological distress, with the educational status of the participant women being inversely proportional to their distress levels [15].

Only a limited number of studies have been conducted to determine the knowledge, attitudes, and practices (KAP) of pregnant women regarding COVID-19 [13, 16-18]. While the majority of these studies have reported adequate knowledge and positive attitudes among pregnant women, there is still a need to strive for continuous awareness regarding the disease. The Ministry of Health (MOH) in Saudi Arabia has published online awareness content regarding pregnancy and COVID-19 [19]; this and other updated resources must be utilized to spread proper awareness and dispel the fears of pregnant women. The objective of the present study is to evaluate the KAP of women who were either currently pregnant or previously pregnant during the pandemic in Saudi Arabia.

MATERIALS AND METHODS

A questionnaire-based cross-sectional study was conducted online among women for 1 month, from February 2021 to March 2021. Ethical approval for the study was obtained from the Institutional Review Board Committee, Security Forces Hospital, Makkah, with registration number HAP-02-K-052 and IRB number 0432-280621. A self-reported questionnaire was created on Google Forms and was distributed online using social media platforms such as Twitter, WhatsApp, and Instagram. The questionnaire used an automatic selection process: consecutive participants who identified as women, were either pregnant during the pandemic or during the time of data collection, and provided informed consent to complete the survey and have their data stored and collected for research were allowed to proceed with filling out the questionnaire, while the remainder were excluded.

Based on CDC recommendations regarding COVID-19 and World Health Organization (WHO) recommendations on COVID-19 in pregnancy and breastfeeding, a questionnaire was self-constructed in English and translated into Arabic. The questionnaire was reviewed and verified by all the authors; additionally, it was reviewed by two virologists and one gynecologist, and the linguistic validity of the translated questionnaire was confirmed by a linguistics expert. The questionnaire was distributed online in the Arabic language only. The background and goals of the study were explained in the first section of the questionnaire. Pilot testing of the questionnaire was carried out on 32 pregnant women to ensure the internal consistency and reliability of the questionnaire, as well as help the respondents understand the questions — these women were excluded from the final analysis.

The questionnaire was subdivided into four sections: the first dealt with demographic information, including age, pregnancy status (such as currently pregnant or pregnant at any stage during the pandemic), trimester (for currently pregnant women), nationality, region, level of education, and a history of any comorbid diseases. Subsequent sections were focused on knowledge of pregnant women regarding COVID-19 (19 questions), the practices of pregnant women (seven questions), and the attitudes of the participants toward COVID-19 (five questions). The grading of the responses was performed on a 3-point Likert scale: Yes, No, and I Don't Know; 1 point was awarded for each correct response, while 0 points were awarded for incorrect responses. An average of 7–10 minutes was required to complete the questionnaire.

After data collection was completed, the results were downloaded as a Microsoft Excel file and analyzed using the Statistical Package for the Social Sciences (SPSS) software Version 26. Knowledge, attitude, and practice (KAP) scores were compared for each demographic variable to find significant correlations. Descriptive variables were described using frequency (percentage), while quantitative variables were described using mean ± SD or median (interquartile range), as per data distribution. Correlations between categorical variables were calculated using a Chi-square test, while those between continuous variables were calculated by using an independent samples t-test or ANOVA, with the level of significance being $p<0.0$.

RESULTS AND DISCUSSION

Of the 2,174 women who responded to the questionnaire, 1,574 were eligible for participation in the study, while the remainder were excluded based on not being pregnant. The various sociodemographic characteristics of the participant women are outlined in **Table 1**:

Table 1. Baseline Characteristics of Participants

Parameter	Total Number = 1,574
Age	
<30 Years	822 (52.2%)
>30 Years	752 (47.8%)
Pregnancy Status	
Pregnant During Pandemic	608 (38.6%)
Currently Pregnant	966 (61.4%)
Trimester	
1st	337 (34.8%)
2nd	252 (26%)
3rd	377 (39%)
Education	
Pre-University	287 (18.2%)
Bachelors	1,078 (68.5%)
Graduate School	209 (13.3%)
Region Of Current Residence	
Central Region	281 (17.9%)
Western Region	991 (63.0)
Eastern Region	196 (12.5%)
Northern Region	56 (3.6%)
Southern Region	50 (3.2%)
Profession	
Healthcare Profession	227 (14.4%)
Non-Healthcare Profession	1,347 (85.6%)
Comorbid Conditions	
None	1,290 (82.0%)
Diabetes	44 (2.8%)
Heart Disease	3 (0.2%)
Kidney Disease	2 (0.1%)
Cancer	3 (0.2%)
Hypertension	23 (1.5%)
Respiratory Disease	48 (3.0%)
Thyroid Disease	132 (8.4%)
Others	29 (1.8%)

The responses of participants to each question regarding knowledge are presented in **Table 2**. The overall mean knowledge score of the participants was 10.36 ± 2.58, and only 48.5% of the participants were found to have good knowledge scores (≥ 11).

Table 2. Knowledge regarding COVID-19

Question	Response			Correct Response N (%)
	Yes n (%)	No n (%)	Don't know n (%)	
K1: Is a Novel Coronavirus the Same as the Influenza Virus?	95 (6%)	1277 (81%)	202 (12.8%)	1,277 (81.1%)
K2: Does the Novel Coronavirus Spread by Close Contact with Infected People Through Air Droplets During Coughing/Sneezing?	1514 (96.2%)	21 (1.3%)	39 (2.5%)	1,514 (96.2%)

K3: Does the Novel Coronavirus Spread from Place to Place (Via Air)?	535 (34%)	764 (48.5%)	275 (17.5%)	764 (48.5%)
K4: Does the Novel Coronavirus Spread Indirectly Via Contact with Contaminated Surfaces and then Touching the Eyes, Nose, or Mouth?	1491 (94.7%)	32 (2%)	51 (3.2%)	1,491 (94.7%)
K5: Can a Person be Infected with a Novel Coronavirus without Showing any Symptoms?	1487 (94.5%)	30 (1.9%)	57 (3.6%)	1,487 (94.5%)
K6: Is It Possible for Asymptomatic Novel Coronavirus Patients to Transmit the Disease to others?	1295 (82.3%)	110 (7%)	165 (10.7%)	1,295 (82.3%)
K7: Is There any Possibility for a Recovered Novel Coronavirus Patient to Become Infected again?	1209 (76.8%)	70 (4.4%)	295 (18.7%)	1,209 (76.8%)
K8: Is Novel Coronavirus Transmitted to Infants (Vertically) during Pregnancy?	111 (7.1%)	775 (49.2%)	688 (43.7%)	775 (49.2%)
K9: Is There any Approved Treatment that Can Help to Prevent the Transmission of the Virus to The Infant during Pregnancy?	35 (2.2%)	643 (40.9%)	896 (56.9%)	643 (40.9%)
K10: Do You Think that the Effects of Novel Coronavirus on Pregnancy Would Vary Throughout the First Trimester, Second Trimester, and Last Trimester?	552 (35.1%)	402 (25.5%)	620 (39.4%)	402 (25.5%)
K11: If a Pregnant Woman is Infected with a Novel Coronavirus, is it Necessary to Take a Sample from the Infant after Delivery for Testing?	783 (49.7%)	336 (21.3%)	455 (28.9%)	783 (49.7%)
K12: If a Pregnant Woman is Infected with a Novel Coronavirus, is it Necessary to Isolate the Infant after Delivery?	797 (50.6%)	386 (24.5%)	391 (24.8%)	386 (24.5%)
K13: If a Pregnant Woman is Infected with the Novel Coronavirus during the Last 3 Months of the Pregnancy, are There any Regulations Regarding Either Delivery Vaginal or Cesarean Section?	512 (32.5%)	310 (19.7%)	752 (47.8%)	310 (19.7%)
K14: Does The Risk of Novel Coronavirus Disease Increase for Pregnant Women if they Have Chronic Diseases?	1447 (91.9%)	5 (0.3%)	122 (7.8%)	1,447 (91.9%)
K15: Do You Think that Pregnant Women are More Susceptible to Becoming Infected with Novel Coronavirus as Compared to other Women?	742 (47.1%)	509 (32.3%)	323 (20.5%)	509 (32.3%)
K16: Does the Virus Spread from an Infected Mother to Her Infant Through Breastfeeding?	405 (25.7%)	650 (41.3%)	519 (33%)	650 (41.3%)
K17: Does the Milk of a Recovered Pregnant Woman Contain Specific Novel Coronavirus Antibodies?	351 (22.3%)	232 (14.7%)	991 (63.0%)	351 (22.3%)
K18: Is it Possible for a Breastfeeding Mother to Transmit Immunity to the Infant if the Breastfeeding Woman Has Been Infected with a Novel Coronavirus?	395 (25.1%)	252 (16.0%)	927 (58.9%)	395 (25.1%)
K19: Are there any Precautions Infected Women Should Take during Breastfeeding?	1021 (64.9%)	63 (4%)	490 (31.1%)	1,021 (64.9%)

Table 3 describes the distribution of the responses of pregnant women regarding their attitudes. Overall, pregnant women had positive attitudes, with a mean score of 3.36 ± 1.16. Also, 77.4% of pregnant women had good attitude scores (≥3).

Table 3. Attitudes of pregnant women regarding COVID-19

Question	Response			Correct Response n (%)
	Yes n (%)	No n (%)	Don't know n (%)	
a1: After approving the use of vaccination, do you support the idea of vaccination for pregnant women against novel coronavirus?	326 (20.7%)	980 (62.3%)	268 (17.0%)	980 (62.3%)
a2: Do you regret that you became pregnant during this pandemic?	229 (14.5%)	1291 (82.0%)	54 (3.4%)	1291 (82.0%)
a3: Do you support delaying pregnancy until the end of this pandemic?	596 (37.9%)	861 (54.7%)	117 (7.4%)	861 (54.7%)
a4: Do you support infected women breastfeeding their children?	737 (46.8%)	447 (28.4%)	390 (24.8%)	737 (46.8%)
a5: Do you support the idea of abortion for novel coronavirus-infected pregnant women?	16 (1%)	1422 (90.3%)	136 (8.6%)	1,422 (90.3%)

The responses regarding the practices of pregnant women during the COVID-19 are outlined in **Table 4**. Mean practice scores were also good (5.85 ± 1.20), with 94.7% of women describing good practices during the pandemic. Particularly encouraging was the number of women (82.5%) who were willing to become vaccinated during their pregnancy.

Table 4. Attitudes of pregnant women regarding COVID-19

Question	Response			Correct Response n (%)
	Yes n (%)	No n (%)	Don't know n (%)	
P1: Would you isolate yourself if you haD any of novel coronavirus symptoms, despite your COVID TEST resultS BEING negative?	883 (56.1%)	635 (40.3%)	56 (3.6%)	883 (56.1%)
P2: During this pandemic, do you usually wash or sanitize your personal items after coming from inside?	1,287 (81.8%)	278 (17.7%)	9 (0.6%)	1,287 (81.8%)
P3: During this pandemic, do you avoid going to crowded places?	1,444 (91.7%)	123 (7.8%)	7 (0.4%)	1,444 (91.7%)
P4: During this pandemic, do you usually share food or A water pot with others?	165 (10.5%)	1,399 (88.9%)	10 (0.6%)	1,399 (88.9%)
P5: During this pandemic, do you MAINTAIN A social distance (1.5–2 meters) from others?	1,405 (89.3%)	146 (9.3%)	23 (1.5%)	1,405 (89.3%)
P6: Do you sanitize or wash your hands after touching surfaces or objects?	1,493 (94.9%)	78 (5%)	3 (0.2%)	1,493 (94.9%)
P7: Would you take the novel coronavirus vaccine during PREGNANCY?	77 (4.9%)	1,299 (82.5%)	198 (12.6%)	1,299 (82.5%)

The mean scores for knowledge, practices, and attitudes were compared with the baseline characteristics of the participants, including age, profession, educational status, and region of residence using an ANOVA or t-test **(Table 5)**. Participants aged > 30 years had significantly, albeit slightly, higher mean practice scores ($p = 0.000$). Although there was a significantly higher mean knowledge score for those in a healthcare profession ($p = 0.000$), the mean scores for practice did not vary significantly.

Table 5. Comparison of baseline characteristics of study participants and mean knowledge, practice, and attitudes score using ANOVA or *t*-test

Parameter	Knowledge Score		Practice Score		Attitude Score	
	Mean (SD)	p-value	Mean (SD)	p-value	Mean (SD)	p-value
Overall	10.36 (2.58)		5.85 (1.20)		3.36 (1.16)	
Age						
< 30 years	10.44 (2.56)	0.217	5.73 (1.23)	**0.000**	3.39 (1.12)	0.181
> 30 years	10.28 (2.60)		5.98 (1.16)		3.32 (1.20)	
Profession						
Healthcare	11.22 (2.45)	**0.000**	5.92 (1.16)	0.292	3.50 (1.16)	**0.049**
Non-healthcare	10.22 (2.57)		5.83 (1.21)		3.33 (1.16)	
Education Status						
Pre-university	9.89 (2.83)		5.86 (1.14)		3.20 (1.23)	
Bachelor	10.46 (2.49)	**0.003**	5.82 (1.21)	0.226	3.36 (1.14)	**0.005**
Graduate School	10.48 (2.60)		5.98 (1.25)		3.55 (1.12)	
Region						
Central Region	10.24 (2.52)		5.71 (1.32)		3.36 (1.14)	
Western Region	10.33 (2.53)		5.90 (1.16)		3.35 (1.15)	
Eastern Region	10.88 (2.76)	**0.005**	5.71 (1.26)	0.050	3.54 (1.14)	**0.004**
Northern Region	10.55 (2.78)		5.80 (1.16)		3.25 (1.23)	
Southern Region	9.46 (2.62)		6.04 (1.06)		2.84 (1.18)	

The various study domains of knowledge and practice were correlated with one another using Pearson's coefficient **(Table 6)**. Although we found significant associations between several domains of knowledge and practice, the strength of these correlations was relatively weak ($r < 0.1$). A significant positive correlation ($r = 0.118$) was found between knowledge regarding the precautions taken by infected women during breastfeeding and the practice of washing or sanitizing one's personal belongings after coming inside ($p = 0.000$).

Table 6. Pearson's correlation between the study variables and the various domains of knowledge and practice

Variables	Correlation (R)	p-value
Overall knowledge vs practice	0.045	0.075
k2 vs p4	0.067	0.008
k2 vs p6	0.074	0.003
k3 vs p4	0.064	0.011
k4 vs p6	0.061	0.016
k5 vs p1	0.061	0.016
k7 vs p2	0.056	0.025
k7 vs p7	0.060	0.017
k8 vs p7	0.075	0.003
k9 vs p7	0.096	0.000
k10 vs p2	0.054	0.032
k10 vs p3	-0.052	0.040
k12 vs p6	-0.054	0.031
k12 vs p7	0.068	0.007

k13 vs p7	0.060	0.018
k15 vs p1	-0.075	0.003
k15 vs p2	-0.113	0.000
k15 vs p3	-0.098	0.000
k15 vs p5	-0.072	0.004
k15 vs p6	-0.079	0.002
k15 vs p7	0.050	0.048
k17 vs p6	-0.062	0.014
k18 vs p6	-0.051	0.044
k19 vs p2	0.118	0.000
k19 vs p3	0.060	0.018

Pregnant women constitute an important vulnerable group that is at risk of contracting COVID-19 and suffering from its long-term sequelae. The prevention of COVID-19 remains the most important method of protection against the disease. Knowledge, attitudes, and practices (KAP) are crucial in recognizing preventive goals, and for this purpose, we conducted this study among pregnant women in Saudi Arabia.

We found a relatively low average score for knowledge (10.36 ± 2.58 out of 19; 54.7%) among the participating women, similar to a study from South Africa conducted in a primary health setting, in which the mean knowledge score was only 43% [20]; however, certain studies have shown a much higher correct knowledge rate among pregnant women in developing countries [13, 16]. In our study, high knowledge scores were observed related to the transmission routes of the virus (the frequency of correct responses for air droplets, aerosols, and contaminated surfaces was 96.2%, 48.5%, and 94.7%, respectively). This is consistent with other studies and an important indicator of practices that should be undertaken by pregnant women to prevent transmission [21]. Poor knowledge regarding viral transmission and infection prevention has been linked with an increased risk of infection and, subsequently, increased mortality as well [22].

In contrast, participants were unaware of delivery regulations via spontaneous vaginal or cesarean section deliveries, with only 19.7% answering correctly. While fear and concerns about contracting COVID-19 during delivery have been widely reported in cohorts of pregnant women in India, Iran, and Turkey [13, 21, 23], regulations regarding the mode of delivery have not been widely reported in the literature. Current guidelines by the American College of Obstetricians and Gynecologists (ACOG) recommend that cesarean delivery should only be undertaken based on obstetric indications and that decisions regarding the same should not be guided by COVID-19 status alone [24]. Knowledge regarding lactation practices was also poor because only 41.3% knew that SARS-CoV-2 cannot be transmitted via milk and only 22.3% were aware that milk from recovered women contains specific coronavirus antibodies. Kamal *et al.*, also found that only 17% of women believed direct breastfeeding to be the feeding method of choice for COVID-19-positive mothers [16]. Although the risk of transmission of COVID-19 via breastmilk is minimal, there is a small risk of spread via respiratory droplets during direct breastfeeding; consequently, the American College of Obstetricians and Gynecologists (ACOG) recommends that either expressed breastmilk should be used or breastfeeding should be done with the necessary precautions, such as hand-washing and wearing a mask [24]. Low knowledge scores in these areas reflect a gap in health education that must be overcome by governmental programs and media campaigns.

Generally, the pregnant women had good overall attitudes regarding the COVID-19 pandemic (average score 3.36 ± 1.16 out of 5). Participants with a healthcare profession status and those who were highly educated had significantly high levels of positive attitudes, which was consistent with other reported studies [25, 26]. The positive attitudes among educated individuals have been linked with increased access to accurate information on COVID-19 via the Internet and social media, as well as a better understanding of outbreak-related research [27]. However, a majority of pregnant women (62.3%) did not support the idea of vaccination against COVID-19 during pregnancy. This is similar to the low rates of vaccine acceptance reported among pregnant and breastfeeding women [28]. A significant number of participants (90.3%) did not support the idea of abortion during the pandemic without a justified cause.

The majority of participants in our study reported good practices during the pandemic, with 91.7% supporting the idea of avoiding crowded places to prevent the spread of disease and 91.9% considering hand hygiene a good

preventative method. Both of these are essential preventative measures, and other studies show similarly good practices among pregnant women [13, 25]. However, the approach to vaccination during pregnancy was not encouraging, with 82.5% of women being against it. Although it is now known that COVID-19 vaccines are safe during pregnancy, with the CDC recommending them for pregnant and breastfeeding women [29], at the time of our data collection, data on vaccine safety during pregnancy were still pending, with regulatory authorities recommending caution or seeking a physician's advice before receiving a vaccine during pregnancy.

Our study has important health implications, especially for policy-making centered on pregnant women with low KAP (i.e., those with poor educational status and non-healthcare professions). While COVID-19 resources are available through the Ministry of Health (MOH) and the CDC, there are still gaps regarding knowledge and practices that must be resolved. Updated data on vaccination should be provided to pregnant and breastfeeding women so that the spread of infection and mortality can be limited. With the advent of newer COVID-19 variants, it is refreshing that pregnant women have sound practices regarding preventative measures.

Our study has certain limitations. The majority of our participants were from the Western region of Saudi Arabia, and other regions were not represented equally. However, we believe this study is one of the initial studies on KAP among pregnant women in Saudi Arabia, and findings from our study have important implications for policy formulation for this subpopulation. Due to the evolving nature of the evidence on this topic, certain responses may change over time; one example is the response to vaccination during pregnancy, which has significantly shifted in favor of vaccination since our data collection. Nevertheless, sound knowledge, positive attitudes, and good practices are the hallmark of disease prevention, especially in this uncertain time of new variants [30].

CONCLUSION

Overall, pregnant women demonstrated sound knowledge, positive attitudes, and good practices regarding COVID-19. Educational status and healthcare profession status were significantly associated with better KAP. However, knowledge regarding breastfeeding practices and vaccination during pregnancy was relatively poor. Public health efforts should be made in this regard to ease access to updated information for pregnant women, as well as to encourage preventative measures, especially in groups with low KAP.

REFERENCES

1. Feehan J, Apostolopoulos V. Is COVID-19 the worst pandemic? Maturitas. 2021;149:56-8. doi:10.1016/j.maturitas.2021.02.001
2. Alotibi F. Current strategies in diagnostics and therapeutics against novel coronavirus disease (COVID-19). Acta Pharm. 2022;72(2):171-97.
3. Phoswa WN, Khaliq OP. Is pregnancy a risk factor of COVID-19? Eur J Obstet Gynecol Reprod Biol. 2020;252:605-9. doi:10.1016/j.ejogrb.2020.06.058
4. Aldahlawi AM, Zaher KSA. Spotlight on Immunity against COVID-19 with Emphasis on Cytokine Storm. Pharmacophore. 2021;12(2):57-65.
5. Wastnedge EA, Reynolds RM, Van Boeckel SR, Stock SJ, Denison FC, Maybin JA, et al. Pregnancy and COVID-19. Physiol Rev. 2021;101(1):303-18. doi:10.1152/physrev.00024.2020
6. Kotlyar AM, Grechukhina O, Chen A, Popkhadze S, Grimshaw A, Tal O, et al. Vertical transmission of coronavirus disease 2019: A systematic review and meta-analysis. Am J Obstet Gynecol. 2021;224(1):35-53. doi:10.1016/j.ajog.2020.07.049
7. Farber IM, Khachatryan LG, Geppe NA, Kasanave EV. Clinical particularities of a new Coronavirus infection (COVID-19) in children. J Adv Pharm Edu Res. 2020;10(4):135-9.

8. Lassi ZS, Ana A, Das JK, Salam RA, Padhani ZA, Irfan O, et al. A systematic review and meta-analysis of data on pregnant women with confirmed COVID-19: Clinical presentation, and pregnancy and perinatal outcomes based on COVID-19 severity. J Glob Health. 2021;11. doi:10.7189/jogh.11.05018

9. Al-Matary A, Almatari F, Al-Matary M, AlDhaefi A, Alqahtani MH, Alhulaimi EA, et al. Clinical outcomes of maternal and neonate with COVID-19 infection–Multicenter study in Saudi Arabia. J Infect Public Health. 2021;14(6):702-8. doi:10.1016/j.jiph.2021.03.013

10. Wei SQ, Bilodeau-Bertrand M, Liu S, Auger N. The impact of COVID-19 on pregnancy outcomes: A systematic review and meta-analysis. CMAJ. 2021;193(16):E540-8. doi:10.1503/cmaj.202604

11. Van Oosterhout C, Hall N, Ly H, Tyler KM. COVID-19 evolution during the pandemic – Implications of new SARS-CoV-2 variants on disease control and public health policies. Virulence. 2021;12(1):507-8. doi:10.1080/21505594.2021.1877066

12. Zhu Y, Li J, Pang Z. Recent insights for the emerging COVID-19: Drug discovery, therapeutic options and vaccine development. Asian J Pharm Sci. 2021;16(1):4-23.

13. Kaur TP, Rana A, Perumal V, Sharma A, Dadhwal V, Kulshrestha V, et al. A cross-sectional analysis to evaluate knowledge, attitude, and practices among pregnant women during COVID-19 pandemic. J Obstet Gynaecol India. 2021;71(1):18-27. doi:10.1007/s13224-021-01558-y

14. Alghamdi A, Ibrahim A, Alraey M, Alkazemi A, Alghamdi I, Alwarafi G. Side effects following COVID-19 vaccination: A cross-sectional survey with age-related outcomes in Saudi Arabia. J Adv Pharm Educ Res. 2021;11(3):119-25.

15. Meraya AM, Syed MH, Yasmeen A, Mubaraki AA, Kariry HD, Maabouj W, et al. COVID-19 related psychological distress and fears among mothers and pregnant women in Saudi Arabia. Plos One. 2021;16(8):e0256597. doi:10.1371/journal.pone.0256597

16. Kamal D, Thakur VD, Swain SK, Vikneshram CR. Knowledge, attitude, and practice toward COVID-19 among pregnant women in a tertiary care hospital during the COVID-19 outbreak. J Mar Med Soc. 2020;22(3):66. doi:10.4103/jmms.jmms_81_20

17. Allagoa DO, Oriji PC, Obagah L, Tekenah ES, Dambo N, Atemie G. Knowledge, attitudes and practices towards Covid-19 among pregnant women in a tertiary hospital in South-South, Nigeria. Int J Res Rep Gynaecol. 2020;3(3):35-41.

18. Ding W, Lu J, Zhou Y, Wei W, Zhou Z, Chen M. Knowledge, attitudes, practices, and influencing factors of anxiety among pregnant women in Wuhan during the outbreak of COVID-19: A Cross-sectional Study. BMC Pregnancy Childbirth. 2021;21(1):1-9. doi:10.1186/s12884-021-03561-7

19. Pregnant Women and COVID-19 [Internet]. Ministry of Health. 2021 [cited 10 December 2021]. Available from: https://www.moh.gov.sa/en/HealthAwareness/EducationalContent/wh/Pages/030.aspx

20. Hoque AM, Alam AM, Hoque M, Hoque ME, Van HG. Knowledge, attitudes, and practices towards COVID-19 of pregnant women at a primary health care facility in South Africa. Eur J Med Heal Sci. 2021;3(1):50-5. doi:10.24018/ejmed.2021.3.1.654

21. Maharlouei N, Asadi N, Bazrafshan K, Roozmeh S, Rezaianzadeh A, Zahed-Roozegar MH, et al. Knowledge and attitude regarding COVID-19 among pregnant women in Southwestern Iran in the early period of its outbreak: A cross-sectional study. Am J Trop Med Hyg. 2020;103(6):2368. doi:10.4269/ajtmh.20-0608

22. Negera E, Demissie TM, Tafess K. Inadequate level of knowledge, mixed outlook and poor adherence to COVID-19 prevention guideline among Ethiopians. BioRxiv. 2020. doi:10.1101/2020.07.22.215590

23. Yassa M, Birol P, Yirmibes C, Usta C, Haydar A, Yassa A, et al. Near-term pregnant women's attitude toward, concern about and knowledge of the COVID-19 pandemic. J Matern Fetal Neonatal Med. 2020;33(22):3827-34. doi:10.1080/14767058.2020.1763947

24. COVID-19 FAQs for Obstetrician-Gynecologists, Obstetrics [Internet]. Acog.org. 2021 [cited 2 January 2022]. Available from: https://www.acog.org/clinical-information/physician-faqs/covid-19-faqs-for-ob-gyns-obstetrics

25. Alnasser AH, Al-Tawfiq JA, Al-Kalif MS, Shahadah RF, Almuqati KS, Al-Sulaiman BS, et al. Public knowledge, attitudes, and practice towards COVID-19 pandemic in Saudi Arabia: A web-based cross-sectional survey. Med Sci. 2021;9(1):11. doi:10.3390/medsci9010011

26. Asdaq SM, Alshrari AS, Imran M, Sreeharsha N, Sultana R. Knowledge, attitude and practices of healthcare professionals of Riyadh, Saudi Arabia towards COVID-19: A cross-sectional study. Saudi J Biol Sci. 2021;28(9):5275-82. doi:10.1016/j.sjbs.2021.05.036

27. Ferdous MZ, Islam MS, Sikder MT, Mosaddek AS, Zegarra-Valdivia JA, Gozal D. Knowledge, attitude, and practice regarding COVID-19 outbreak in Bangladesh: An online-based cross-sectional study. PloS one. 2020;15(10):e0239254. doi:10.1371/journal.pone.0239254

28. Samannodi M. COVID-19 vaccine acceptability among women who are pregnant or planning for pregnancy in Saudi Arabia: A cross-sectional study. Patient Prefer Adherence. 2021;15:2609. doi:10.2147/PPA.S338932

29. Vaccination considerations for people pregnant or breastfeeding [Internet]. Centers for Disease Control and Prevention. 2021 [cited 2 January 2022]. Available from: https://www.cdc.gov/coronavirus/2019-ncov/vaccines/recommendations/pregnancy.html

30. What we know about the Omicron variant [Internet]. Unicef.org. 2021 [cited 2 January 2022]. Available from: https://www.unicef.org/coronavirus/what-we-know-about-omicron-variant