Knowledge, attitudes, and behaviours of pregnant women towards COVID-19: a cross-sectional survey

WY Lok *, CY Chow, CW Kong, William WK To

ABSTRACT

Introduction: This study investigated the knowledge, attitudes, and behaviours of pregnant women towards coronavirus disease 2019 (COVID-19), as well as obstetric services provided by public hospitals (eg, universal screening) during the pandemic.

Methods: This cross-sectional survey was performed in the antenatal clinics of Kowloon East Cluster, Hospital Authority. Questionnaires were distributed to pregnant women for self-completion during follow-up examinations.

Results: In total, 623 completed questionnaires were collected from 28 July 2020 to 13 August 2020. Within this cohort, 83.1% of the women expressed high levels of worry (41.9% very worried and 41.3% worried) about contracting COVID-19 during pregnancy, 70.5% believed that maternal COVID-19 could cause intrauterine infection of their fetuses, and 84.3% objected to banning husbands from accompanying wives during labour and delivery. Most women (80.6%) agreed with universal screening for COVID-19 at certain points during pregnancy. Logistic regression modelling showed that women who were very worried about contracting COVID-19 (P=0.005) and women in their third trimester of pregnancy (P=0.009) were more likely to agree with universal screening during pregnancy; women with higher income (P=0.017) and women who planned to deliver in a private hospital (P=0.024) were more likely to disagree with such screening.

Conclusion: Pregnant women expressed high levels of worry about contracting COVID-19 during pregnancy; universal screening during pregnancy was acceptable to a large proportion of our participants. Efforts should be made to specifically include pregnant women when launching any population screening programme for COVID-19.

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New knowledge added by this study

- This study investigated the knowledge, psychosocial behavioural responses, and opinions of pregnant women in Hong Kong towards coronavirus disease 2019 (COVID-19).
- A large majority of the women in this study expressed worry about COVID-19, despite a lack of comprehensive knowledge about the disease.
- More than 80% of the women agreed with universal screening for COVID-19 in pregnant women during visits to clinics and hospitals.

Implications for clinical practice or policy

- Universal screening should be incorporated as part of routine clinical management and in-patient care for pregnant women during the COVID-19 pandemic.
- Husbands should be allowed to accompany their wives during labour and delivery if a rapid screening method shows that the husbands do not have COVID-19.
- Online resources should be developed to enhance public knowledge about COVID-19-related complications in pregnancy.

Introduction

Coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has been a worldwide pandemic for more than 2 years. The first reported case of COVID-19 occurred in Wuhan, China in late December 2019.[1,2] On 21 January 2020, the first confirmed imported case of COVID-19 in Hong Kong was identified in a mainland Chinese tourist who arrived from Wuhan by high-speed rail.[3]

The dynamics of the current COVID-19 pandemic closely resemble the previous SARS epidemic because each has involved a respiratory disease caused by a coronavirus. Despite various

measures and strategies employed by the Hong Kong government and the public in an effort to combat viral spread, a third wave of infections occurred in the middle of 2020, leading to >100 new confirmed COVID-19 cases daily for 12 days consecutively in late July 2020.[4] In response, the government announced a variety of new measures to contain the spread of COVID-19.

Pregnant women in Hong Kong are particularly worried about the effects of COVID-19 because of their vulnerable immune status during pregnancy, as well as the fear of vertical transmission to the neonate.[5,6] During the 2003 SARS epidemic in Hong Kong, 12 pregnant women contracted SARS and three died. Among the survivors, SARS was associated with poor outcomes including high rates of mechanical ventilation and intensive care unit admission, as well as spontaneous miscarriage, preterm delivery, and intrauterine growth restriction. However, there was no evidence of perinatal transmission of SARS to infants.[7] In early 2020, the first reports of COVID-19 in Chinese pregnant women were published.[8,9] Systematic reviews concerning maternal and perinatal outcomes in cases of COVID-19 have since been published.[10-13]

To our knowledge, no studies have specifically assessed the basic knowledge and concerns of pregnant women with respect to COVID-19, or their acceptance of universal screening for infection by the causative virus (SARS-CoV-2); such information is important for the establishment of public education campaigns and launching COVID-19 population screening efforts that target pregnant women. This study aimed to evaluate the opinions of pregnant women concerning obstetric services provided during the pandemic, with particular focus on acceptance of universal screening for COVID-19 during pregnancy. The study also explored the knowledge, attitudes, and behaviours of pregnant women towards the COVID-19 pandemic.

Methods

This cross-sectional survey was conducted in two antenatal clinics in the Kowloon East Cluster of Hong Kong. The questionnaires were distributed to consecutive pregnant women who attended antenatal follow-up examinations in the two clinics from July 2020 to August 2020.

The paper questionnaires were anonymous, self-administered, and available in either Chinese or English. The first section of the questionnaire collected basic demographic data from the recruited women. The remaining sections comprised four domains with 31 total questions; five questions had multiple parts. The four domains included questions regarding (1) knowledge of COVID-19 in pregnancy, (2) attitudes towards COVID-19, (3) social behaviours during the COVID-19 pandemic, and (4)

孕婦對2019冠狀病毒病的認識、態度和行為：橫斷面調查

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引言：本研究檢視孕婦對大流行期間對2019冠狀病毒病（新冠病毒）的認識、態度和行為，以及對公立醫院產科服務的看法（例如篩檢）。

方法：這項橫斷面調查在醫院管理局九龍東聯網產前診所進行。孕婦在隨訪檢查期間自行填寫問卷。

結果：2020年7月28日至2020年8月13日期間共收集623份已完成問卷。當中，83.1%受訪孕婦高度憂慮懷孕期間會感染新冠病毒（41.9%表示非常擔憂，41.3%表示擔憂），70.5%認為孕婦感染新冠病毒可導致胎兒宮內感染，84.3%反對禁止丈夫在妻子生產和分娩時陪產。大部分（80.6%）同意在懷孕期間的某些時間點進行新冠病毒篩檢。邏輯迴歸模型顯示，非常擔憂感染新冠病毒（P=0.005）和處於妊娠第三期的孕婦（P=0.009）較大機會同意妊娠期間進行新冠病毒篩檢；收入較高（P=0.017）和計劃在私家醫院分娩的孕婦（P=0.024）較大機會不同意新冠病毒篩檢。

結論：孕婦高度擔憂於懷孕期間感染新冠病毒。大部分接受懷孕期間進行新冠病毒篩檢。在推行新冠病毒篩檢計劃時，應考慮將孕婦納入篩檢人士名單。

TABLE 1. Maternal characteristics of pregnant women in antenatal clinics in the Kowloon East Cluster of Hong Kong (n=623)*

Maternal characteristic	
Maternal age, y	
<35	406 (65.2%)
≥35	217 (34.8%)
Parity (births)	
0	287 (46.1%)
≥1	336 (53.9%)
Ethnicity	
Chinese	581 (93.3%)
Non-Chinese	42 (6.7%)
Education level	
Non-tertiary	310 (49.8%)
Tertiary or above	313 (50.2%)
Family income, HK$	
<20 000	178 (28.6%)
20 000-39 999	245 (39.3%)
40 000-60 000	103 (16.5%)
>60 000	97 (15.6%)
Gestation, wk	
<14	106 (17.0%)
14-28	221 (35.5%)
>28	296 (47.5%)

* Data are shown as No. (%)

TABLE 2. Knowledge of COVID-19 among pregnant women (n=623)*

Knowledge of COVID-19	
Transmission route of COVID-19†	
Airborne	240 (38.5%)
Droplets	564 (90.5%)
Direct contact	286 (45.9%)
Pregnant women are more likely to contract COVID-19	
Yes	261 (41.9%)
No	243 (39.0%)
Unsure	119 (19.1%)
Pregnant women with COVID-19 have more severe disease and a higher death rate, compared with the general population	
Yes	203 (32.6%)
No	214 (34.3%)
Unsure	206 (33.1%)
COVID-19 in pregnancy is associated with pregnancy complications (eg, miscarriage, stillbirth, growth restriction, and preterm birth)	
Yes	457 (73.4%)
No	71 (11.4%)
Unsure	95 (15.2%)
COVID-19 in the mother can cause teratogenicity in the baby	
Yes	131 (21.0%)
No	215 (34.5%)
Unsure	277 (44.5%)
COVID-19 can be transmitted from the mother to the fetus during pregnancy	
Yes	439 (70.5%)
No	71 (11.4%)
Unsure	113 (18.1%)
COVID-19 can be transmitted to the neonate during vaginal delivery	
Yes	184 (29.5%)
No	165 (26.5%)
Unsure	274 (44.0%)
Pregnant woman with COVID-19 should deliver by caesarean section	
Yes	147 (23.6%)
No	208 (33.4%)
Unsure	268 (43.0%)
Pregnant women with COVID-19 can breastfeed their babies after delivery	
Yes	95 (15.2%)
No	308 (49.4%)
Unsure	220 (35.3%)
Effective vaccines are now available for the prevention of COVID-19	
Yes	17 (2.7%)
No	509 (81.9%)
Unsure	95 (15.2%)

Abbreviation: COVID-19 = coronavirus disease 2019

* Data are shown as No. (%)

† Participants allowed to choose more than one option

opinions about the provision of obstetric services during the COVID-19 pandemic. The questions were answered in the following formats (as appropriate): binary (Yes/No), three options (Yes/No/unsure), 4-point Likert scale, or selection of available answers (online supplementary Appendix).

The study protocol was approved by the Research Ethics Committee of Kowloon East Cluster, Hospital Authority. SPSS software (Windows version 20.0; IBM Corp, Armonk [NY], United States) was used for data entry and analysis. Descriptive categorical data were expressed as numbers and percentages; they were compared and analysed by the Chi squared test or Fisher's exact test as appropriate. Multivariate logistic regression analysis was used to identify clinical covariates that were significantly associated with pregnant women's opinions about universal screening for COVID-19. A P value of <0.05 was considered statistically significant.

Results

Participants

The questionnaires were distributed to 700 pregnant women for 17 days, from 28 July 2020 to 13 August 2020. Seven women were excluded because they could not understand either version of the questionnaire (ie, Chinese or English), while 54 women refused to participate in the study. Of the 639 women who completed the questionnaire, 16 were excluded because of missing answers; thus, 623 participants were included in the final analysis. Nearly all participants were Chinese (93.3%). Half of the participants (50.2%) had an education level of tertiary or above; 47.5% were in the third trimester of pregnancy (Table 1).

Knowledge of COVID-19 in pregnancy

A large proportion of the participants (90.5%) knew that COVID-19 was transmitted by droplets, while more than one-third of participants (38.5%) thought that airborne transmission of COVID-19 was also possible. Additionally, more than one-third of participants (41.9%) thought that they were more likely to contract COVID-19, while 32.6% presumed that pregnant women with COVID-19 would have more severe disease and experience higher mortality rates compared with the general population. Moreover, 73.4% of participants thought that maternal COVID-19 was associated with pregnancy complications such as miscarriage, stillbirth, growth restriction, and preterm birth; 70.5% believed that maternal COVID-19 could be vertically transmitted to the fetus during pregnancy. Substantial proportions of participants were unsure whether COVID-19 in pregnant women could lead to teratogenicity in the fetus (44.5%), or whether women with COVID-19 should be able to perform vaginal delivery (44%) or breastfeed (35.3%) [Table 2].

Attitudes and behaviours of pregnant women during the COVID-19 pandemic

The majority (83.1%) of participants were worried about contracting COVID-19 during pregnancy (41.9% were very worried and 41.3% were worried). Similarly, 87.0% of participants only left home when necessary during the pandemic, while 71.3% of participants were worried about contracting COVID-19 during their antenatal visits in public hospitals (27.1% were very worried and 44.1% were worried). One-third of the participants (33.1%) used extra protective gear other than surgical masks when attending antenatal clinics (eg, N95 masks, goggles, gloves, or face shields), while 28.9% of participants reported cleaning the chair and examination bed with disinfectants before use during an antenatal clinic visit. Almost one-quarter of participants (23.6%) intended to deliver in a private hospital, among which 49.7% (73/147) believed that the risk of contracting COVID-19 was lower when delivering in a private hospital than in a public hospital. Moreover, 61.2% of participants who intended to deliver in a private hospital (90/147) stated that public hospitals no longer permitted husbands to accompany wives during labour and delivery during the COVID-19 pandemic, while private hospitals continued to allow such practices. Seventy-two participants (11.6%) decided not to breastfeed because of the COVID-19 pandemic, of which 77.8% (56/72) believed that COVID-19 could be transmitted to the baby through breast milk even if the mother had asymptomatic illness (Table 3).

TABLE 3. The attitudes and behaviours of pregnant women during the COVID-19 pandemic (n=623)*

Attitude and behaviours regarding COVID-19	
Risk of contracting COVID-19 during pregnancy	
Very worried	261 (41.9%)
Worried	257 (41.3%)
A bit worried	98 (15.7%)
Not worried at all	7 (1.1%)
Leaving home during the COVID-19 pandemic	
Only when necessary	542 (87.0%)
Reduced frequency	71 (11.4%)
No change from pre-pandemic habits	10 (1.6%)
Risk of contracting COVID-19 during antenatal visit in public hospital	
Very worried	169 (27.1%)
Worried	275 (44.1%)
A bit worried	161 (25.8%)
Not worried at all	18 (2.9%)
Use extra protective equipment other than surgical mask when attending antenatal visits in public hospitals (eg, N95 mask, goggles, gloves, and/or face shield)	206 (33.1%)
Clean the chair and examination bed before use during antenatal clinic check-up in public hospital	180 (28.9%)
Plan for subsequent antenatal check-up in private hospital/ clinic instead of public hospital	92 (14.8%)
Plan for delivery in private hospital instead of public hospital	147 (23.6%)
Plan not to breastfeed because of the COVID-19 pandemic	72 (11.6%)

Abbreviation: COVID-19 = coronavirus disease 2019

* Data are shown as No. (%)

Opinions about the provision of obstetric services during the COVID-19 pandemic

Most participants agreed that antenatal seminars and antenatal exercise classes should be cancelled, and that visitors should not be allowed in postnatal wards and neonatal wards (including husbands and parents). However, a large proportion of participants (84.3%) objected to banning husbands from accompanying wives during labour and delivery in the COVID-19 pandemic; 94.7% of participants agreed that husbands a with negative COVID-19 test results should be allowed to accompany wives during labour, and 65.6% agreed with paying for such a test if the price was ≤HK$300. While 80.6% of participants agreed that pregnant women should undergo universal screening for COVID-19 during pregnancy, their preferences varied regarding the optimal time to perform such screening. The most popular option was screening in every trimester (36.7%), followed by screening when preparing for labour or in labour (36.3%). Almost all participants (92.5%) agreed that hospital staff caring for pregnant women should undergo regular universal COVID-19 screening (Table 4).

Factors that affect pregnant women's opinions about universal screening for COVID-19

Univariate analysis showed that a significantly greater proportion of women who agreed with universal screening had family income <$40 000 (72.7% vs 47.9%, P<0.001), were very worried about contracting COVID-19 during pregnancy (45.0% vs 28.9%, P=0.001), or were in their third trimester (50.8% vs 33.9%, P=0.001). Conversely, women who did not agree with screening were more likely to have an education level of tertiary or above (46.4% vs 66.1%, P<0.001) and intended to deliver in a private hospital (14.3% vs 40.5%, P<0.001). However, no differences were observed in terms of parity, ethnicity, or the proportion of women with advanced maternal age between women who did and did not agree with universal screening (Table 5). Logistic regression analysis showed that women who were very worried about contracting COVID-19 (P=0.005, odds ratio [OR]=1.89) and women in their third trimester of pregnancy (P=0.009, OR=1.77) were more likely to

TABLE 4. Pregnant women's opinions about obstetric services during the COVID-19 pandemic (n=623)*

Opinions of obstetric services	
Agree with cancellation of antenatal seminars	499 (80.1%)
Agree with cancellation of antenatal exercise classes	504 (80.9%)
Agree with not permitting husband to accompany wife during labour	98 (15.7%)
Agree with husband accompanying wife during labour if his COVID-19 test result is negative (within 24 hours)	590 (94.7%)
Acceptable cost for husband's COVID-19 test, HK$ (n=590)†	
0	182 (30.8%)
≤300	205 (34.7%)
≤500	126 (21.4%)
≤1000	56 (9.5%)
>1000	21 (3.6%)
Agree with not allowing husbands to visit their wives in postnatal ward after delivery	543 (87.2%)
Agree with not allowing parents to visit their babies in paediatric ward	416 (66.8%)
Agree that all pregnant women should undergo universal screening for COVID-19 (regardless of symptoms, travel history, or contact history)	502 (80.6%)
Appropriate timing for universal screening (n=502)‡	
First antenatal visit	49 (9.8%)
At term gestation (≥37 weeks)	138 (27.5%)
Every trimester	184 (36.7%)
Every antenatal visit	140 (27.9%)
When preparing for labour or in labour	182 (36.3%)
Every hospital admission	92 (18.3%)
Agree with separate clinics for pregnant women who agreed to undergo universal COVID-19 screening and pregnant women who refused universal COVID-19 screening	453 (72.7%)
Agree that hospital staff caring for pregnant women should undergo universal COVID-19 screening	576 (92.5%)

Abbreviation: COVID-19 = coronavirus disease 2019

* Data are shown as No. (%)

† Percentage of women who agreed with husband to accompany wife during labour if COVID-19 test result was negative

‡ Participants allowed to choose more than one option; percentage calculated from women who desired universal screening

agree with universal screening during pregnancy; women with family income >$40 000 (P=0.017, OR=0.55) and women who planned to deliver in a private hospital (P=0.024, OR=0.57) were more likely to disagree with such screening. Education level was not a significant risk factor according to multivariate analysis (Table 6).

Discussion

To our knowledge, this is the first large study in Hong Kong concerning the knowledge and psychobehavioural responses of pregnant women towards the COVID-19 pandemic. While basic concepts concerning COVID-19 appeared to be understood by our study participants (eg, COVID-19 is primarily spread through droplets and that vaccines were not available at the time of the study), there was the potential for improved knowledge regarding other concepts. For instance, there is evidence that, compared with the general population, pregnant women are not more susceptible to contract COVID-19 and the majority of them do not experience severe complications of COVID-19 in pregnancy; however, it has been suggested that pregnant women may be at higher risk of more severe disease than the non-pregnant women in terms of intensive care unit admission particularly when they are in the third trimester.[14] In a systematic review, the rate of severe pneumonia in pregnant women with COVID-19 ranged from 0% to 14%; sporadic maternal death was reported in case reports of patients with severe COVID-19.[10] Furthermore, approximately 70% of women in our cohort thought that maternal COVID-19 led to increased pregnancy complications and carried a high rate of vertical transmission, more evidence in these areas are now emerging. Systematic reviews have shown that there could be increased risks of miscarriage and stillbirths in pregnant women with COVID-19; and pregnant women with symptomatic infection had two-to-three-fold increased risks of preterm birth, most of these were iatrogenic.[12,13] In contrast, there is no evidence showing increased risk for teratogenicity or intrauterine growth restriction of baby with maternal COVID-19 infection.[15] The risks of vertical transmission of COVID-19, which despite remaining controversial, has now been supported by systematic reviews.[16] Online resources, such as websites or mobile apps, should be considered to provide updated information regarding the effects of COVID-19 on pregnancy.

Our pregnant women demonstrated uncertainties concerning the mode of delivery and breastfeeding should they contract COVID-19, mainly because they feared disease transmission during delivery or via breast milk. While the literature has reported that vertical transmission during vaginal delivery or in the peripartum period could be possible, the actual risks appeared to be very low and caesarean may not prevent vertical transmission.[17] Indeed, vaginal delivery is not contra-indicated although high rates of caesarean delivery have been reported in studies, with up to 85.9% of deliveries via caesarean section in a large series of 116 women with COVID-19 (38.8% had COVID-19 pneumonia).[18] However, there has been conflicting evidence regarding the safety of breastfeeding.[19] According to the Centers for Disease Control and Prevention guidelines, breastfeeding is not contra-indicated when a mother contracts COVID-19 but should be determined by the mother's overall health

TABLE 5. Factors that affected pregnant women's opinions about universal screening*

	Agree with universal screening (n=502)	Disagree with universal screening (n=121)	P value
Maternal age, y			
<35	325 (64.7%)	81 (66.9%)	0.648
≥35	177 (35.3%)	40 (33.1%)	
Parity (births)			
0	230 (45.8%)	57 (47.1%)	0.833
≥1	272 (54.2%)	64 (52.9%)	
Ethnicity			
Chinese	471 (93.8%)	110 (90.9%)	0.181
Non-Chinese	31 (6.2%)	11 (9.1%)	
Education level			
Non-tertiary	269 (53.6%)	41 (33.9%)	<0.001
Tertiary or above	233 (46.4%)	80 (66.1%)	
Family income, HK$			<0.001
<40 000	365 (72.7%)	58 (47.9%)	
>40 000	137 (27.3%)	63 (52.1%)	
Gestation			0.001
First/second trimester	247 (49.2%)	80 (66.1%)	
Third trimester	255 (50.8%)	41 (33.9%)	
Very worried about contracting COVID-19 during pregnancy	226 (45.0%)	35 (28.9%)	0.001
Plan to deliver in private hospital	72 (14.3%)	49 (40.5%)	<0.001

Abbreviation: COVID-19 = coronavirus disease 2019
* Data are shown as No. (%)

TABLE 6. Logistic regression of factors associated with support for universal COVID screening among pregnant women

Risk factors	B	SE	Wald	Significance (P value)	Odds ratio	95% confidence interval
Significant factors in the equation						
Very worried about COVID-19 in pregnancy	0.636	0.227	7.808	0.005	1.89	1.21 to 2.94
Family income >$40 000	-0.791	0.248	5.665	0.017	0.55	0.34 to 0.901
Third trimester of pregnancy	0.573	0.220	6.781	0.009	1.77	1.15 to 2.73
Plan to deliver in private hospital	-0.558	0.247	5.094	0.024	0.57	0.35 to 0.93
Factor excluded from equation						
Education level of tertiary or above	-0.367	0.245	2.248	0.134	0.69	0.43 to 1.12

Abbreviations: COVID-19 = coronavirus disease 2019; SE = standard error

status.[20] Available data suggest that SARS-CoV-2 is not detectable in breast milk samples from mothers with COVID-19. While some authors have suggested isolation of the mother and baby,[21] a large series of 82 neonates roomed with mothers who had COVID-19 in a closed Giraffe isolette (with necessary contact precautions during direct breastfeeding) showed that these neonates remained free of COVID-19.[22]

A large majority of the pregnant women in our cohort expressed worry about contracting COVID-19 during pregnancy or antenatal follow-up examinations in public hospitals. A survey of the psychological and behavioural responses of pregnant women during the SARS epidemic in Hong Kong revealed that pregnant women had slightly greater anxiety during SARS than before the epidemic.[23] In

addition to their memories of the SARS epidemic, the widespread worry among pregnant women in our cohort could be explained by the timing of our survey, which was conducted during a wave of COVID-19 transmission in Hong Kong. We might have been able to partially alleviate their fears if we had stated that the World Health Organization's provisional case fatality rate of COVID-19 was 3.7% during the study period, considerably lower than the 10% of SARS.[24] A substantial proportion of pregnant women (approximately 20%) in our survey revealed that they had considered subsequent follow-up examinations and delivery in private hospitals, which they believed to be safer; however, this proportion might be an underestimation because women who intended to deliver in a private hospital might not have attended our clinics for any examinations.

More than 80% of women objected to banning husbands from accompanying wives during labour and delivery in the COVID-19 pandemic, particularly if those husbands had negative COVID-19 test results. Indeed, many women reported considering delivery in a private hospital for this reason. A previous study conducted in our unit demonstrated that partner companionship during labour could offer emotional support and enhance maternal satisfaction during delivery.[25] As extended screening becomes available, husbands should be offered the opportunity to undergo screening when their wives are admitted for labour and delivery to address this need for partner companionship.

Because COVID-19 is highly transmissible and COVID-19 carriers may be asymptomatic, universal screening of all patients is important to curb disease spread in the community. In August 2020, the Hong Kong Government announced that a voluntary universal COVID-19 testing programme would be launched. In partnership with the Board of Directors of Yan Chai Hospital, the government's trial community testing programme for COVID-19 among pregnant women was launched on 10 August 2020, although we did not have data regarding this programme during our study. Around 1 month after our study, the Hospital Authority extended the COVID-19 screening to all asymptomatic in-patients including pregnant women. Our survey showed that approximately 80% of pregnant women agreed with universal screening for COVID-19 in the hospital setting. While their opinions differed concerning the frequency and timing of screening, women in the third trimester of pregnancy generally wanted to confirm that they were COVID-19-free at the time of delivery. However, it is understandable that women with higher family income and women who intended to deliver in a private hospital might not agree with universal screening in public hospitals. In the literature, universal screening for COVID-19 in pregnant women has mainly focused on screening at the time of admission for delivery; this practice was implemented as early as March 2020 in countries where community prevalence rates were considered high. Such universal screening has yielded prevalence rates of 0.43% to 13.7% for asymptomatic COVID-19 in pregnant women, depending on the local epidemiological situation.[26-29] In the latest update, the Royal College of Obstetricians and Gynaecologists recommended all pregnant women admitted to hospitals in England should be offered SARS-CoV-2 testing regardless of symptoms.[30] Ideally, such screening enables early identification and cohorting of asymptomatic women with COVID-19, thus protecting other pregnant women, their newborn infants, and healthcare staff. Negative test results can be used to reassure the women and encourage them to practise breastfeeding. The inclusion of universal screening for COVID-19 among pregnant women should be a key aspect of maternity care after considering the need for laboratory support, availability of isolation facilities and personal protective equipment, and (most importantly) the cost-effectiveness of screening based on the estimated community prevalence of COVID-19.

There were some limitations in this study. While we performed a small pilot study (involving face-to-face interviews) when designing and refining the survey questions to confirm responses by pregnant women, we did not conduct further formal validation or assessment of internal reliability. The questionnaires were developed around the peak of the third wave in Hong Kong; the results drawn from the survey reflected only the recruited women's knowledge and opinions at that time point. Thus, our findings might not be generalisable to other populations or other points in the COVID-19 pandemic with different epidemiological characteristics.

Conclusion

Among pregnant women, knowledge about COVID-19 during pregnancy should be strengthened through public education that specifically focuses on COVID-19-related complications in pregnancy. A large majority of pregnant women expressed worry about contracting COVID-19 during pregnancy, and most women in the study agreed with universal screening during pregnancy. While the optimal timing for screening in pregnancy requires further consideration, there is a need to specifically include pregnant women in population screening programmes for COVID-19.

Author contributions

Concept or design: WY Lok, CW Kong, WWK To.
Acquisition of data: WY Lok, CY Chow.
Analysis or interpretation of data: WY Lok, CW Kong, WWK To.

Drafting of the manuscript: WY Lok, CW Kong.
Critical revision of the manuscript for important intellectual content: All authors

All authors had full access to the data, contributed to the study, approved the final version for publication, and take responsibility for its accuracy and integrity.

Conflicts of interest

All authors have disclosed no conflicts of interest.

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Ethics approval

Ethics approval was obtained from the Kowloon Central/Kowloon East Research Ethics Committees (Ref: KC/KE-20-0226/ER-3).

References

1. Zhu N, Zhang D, Wang W, et al. A novel coronavirus from patients with pneumonia in China, 2019. N Engl J Med 2020;382:727-33.
2. Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet 2020;395:497-506.
3. Cheung E. China Coronavirus: death toll almost doubles in one day as Hong Kong reports its first two cases. South China Moring Post. 2020 Jan 22. Available from: https://www.scmp.com/news/hong-kong/health-environment/article/3047193/china-coronavirus-first-case-confirmed-hong-kong. Accessed 16 Aug 2020.
4. Ting V, Leung K, Cheung E. Hong Kong third wave: city's Covid-19 social-distancing measures set to be extended after recent spike in cases. South China Moring Post. 2020 Aug 1. Available from: https://www.scmp.com/news/hongkong/healthenvironment/article/3095642/hong-kong-third-wave-more-100-new-covid-19-cases. Accessed 16 Aug 2020.
5. Dashraath P, Wong JL, Lim MX, et al. Coronavirus disease 2019 (COVID-19) pandemic and pregnancy. Am J Obstet Gynecol 2020;222:521-31.
6. Rasmussen SA, Smulian JC, Lednicky JA, Wen TS, Jamieson DJ. Coronavirus disease 2019 (COVID-19) and pregnancy: what obstetricians need to know. Am J Obstet Gynecol 2020;222:415-26.
7. Wong SF, Chow KM, Leung TN, et al. Pregnancy and perinatal outcomes of women with severe acute respiratory syndrome. Am J Obstet Gynecol 2004;191:292-7.
8. Schwartz DA. An analysis of 38 pregnant women with COVID-19, their newborn infants, and maternal-fetal transmission of SARS-CoV-2: maternal coronavirus infections and pregnancy outcomes. Arch Pathol Lab Med 2020;144:799-805.
9. Chen H, Guo J, Wang C, et al. Clinical characteristics and intrauterine vertical transmission potential of COVID-19 infection in nine pregnant women: a retrospective review of medical records. Lancet 2020;395:809-15.
10. Juan J, Gil MM, Rong Z, Zhang Y, Yang H, Poon LC. Effect of coronavirus disease 2019 (COVID-19) on maternal, perinatal and neonatal outcome: systematic review. Ultrasound Obstet Gynecol 2020;56:15-27.
11. Zaigham M, Andersson O. Maternal and perinatal outcomes with COVID-19: a systematic review of 108 pregnancies. Acta Obstet Gynecol Scand 2020;99:823-9.
12. Kazemi SN, Hajikhani B, Didar H, et al. COVID-19 and cause of pregnancy loss during the pandemic: a systematic review. PLoS One 2021;16:e0255994.
13. 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:E540-8.
14. Vousden N, Bunch K, Morris E, et al. The incidence, characteristics and outcomes of pregnant women hospitalized with symptomatic and asymptomatic SARS-CoV-2 infection in the UK from March to September 2020: a national cohort study using the UK Obstetric Surveillance System (UKOSS). PLoS One 2021;16:e0251123.
15. Mullins E, Hudak ML, Banerjee J, et al. Pregnancy and neonatal outcomes of COVID-19: coreporting of common outcomes from PAN-COVID and AAP-SONPM registries. Ultrasound Obstet Gynecol 2021;57:573-81.
16. Musa SS, Bello UM, Zhao S, Abdullahi ZU, Lawan MA, He D. Vertical transmission of SARS-CoV-2: a systematic review of systematic reviews. Viruses 2021;13:1877.
17. Sinaci S, Ocal DF, Seven B, et al. Vertical transmission of SARS-CoV-2: a prospective cross-sectional study from a tertiary center. J Med Virol 2021;93:5864-72.
18. Yan J, Guo J, Fan C, et al. Coronavirus disease 2019 in pregnant women: a report based on 116 cases. Am J Obstet Gynecol 2020;223:111.e1-14.
19. Poon LC, Yang H, Kapur A, et al. Global interim guidance on coronavirus disease 2019 (COVID-19) during pregnancy and puerperium from FIGO and allied partners: information for healthcare professionals. Int J Gynecol Obstet 2020;149:273-86.
20. Centers for Disease Control and Prevention. Care for breastfeeding people. Interim guidance on breastfeeding and breast milk feeds in the context of COVID-19. Available from: https://www.cdc.gov/coronavirus/2019-ncov/hcp/care-for-breastfeeding-women.html. Accessed 11 Aug 2020.
21. Griffin I, Benarba F, Peters C, et al. The impact of COVID-19 infection on labor and delivery, newborn nursery, and neonatal intensive care unit: prospective observational data from a single hospital system. Am J Perinatol 2020;37:1022-30.
22. Salvatore CM, Han JY, Acker KP et al. Neonatal management and outcomes during the COVID-19 pandemic: an observation cohort study. Lancet Child Adolesc Health 2020;4:721-7.
23. Lee DT, Sahotab D, Leung TN, Yip AS, Lee FF, Chung TK. Psychological responses of pregnant women to an infectious outbreak: a case-control study of the 2003 SARS outbreak in Hong Kong. J Psychosom Res 2006;61:707-13.
24. World Health Organization. Coronavirus disease (COVID-2019) situation reports-204. Available from: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200811-covid-19-sitrep-204.pdf?sfvrsn=1f4383dd_2. Accessed 12 Aug 2020.
25. Chung VW, Chiu JW, Chan DL, To WW. Companionship during labour promotes vaginal delivery and enhances maternal satisfaction. Hong Kong J Gynaecol Obstet Midwifery 2017;17:12-7.

26. Sutton D, Fuchs K, D'Alton M, Goffman D. Universal screening for SARS-CoV-2 in women admitted for delivery. N Engl J Med 2020;382:2163-4.
27. Fassett MJ, Lurvey LD, Yasumura L, et al. Universal SARS-Cov-2 screening in women admitted for delivery in a large managed care organization. Am J Perinatol 2020;37:1110-4.
28. Tanacana A, Erola SA, Turgay B, et al. The rate of SARS-CoV-2 positivity in asymptomatic pregnant women admitted to hospital for delivery: experience of a pandemic center in Turkey. Eur J Obstet Gynecol Reprod Biol 2020;253:31-4.
29. Herraiz I, Folgueira D, Villalaín C, Forcén L, Delgado R, Galindo A. Universal screening for SARS-CoV-2 before labor admission during Covid-19 pandemic in Madrid. J Perinat Med 2020;48:981-4.
30. The Royal College of Obstetricians and Gynaecologists. Principles for the testing and triage of women seeking maternity care in hospital settings, during the COVID-19 pandemic. A supplementary framework for maternity healthcare professionals. version 2. Available from: https://www.rcog.org.uk/globalassets/documents/guidelines/2020-08-10-principles-for-the-testing-and-triage-of-women-seeking-maternity-care-in-hospital-settings-during-the-covid-19-pandemic.pdf. Accessed 2 Oct 2020.