



BMJ Open Effect of restrictions imposed due to COVID-19 pandemic on the antenatal care and pregnancy outcomes: a prospective observational study from rural North India

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ABSTRACT

Objectives To assess the difficulties faced by the pregnant women in seeking appropriate antenatal care due to the restrictions imposed during the COVID-19 pandemic; assess the difficulties encountered during delivery and postpartum period; the suitability of the teleconsultation services offered; effect of COVID-19 infection on pregnancy outcomes and the effect of restrictions on the nutrition profile of the pregnant women.

Design Prospective observational study.

Setting and participants We included 1374 pregnant women from the rural areas of three districts of Punjab, India registered at government health centres before the implementation of lockdown due to the COVID-19 pandemic on 24 March 2020.

Primary and secondary outcome measures The primary outcome was the difficulties faced by the women during their pregnancies due to restrictions imposed during the lockdown. The secondary outcomes included the effect of COVID-19 infections on pregnancy outcomes, satisfaction from the telemedicine services and restrictions on the nutrition profile of the pregnant women.

Results One-third of the women (38.4%) considered their last pregnancy unplanned. Women faced difficulties due to the restrictions in getting adequate nutrition (76.5%), accessing transportation facilities (35.4%), consultations from doctors (22.4%) or getting an ultrasonography scan (48.7%). One-fifth (21.9%) of women could not access safe abortion services. Only 3.6% of respondents ever took any teleconsultation services offered by the government. Most of them felt unsatisfied compared with routine visits (77.5%). COVID-19-infected women were primarily asymptomatic (76.1%), but there was a high incidence of preterm birth (42.8%). Frontline workers could visit 64.3% of the women in the postpartum period despite restrictions.

Conclusions Lockdown compromised the antenatal care in our study area while the frontline workers attempted to minimise the inconvenience. Telemedicine services did not prove to be of many benefits to pregnant women and should only work as a supplement to the existing protocols of antenatal care.

Strengths and limitations of this study

- First community-based assessments from rural India to analyse lockdown effects on antenatal care.
- A large cohort of antenatal women was assessed comprehensively for the difficulties faced due to COVID-19 restrictions.
- Telephonic interviews may not help in deriving sensitive information from pregnant women.
- Inability to assess unregistered poor women with no access to telephones, potentially at a higher risk due to COVID-19
- The effect of pre-existing medical conditions exacerbated by restrictions on the current pregnancy and birth outcomes could not be assessed.

INTRODUCTION

COVID-19 is caused by a newly discovered SARS-CoV-2. WHO declared the outbreak of SARS-CoV-2 to be a public health emergency of international concern on 31 January 2020, and then labelled it a pandemic on 11 March 2020.¹ The first case was diagnosed in India on 30 January 2020, and to date, it is among the worst-hit country in terms of the number of people affected and deaths.² Until the vaccine's launch in January 2021, there was no effective pharmacological intervention against the virus. Hence, social distancing was the cornerstone of disease prevention and community transmission of this novel disease. Social distancing was enforced by the Government of India, through a complete nationwide lockdown implemented on 24 March 2020 until 31 May 2020, and was unlocked in phase wise manners until November 2020. Lockdown did help in restricting mobility and controlling the disease transmission to a large extent by shutting off all the nation except hospitals and some essential services.³

However, it is felt that lockdown had implications, as the routine healthcare delivery system was compromised, including the antenatal care services.

Pregnant women constitute a significant percentage of the vulnerable population due to altered anatomy, physiology and compromised immune status.⁴ COVID-19 infection in pregnant women made clinical management more difficult by prolonging and complicating the illness and compromising the treatment.⁵ This is attributed to several physiological factors, such as lower lung volumes and increased oxygen consumption.⁶ However, a study from Wuhan, China, on 118 pregnant patients affected with COVID-19 does not suggest an increased risk of severe disease among pregnant women compared with the general population. There were no maternal deaths and no cases of neonatal asphyxia in the study.⁷ Also, the additional challenge of safeguarding the fetus imposes a significant burden on the healthcare system. There were concerns about the vertical transmission of the deadly virus. However, initial evidence generated from China did not support intrauterine infection caused by vertical transmission.⁸

It is well known that most maternal deaths can be prevented by adequate and timely obstetrical care during pregnancy, delivery and puerperium. However, the 3-Delays Model became more prominent due to the restrictions imposed during the COVID-19 pandemic.^{9 10} The unprecedented lockdown left the health system unprepared to handle the pregnant women as they struggled to get adequate antenatal care and were deprived of various facilities due to the restrictions.¹¹ The pregnancy risk factors aggravated due to restrictions. Apart from antenatal care services, other services like family planning and abortion also suffered due to the pandemic. Furthermore, the pandemic led to increased unemployment and caused nutrition insecurity.⁵

In the face of a pandemic, the government of India revamped the telemedicine services to avoid face-to-face consultation between the clinician and patients to reduce disease transmission.¹² Telemedicine serves to exchange valid information for diagnosing and treating common ailments.¹³ However, implementing telemedicine services in India is challenging as it depends on adequate knowledge and awareness about such services among the beneficiaries, including pregnant women, who need constant supervision. However, anecdotal evidence suggested that teleconsultations were insufficient to ensure antenatal wellness. The benefits are further attenuated in the rural areas due to a lack of access to advanced technology such as smartphones and the internet, which are crucial for teleconsultation.

With this background, the present study was done with the primary objective of assessing the magnitude of difficulties faced by pregnant women due to the lockdown in accessing the healthcare services during different stages of pregnancy; and to determine the percentage of women infected with COVID-19 during their pregnancy and its impact on maternal and fetal health-related outcomes.

The secondary objectives were to ascertain the suitability of teleconsultation services during pregnancy and the effect of lockdown on the nutrition of pregnant women.

METHODS

We adopted a prospective observational study design. The study was conducted over 8 months, that is, from October 2020 to May 2021, in the rural areas of three districts of Punjab (India), that is, Bathinda, Faridkot and Muktsar. The population of the three districts is about 25 lakhs as per the census 2011. Lockdown was thoroughly enforced in these three districts as per national guidelines from 24 March 2020 to 31 May 2020, following which unlock was started, and restrictions were slowly lifted in a phased manner. The process of unlocking continued until 30 November 2020, following which schools were partially reopened as per the orders of the Ministry of Home Affairs.¹⁴

Study population

The sampling frame included the pregnant women enlisted in the study area just before the enforcement of the lockdown.

Sample size and sampling

Considering population per community health centre (CHC) area to be around 80 000, the birth rate of Punjab at 15.2 births per 1000 population (2018) and 10% pregnancy wastage, approximately 4000 pregnancies per year were estimated in the three CHCs included in the study. About half of them, that is, 2000, are anticipated to be available during the study period. However, we could reach out to only 1400 such women, and only 1374 were included in the final analysis.

Sampling technique and data collection protocol

Data were collected using a multistage sampling technique. In the first stage, three districts were chosen from the Malwa region of Punjab, that is, Bathinda, Faridkot and Muktsar, based on the ease of accessibility and follow-up of the sample population during the pandemic. In the second stage, one CHC was randomly selected from each district. Finally, in the third stage, we included all pregnant women registered before 24 March 2020. We first enumerated such women after seeking the district civil surgeon's office's due approvals. We then retrieved their phone numbers from the CHC and primary healthcare centres (PHC). Such mothers were then contacted telephonically during the daytime by the study investigators, who were adequately sensitised and trained for this purpose. The women with no access to telephones could not be contacted.

After informing the interested study participants about the purpose of the study, verbal consent was taken. The data were collected using a structured interview tool to determine the impact of lockdown on the pregnancy and its outcomes (online supplemental appendix 1).

Part 'a' of the tool collected information about socio-demographic and obstetric history. Subsequent parts of the tool collected information about the different objectives of the study. If a woman had not delivered at the time of the first telephonic call, she was followed up and contacted again around her expected delivery date. The study investigators also offered them specialist consultation if they sought medical help. Field investigators also visited some of the participants at their home, who could not be approached telephonically, despite repeated calls.

Statistical analysis

The data were entered, cleaned and analysed using statistical software. Performa with missing data were not included in the final analysis. Variables were categorised suitably for straightforward interpretation. We used descriptive statistics to depict our results. Bivariate analysis was done to depict interdistrict disparities using the χ^2 test. P value of <0.05 was considered to be statistically significant. Graphical flow charts were used to present the pregnancy outcomes during the lockdown period and the pregnant women infected by COVID-19 during their pregnancy.

Patient and public involvement

Patients and the public were not involved in the design, conduct, reporting or dissemination plans of this research.

RESULTS

We could contact a total of 1384 women from our study areas, and 1374 were included in the analysis after data cleaning. **table 1** Table 1 describes the essential socio-demographic characteristics of the pregnant women enrolled in our study. Most of them (84.4%) were between 21 and 30 years of age, living in a joint family (71.5%) and belonged to a lower socioeconomic class (53.5%). About one-third of them had a 'below poverty line' family identification card. Most of the study participants and their spouses had qualifications between middle school and a posthigh school diploma. A large number of the respondents (95.1%) were homemakers at the time of the study, and nearly half of the women (n=30/67) who were earning before the lockdown were not earning during the lockdown period. Many respondents' spouses were either unskilled or semi-skilled workers (50.8%), and only one-fifth of them (n=263/1374) were earning during the lockdown period. Almost all the respondents were aware of the COVID-19 and its mode of transmission, most common presenting symptoms like cough and fever. However, many participants were unaware of the role of sanitation (41.9%) and social distancing (48.0%) in preventing the transmission of COVID-19. In comparison, the majority of them accepted the utility of facemask (98.3%) and frequent handwashing (81.7%) during the pandemic. Most of them (97.7%) felt apprehensive about the situation during the lockdown, had a fear of catching

the infection (97.9%) and were concerned about the risk of transmission of infection to the fetus (97.8%).

A little more than one-third of the women (38.4%) considered their last pregnancy to be unplanned, and all of them except two had continued this pregnancy. The primary reasons to continue this unplanned pregnancy during the lockdown were the pressure from the family and spouse (43.8%), inability to access postconception abortion services (37.3%) and expectations of having a male child in the current pregnancy (17.5%).

Around 87% of the pregnant women faced difficulties during the lockdown period concerning their pregnancy (**table 2**). Most of the women (76.5%) faced problems in getting adequate nutrition during the lockdown, followed by getting an ultrasonography (USG) appointment (48.7%), appropriate transportation facilities (35.4%), consultations from doctors (22.4%) and other antenatal investigations (21.5%). Most of our respondents (84.7%) could visit doctors in their first trimester. However, 47.2% of the respondents could only get two hospital visits during their entire pregnancy because of the lockdown. Only half of the study participants (49%) got the required number of USG scans done, with the highest in the Faridkot district (59.1%), while 1% of women did not get a single USG done. Nearly 85% of the pregnant women had to shift to private hospitals for getting an antenatal USG, as in the government hospitals, access to USG was difficult during the lockdown. Only 31.7% of our patients could get scanned for birth anomalies. Auxiliary Nurse Midwives (ANM) and Accredited Social Health Activist (ASHA) workers visited around 69.7% of the respondents at their homes during pregnancy, even during the lockdown. Around 46.8%, 41.9% and 41.2% of participants could get investigated for haemoglobin titres, blood pressure and urine for sugar and proteins more than twice in their pregnancy (data not tabulated).

Table 3 depicts the course of pregnancy, various complications faced and pregnancy outcomes. Of the different sorts of complications faced during the pregnancy, mild-to-moderate anaemia (93.8%), hyperemesis gravidarum (14.4%) and severe anaemia requiring blood transfusion (6.6%) were among the most common complications faced by the study participants. Initially, one-fourth of the participants planned to deliver in a private hospital (24.5%), while the rest wanted to opt-in to any government health facility (74.6%). However, 15.6% could not deliver at their planned places, while 2.2% delivered at home. Overall, the proportion of abortions, stillbirths, live births was 3.0%, 2.5% and 94.5% (**figure 1**). Nearly one-third of respondents (29.9%) delivered through a caesarean section, while 5.6% required assisted delivery. The postpartum period was uneventful in all but 8.3% of the respondents, where the most common complications were either systemic (3.3%), episiotomy or caesarean section wound-related (2.4%) or breast-related (2.3%), which were attended to in nearly two-thirds of the cases, and by a specialist in one-third cases. Two-thirds of the respondents agreed that the healthcare workers visited

Table 1 Sociodemographic characteristics of the pregnant women from the three districts of rural north India and their knowledge and awareness regarding the COVID-19 pandemic

	Bathinda	Faridkot	Muktsar	Total	P value
Total	742 (100)	532 (100)	100 (100)	1374 (100)	
Age of the client (years)					
15–20	24 (3.2)	18 (3.4)	5 (5)	47 (3.4)	0.832
21–30	635 (85.6)	442 (83.1)	83 (83)	1160 (84.4)	
31–40	81 (10.9)	70 (13.2)	12 (12)	163 (11.9)	
>40	2 (0.3)	2 (0.4)	0	4 (0.3)	
Type of family					0.042
Nuclear	191 (25.7)	171 (32.1)	30 (30.0)	392 (28.5)	
Joint	551 (74.3)	361 (67.9)	70 (70.0)	982 (71.5)	
Education					<0.001
Postgraduation	51 (6.9)	64 (12)	4 (4)	119 (8.7)	
Graduate	89 (12)	89 (16.7)	8 (8)	186 (13.5)	
Intermediate/Posthigh school diploma	174 (23.5)	108 (20.3)	17 (17)	299 (21.8)	
High school certificate	148 (19.9)	74 (13.9)	15 (15)	237 (17.2)	
Middle school certificate	111 (15)	76 (14.3)	18 (18)	205 (14.9)	
Primary school certificate	91 (12.3)	43 (8.1)	19 (19)	153 (11.1)	
Less than primary school	6 (0.8)	2 (0.4)	2 (2)	10 (0.7)	
Illiterate	72 (9.7)	76 (14.3)	17 (17)	165 (12)	
Socioeconomic status					<0.001
Upper class	40 (5.4)	59 (11.1)	8 (8.0)	107 (7.8)	
Upper middle class	86 (11.6)	72 (13.5)	3 (3.0)	161 (11.7)	
Lower middle class	223 (30.1)	127 (23.9)	21 (21.0)	371 (27)	
Upper lower class	341 (46)	226 (42.5)	57 (57.0)	624 (45.4)	
Lower class	52 (7)	48 (9)	11 (11.0)	111 (8.1)	
BPL card holder					<0.001
Yes	298 (40.2)	134 (25.2)	49 (49)	481 (35)	
No	444 (59.8)	398 (74.8)	51 (51)	893 (65)	
Awareness about					
COVID-19	741 (99.9)	532 (100)	100 (100)	1373 (99.9)	>0.05
Mode of transmission	730 (98.4)	511 (96.4)	98 (98)	1339 (97.5)	<0.05
COVID-19 symptoms					>0.05
Cough	738 (99.5)	520 (97.7)	100 (100)	1358 (98.8)	
Fever	687 (92.6)	489 (91.9)	93 (93)	1358 (98.8)	
Sore throat	163 (22)	80 (15)	12 (12)	255 (18.6)	
Sneezing	427 (57.5)	251 (47.2)	41 (41)	719 (52.3)	
Malaise	347 (46.8)	206 (38.7)	36 (36)	589 (42.9)	
Diarrhoea	146 (19.7)	64 (12)	11 (11)	221 (16.1)	
Preventive measures against COVID-19					<0.01
Regular use of the face mask	732 (98.7)	521 (97.9)	97 (97)	1350 (98.3)	
Frequent handwashing	596 (80.3)	440 (82.7)	87 (87)	1123 (81.7)	
Sanitation practices	470 (63.3)	281 (52.8)	47 (47)	798 (58.1)	
Social distancing measures	423 (57)	252 (47.4)	40 (40)	715 (52)	
Felt apprehensive about the situation of lockdown	721 (97.2)	521 (97.9)	100 (100)	1342 (97.7)	>0.05
Fear of catching the infection	721 (97.2)	522 (98.1)	100 (100)	1343 (97.9)	>0.05
Concerned for fetus getting an infection	721 (97.2)	523 (98.3)	100 (100)	1344 (97.8)	>0.05

BPL, Below Poverty Line.

Table 2 Descriptive statistics of the study participants depicting the healthcare-seeking behaviour in the antenatal period during the restrictions imposed due to the COVID-19 pandemic

	Bathinda	Faridkot	Muktsar	Total	P value
Total	742 (100)	532 (100)	100 (100)	1374 (100)	
Difficulties faced during the lockdown	633 (85.3)	465 (87.4)	97 (97)	1195 (87)	<0.01
Type of difficulties faced					
Nutrition	558 (75.2)	400 (75.2)	93 (93.0)	1051 (76.5)	<0.001
Ultrasonography appointment	299 (40.3)	292 (54.9)	78 (78.0)	669 (48.7)	<0.05
Transportation	268 (36.1)	152 (28.6)	66 (66.0)	486 (35.4)	<0.001
Healthcare provider access	155 (20.9)	126 (23.7)	27 (27.0)	308 (22.4)	>0.05
ANC investigations	172 (23.2)	88 (16.5)	36 (36.0)	296 (21.5)	<0.001
Dietary Supplements	69 (9.3)	48 (9.0)	8 (8.0)	125 (9.1)	>0.05
Immunisation against tetanus	16 (2.2)	2 (0.4)	0	18 (1.3)	<0.05
Gestational age at the time of first visit to health facility					<0.001
First trimester	642 (86.4)	451 (84.8)	72 (72)	1165 (84.7)	
Second trimester	97 (13.1)	78 (14.7)	28 (28)	203 (14.8)	
Third trimester	3 (0.4)	3 (0.6)	0	6 (2.3)	
Number of hospital visits during the pregnancy					<0.001
Nil	23	5 (0.9)	1 (1)	29 (2.1)	
1	78 (10.5)	30 (5.6)	12 (12)	120 (8.7)	
2	341 (46)	232 (43.6)	76 (76)	649 (47.2)	
3	205 (27.6)	165 (31.0)	10 (10)	380 (27.7)	
4	84 (11.3)	92 (17.3)	1 (1)	177 (12.9)	
5	11 (1.5)	8 (1.5)	0	19 (1.4)	
Number of ultrasonographic scans done to assess fetal well-being					<0.001
Nil	5 (0.7)	8 (1.5)	1 (1)	14 (1.0)	
1	100 (13.5)	53 (10.0)	7 (7)	160 (11.6)	
2	320 (43.1)	157 (29.5)	50 (50)	527 (38.4)	
3	295 (39.8)	280 (52.6)	39 (39)	614 (44.7)	
>3	22(3)	34 (6.4)	3 (3)	59 (4.3)	
Purpose of the ultrasonographic scan					
Dating	355 (47.8)	342 (64.30)	30 (30)	727 (52.9)	<0.001
Second Trimester	355 (47.8)	342 (64.30)	30 (30)	727 (52.9)	>0.05
Level 2 USG	199 (26.8)	386 (72.6)	13 (13)	435 (31.7)	<0.001
Growth scan	618 (83.3)	449 (84.4)	93 (93)	1160 (84.4)	>0.05
ANM/ASHA visited home during pregnancy					<0.01
Yes	492 (66.3)	388 (72.9)	78 (78)	958 (69.7)	
No	250 (33.7)	144 (27.1)	22 (22)	416 (30.3)	

ANC, antenatal care; ANM, Auxiliary Nurse Midwives; ASHA, Accredited Social Health Activist; USG, ultrasonography.

**Table 3** Complications faced by the pregnant women during the lockdown in various stages of pregnancy and the postpartum period

	Bathinda	Faridkot	Muktsar	Total	P value
Total	742 (100)	532 (100)	100 (100)	1374 (100)	
Pregnancy					
Complications observed during pregnancy	548 (78.9)	447 (84)	80 (80)	1075 (78.2)	<0.001
Type of complications					
Anaemia	499 (91.0)	432 (96.6)	78 (97.5)	1009 (93.8)	<0.001
Hyperemesis gravidarum	96 (17.5)	57 (12.7)	2 (2.5)	155 (14.4)	<0.01
Need for blood transfusion	38 (5.1)	49 (9.2)	4 (4.0)	91 (6.6)	
Hypertension	35 (6.3)	16 (3.5)	3 (3.7)	54 (5.0)	>0.05
Antepartum haemorrhage	40 (7.2)	17 (3.8)	2 (2.5)	59 (5.4)	>0.05
Preterm labour	39 (7.1)	19 (4.2)	1 (1.2)	59 (5.4)	>0.05
Premature rupture of membranes	17 (3.1)	7 (1.5)	0	24 (2.2)	>0.05
Diabetes mellitus	4 (0.7)	5 (1.1)	0	9 (0.8)	>0.05
Delivery at					<0.001
Planned place	606 (81.7)	428 (80.5)	96 (96)	1130 (82.2)	
Unplanned place	115 (15.5)	95 (17.9)	4 (4)	214 (15.6)	
Home	21 (2.8)	9 (1.7)	0	30 (2.2)	
Mode of birth					<0.001
NVD	451 (60.8)	315 (59.2)	79 (79)	845 (61.5)	
LSCS	238 (32.1)	154 (28.9)	19 (19)	411 (29.9)	
Instrumental (forceps/ventouse)	31 (4.2)	44 (8.3)	2 (2.0)	77 (5.6)	
Postpartum period					
Eventful	76 (10.2)	35 (6.6)	3 (3)	114 (8.3)	<0.001
Type of complications faced					<0.05
Wound (episiotomy/caesarean) related	18 (2.4)	13 (2.4)	2 (2)	33 (2.4)	
Local (perineal)	3 (0.4)	0	0	3 (0.2)	
Systemic	27 (3.6)	18 (3.4)	1 (1)	46 (3.3)	
Breast related	28 (3.8)	4 (0.8)	0	32 (2.3)	
Complications attended					<0.05
Yes	49 (6.6)	25 (4.7)	3 (3)	77 (5.6)	
Complications attended by					>0.05
Medical Specialist	20 (2.7)	14 (2.6)	1 (1)	35 (2.5)	
General Physician	8 (1.1)	5 (0.9)	1 (1)	14 (1.0)	
Nurse	13 (1.8)	1 (0.2)	1 (1)	15 (1.1)	
ANM	4 (0.5)	3 (0.6)	0	7 (0.5)	
ASHA	4 (0.5)	2 (0.4)	0	6 (0.4)	
O (This row can be deleted)	0	0	0	0	
Care sought through					>0.05
OPD services	22 (3.0)	12 (2.3)	3 (3)	37 (2.7)	
Hospitalisation	24 (3.2)	10 (1.9)	0	34 (2.5)	
Teleconsultation	3 (0.4)	3 (0.6)	0	6 (0.4)	
Healthcare workers visited home in the postnatal period	455 (61.3)	345 (64.8)	83 (83)	883 (64.3)	0.001

Continued

Table 3 Continued

	Bathinda	Faridkot	Muktsar	Total	P value
Told about the danger signs of the postpartum period	386 (52)	288 (54.1)	76 (76)	750 (54.6)	<0.001
Family planning services in postpartum period					
Availed any contraceptives	464 (62.5)	237 (44.5)	100 (100)	762 (55.5)	<0.001
Type					<0.001
Temporary methods	432 (58.2)	220 (41.4)	58 (58)	710 (51.7)	
Permanent	32 (4.3)	17 (3.2)	3 (3)	52 (3.8)	
Difficulty faced in availing services	5 (0.7)	7 (1.3)	1 (1)	13 (0.9)	>0.05
Type of difficulty faced					
Neglecton by staff	1 (20)	0	0	1 (7.6)	
Unavailability of contraceptives	3 (60)	6 (71.4)	1 (100)	10 (76.9)	
Contraceptives not placed properly	1 (20)	1 (4.2)	0	2 (15.3)	
Abortion services					>0.05
Total	22 (100)	19 (100)	0	41 (100)	
Visited the hospital					>0.05
Yes	19 (86.3)	17 (89.4)	0	36 (87.8)	
No	3 (13.6)	2 (10.5)	0	5 (12.1)	
Faced difficulty to access healthcare facility	5 (22.7)	4 (21.5)	0	9 (21.9)	>0.05
Neonatal outcomes					
Baby attended by a paediatrician at the time of birth	349 (47)	352 (66.2)	19 (19)	720 (52.4)	<0.001
Breast feeding initiated within a half-hour of NVD and 6 hours of LSCS	528 (71.2)	405 (76.1)	81 (81)	1014 (73.8)	<0.05
Colostrum is given to baby	605 (81.5)	429 (80.6)	92 (92)	1126 (82)	>0.05
Prelacteal feeds given to baby	578 (77.9)	433 (81.4)	88 (88)	1099 (80)	<0.05
Mother taught about breast feeding, latching and kangaroo mother care practices	647 (87.2)	460 (86.5)	95 (95)	1202 (87.5)	>0.05
Birth registered within 14 days for birth certificate	674 (90.8)	473 (88.9)	94 (94)	1241 (90.3)	>0.05
If the baby was preterm, did the baby need NICU admission	80 (10.8)	69 (12.6)	6 (6)	155 (11.1)	>0.05
Did you face any difficulty with NICU admission	4 (5)	2 (2.5)	1 (1.25)	7 (8.75)	>0.05
Immunisation services					
Newborn vaccinated as per UIP	700 (94.3)	499 (93.8)	100 (100)	1299 (94.5)	>0.05
Services provided at					
Government setup	676 (91.1)	480 (90.2)	98 (98)	1254 (91.3)	
Private setup	25 (3.4)	19 (3.6)	2 (2)	46 (3.3)	

ANM, Auxiliary Nurse Midwives; ASHA, Accredited Social Health Activist; LSCS, Lower Segment Cesarean Section; NICU, neonatal intensive care unit; NVD, Normal Vaginal Delivery; OPD, outpatient department; UIP, Universal Immunisation Programme.

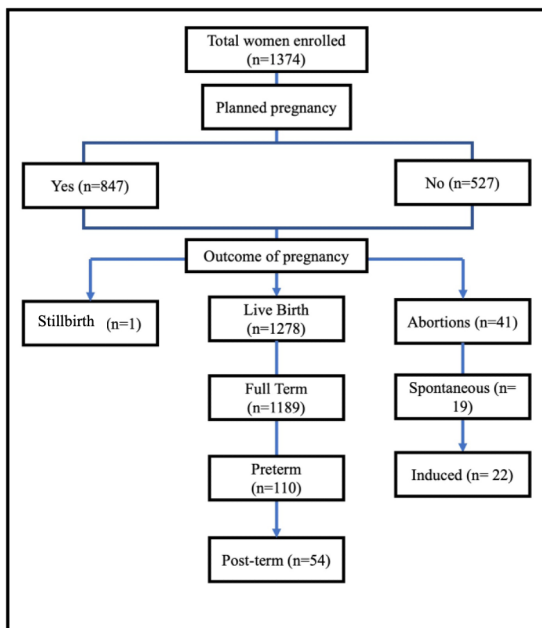


Figure 1 Flow chart depicting the pregnancy outcomes during the COVID-19 restrictions imposed in India.

them at their homes during the postpartum period, and more than half said they were told about the danger signs of the postpartum period. Family planning services were adopted by nearly 55% of the respondents in the postpartum period, and the most common difficulty faced was accessing their choicest methods of contraception. There were 41 abortions, of which 53.6% were spontaneous. About one-fifth faced any kind of difficulty accessing healthcare services. Nearly half of the babies were attended by a paediatrician at the time of birth. The majority of newborns (94.5%) were vaccinated as per Universal Immunisation Programme (UIP), out of which 91.3% and 3.3% were vaccinated in the government and the private setup.

About 58.4% of our study participants got themselves tested for COVID-19. Of them, 21 respondents tested positive for COVID-19 during their pregnancy, and of them, 7 tested positive during the delivery. Most of them tested positive in the third trimester and were primarily asymptomatic. Nearly half of them were home-quarantined, and the rest were quarantined in designated COVID-19 centres of their districts. Half of the COVID-19-positive pregnant women agreed that they observed a change in behaviour of the labour room staff, but 42% also agreed that their pregnancy was appropriately handled. There was an equal number of normal vaginal deliveries and caesarean sections (n=10). [Table 4](#) and [figure 2](#) summarise the pregnancy outcomes in study participants who tested positive for COVID-19 infection in the antenatal period. The outcome of pregnancy was a live birth in all except one, where it was a stillbirth, and six neonates required admission in neonatal intensive care unit (NICU). Nine pregnancies (42.8%) were preterm. None of the newborns who were tested (n=40) was declared positive.

Table 4 Status of the women tested positive for COVID-19 during their pregnancy

	Total
Total	1374 (100)
Tested for COVID-19 during pregnancy	802 (58.4)
Tested positive	
During pregnancy and delivery	21 (1.5)
Only during delivery	7 (0.5)
Period of gestation	
First trimester	1 (4.7)
Second trimester	3 (14.2)
Third trimester	17 (80.9)
Symptoms of infection	
Asymptomatic	16 (76.1)
Body pain/Fever	2 (9.5)
Liver infection	
Typhoid	
Mild dyspnoea	1 (4.7)
Diarrhoea	
Cold/Cough	2 (9.5)
If positive, quarantined	21
Home quarantine	9
Faridkot COVID-19 centre	8
Bajakhana COVID-19 centre	1
Ghuddha COVID-19 centre	2
Difficulties faced	
Changed behaviour of staff	10 (47.6)
Pregnancy handled properly	9 (42.8)
Difficulty in transport	1 (4.7)
Difficulty in getting admission	1 (4.7)
Outcome of pregnancy	
Live birth	20 (95.2)
Stillbirth	1 (4.7)
Abortion	0
Mode of birth	
Normal vaginal delivery	10 (47.6)
Caesarean section	10 (47.6)
Assisted delivery	1 (4.7)
Period of gestation	
Full-term	12 (57.1)
Preterm	9 (42.8)
Baby admitted to NICU	6 (28.5)

NICU, neonatal intensive care unit.

[Table 5](#) depicts the utility of the teleconsultations services offered by the government. Only one-third (32%) of study participants had smartphones with significant interdistrict variations. Of them, 6.7% knew about

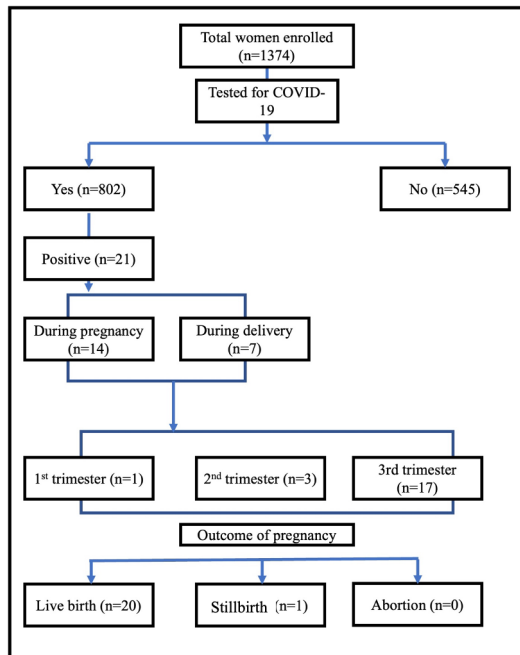


Figure 2 Flow chart depicting the outcome of the COVID-19-positive pregnant women during the COVID-19 restrictions imposed in India.

teleconsultation services, but only 3.6% of respondents ever took any teleconsultation. Of the small proportion of the participants who used this service, 16.3% faced difficulties taking teleconsultation. Most of the respondents (88%) still felt a need to go to hospitals for definite diagnosis and treatment, and only 20% were clear about the prescriptions given to them. Nevertheless, overall, 83% felt satisfied with these consultation services.

Table 6 depicts the effect of lockdown on the nutrition of pregnant women. Three-fourths (76.5%) of the participants perceived that lockdown had affected their diet, and half of them (55%) felt undernourished. Most of the study participants reported their diet to be deficient in fruits, followed by nuts, vegetables and oil and ghee during the lockdown. About 85% of women agreed to have spent extra to procure food items. Around 9% of women faced difficulty receiving iron/calcium supplements from the ANM/ASHA workers during pregnancy due to lack of access at the health centre, and 8.7% had to purchase their supplements. Most of the women who were also Anganwadi beneficiaries (815/1118) continued to receive their meals even during the lockdown.

DISCUSSION

The COVID-19 pandemic has affected the provision and utilisation of maternal and child health services. These disruptions were attributed to mobility restrictions imposed by the government, reassignment of health workers, equipment and facilities to cater to COVID-19, and concerns over contracting the infection while availing these services in public health facilities. With this background, we conceptualised the present study. To the best of our knowledge, this is

Table 5 Assessment of the teleconsultation services offered to antenatal women during the lockdown in the rural area of North India

	Total
Total	1374 (100)
Accessibility to smartphone	439 (32)
Know about emails	21 (1.5)
know about teleconsultation	92 (6.7)
Took teleconsultation	49 (3.6)
If yes, through	
Private hospital	21 (1.5)
Government hospital	28 (2.0)
Mode of teleconsultation	
Audio	49 (3.6)
Video	0
Teleconsultation experience	49 (100)
Faced difficulty in taking teleconsultation appointment	8 (16.3)
Ease of connection for appointment	40 (81.6)
Good voice/Video quality of the service	48 (97.9)
The concern showed by the doctor towards the problems	44 (89.7)
Received adequate explanation of your problem by the doctor	44 (89.7)
Received adequate explanation of the treatment	44 (89.7)
Relieved of your problems	33 (67.3)
Felt the need to go to the hospital for definite diagnosis and treatment	43 (87.7)
Clarity of the prescription	10 (20.4)
Satisfaction with your last telemedicine session	
Satisfied	41 (83.6)
Unsatisfied	8 (16.3)
Telemedicine as compared with an ordinary in-person visit	
Satisfied	11 (22.4)
Unsatisfied	38 (77.5)
Use telemedicine again	33 (67.3)

among the few studies from India that have comprehensively assessed the problems faced by pregnant women during the lockdown, especially in rural areas. There are specific critical highlights of the study. Many pregnancies were unwanted and continued as abortion services were non-accessible. Most of the participants faced one or the other difficulties due to the restrictions imposed. Hospital visits and investigations were decreased. Among the COVID-19-positive women, there was a high incidence of preterm birth. Telemedicine services were of little use to pregnant women. The pregnant women felt undernourished during the lockdown period.

Table 6 Effect of lockdown on the nutritional profile of pregnant women in the rural area of North India

	Bathinda	Faridkot	Muktsar	Total	χ^2 (p value)
Total	742 (100)	532 (100)	100 (100)	1374 (100)	
Felt the effect of lockdown on a diet during pregnancy	556 (74.9)	402 (75.6)	93 (93)	1051 (76.5)	<0.001
Felt undernourished during lockdown	408 (55)	280 (52.6)	75 (75)	763 (55.5)	<0.001
Diet was deficient in					
Fruits	535 (72.2)	388 (72.9)	92 (92)	1016 (73.9)	<0.001
Vegetables	267 (36)	207 (38.9)	43 (43)	517 (37.6)	>0.05
Dairy products	155 (20.9)	148 (27.8)	40 (40)	343 (25.0)	<0.001
Oil and ghee	159 (21.4)	145 (27.3)	43 (43)	347 (25.3)	<0.001
Pulses	55 (7.4)	32 (6)	3 (3)	90 (6.6)	>0.05
Cereals	128 (17.3)	106 (19.9)	24 (24)	258 (18.8)	>0.05
Nuts	428 (57.7)	343 (64.5)	85 (85)	856 (62.3)	<0.001
Spend extra to procure food items	631 (85)	452 (85)	91 (91)	1174 (85.4)	>0.05
Micronutrient supplements					
Difficulty in receiving iron/calcium	67 (9)	46 (8.6)	10 (10)	123 (9.0)	>0.05
Ever skipped iron/calcium with fear of running out of stock	14 (1.9)	29 (5.5)	2 (2)	45 (3.3)	>0.05
Purchased supplements	66 (8.9)	46 (8.6)	8 (8)	120 (8.7)	>0.05
Anganwadi beneficiaries					
Beneficiary registered for midday meal supplements	699 (94.2)	330 (62)	89 (89)	1118 (81.4)	<0.001
Meals are given during lockdown	597 (80)	144 (27.1)	74 (74)	815 (59.3)	<0.001

Awareness about the COVID-19

Characteristics of the participants were comparable across the three study districts, apart from the socioeconomic differences. Our study demonstrates high awareness of COVID-19, its transmission mode, presenting symptoms and main preventive measures. The reported understanding is better than the studies conducted in Ethiopia and Pakistan.^{15,16} This can be attributed to the disease burden in the two study areas and the time of the survey. Public awareness has been crucial in controlling the spread of COVID-19 as it is directly linked to the implementation of COVID-19-appropriate behaviour.¹⁷ About 97.7% of the pregnant women were apprehensive of the lockdown and had fear about its adverse effects on their fetuses. Previous studies have also demonstrated that pregnant women, postpartum women or women who experience a miscarriage are at high risk of developing mental health problems during the pandemic.¹⁸ Hence, proactive outreach to these women and enhancement of social supports could help them to relieve their apprehensions. Our study observed that a higher number of participants used face masks than

social distancing measures, which can be attributed to prevalent misconceptions that they could not catch an infection from their knowns. Another study from Ghana had observed low adherence to COVID-19-appropriate measures among pregnant women.¹⁹ However, it is advisable to continue the sensitisation of the pregnant women about the COVID-19-appropriate behaviour during the antenatal counselling sessions because of the constant emergence of new variants of concern with an unknown impact on the pregnancy. ASHA and ANM workers can help sensitise the women during antenatal check-up visits at their homes.

Access to antenatal clinics

Our study reports a high number of unplanned pregnancies that were continued. This corroborates the results from Ethiopia, where the magnitude of unintended pregnancy during the COVID-19 pandemic among women attending antenatal care was 47.17%.²⁰ This can be attributed to the inaccessibility of abortion services similar to many countries globally.²¹ In addition, the

COVID-19 restrictions may have indirectly increased the risk of sexual violence.²² This, in turn, is one factor for the increase in the magnitude of unintended pregnancy.

Furthermore, we observed a decline in antenatal visits to the health centres by pregnant women. The majority of them visited the health centre only two times during the entire pregnancy, irrespective of the risk status of the pregnancy. Few could not visit the hospital even once during the lockdown. Traditional antenatal care includes eight visits, as recommended by WHO 2016, to reduce stillbirths and neonatal mortality.²³ However, it was considered to reduce the number of recommended prenatal visits for low-risk pregnancies during the current pandemic. Global interim guidance on COVID-19 during pregnancy and puerperium from the Federation of Gynecology and Obstetrics (FIGO) and allied partners have also advocated for a reduced number of antenatal visits for low-risk uncomplicated pregnancies to minimise the risk of cross-infection.²⁴ Difficulty in accessing the transportation facilities was the most common reason for not visiting the health centre and corroborates with the reports from other countries.^{25–27} One of the essential factors in the appropriate antenatal care is timely access to health facilities since delay in treatment can enhance the risk of maternal and perinatal mortality. A study performed in Nepal on the pregnant women during lockdown points towards an increased proportion of women having complications during admission, including preterm birth. As per the study, women at high risk of complications attended the health facilities disproportionately, or the number of complicated cases increased due to delays and other challenges of the lockdown.²⁷

The decline in antenatal visits also hampered the rates of essential investigations during the pregnancy, which corresponds with the previous reports.²⁸ Still, approximately 97% of the pregnant women got diagnostic tests such as blood group, Venereal Disease Research Laboratory, hepatitis B, C and HIV at the time of delivery. The decrease in access and utilisation of healthcare services can be attributed to various demand and supply-related factors. We observed that many women and their spouses lost their jobs during the restrictions, and a high number of pregnancies were reported to be unwanted. Then there was a high level of anxiety among the pregnant women concerning the effect of COVID-19 on their babies, which may alter the perceived risk-benefit calculation for women seeking health services.²⁹ These factors may have created a demand-side barrier. Also, the pandemic has overwhelmed the health system in India. Only COVID-19 cases were prioritised, and human resource for health was relocated, which created a scarcity of medicine and services for other medical conditions, including antenatal care services, and made a temporary supply-chain issue as well.^{29–30} Within this context, we mention that the most critical evidence-based intervention that requires mandatory in-person prenatal visits is checking blood pressure to diagnose and treat pre-eclampsia, a leading cause of maternal mortality and hence has to be ensured. Blood

pressure cannot be measured at home and supervised through telemedicine. This can be managed through the implementation of the drive-through prenatal care model proposed by Turrentine *et al*, where blood pressure measurements, fetal heart rate assessment and selected ultrasound-based observations along with face-to-face doctor-patient interaction can occur with the pregnant women remaining in her private vehicle. This model also can reduce patient anxiety due to restricted antenatal visits.³¹

Maternal and neonatal outcomes

Nearly one-third of the participants reported at least one type of medical complication ranging from anaemia to antepartum haemorrhage during their pregnancy, but there were no maternal deaths. Another report of 108 pregnancies also reported no maternal deaths.³² Most of them could deliver at their planned place, but approximately one-tenth had an eventful postpartum period—about 2.2% of women delivered at home. A similar increase in home deliveries was reported during Liberia's Ebola virus outbreak.²⁸ In our study, only 52% of the neonates were attended by the paediatrician at the time of delivery. Probably, other women could not access adequate healthcare during the lockdown, and 11.1% required NICU admissions due to various complications like low birth weight and meconium aspiration syndrome. There was no significant difference in NICU admission rates for neonates with and without COVID-19-positive mothers.

As a result of the COVID-19 pandemic, the postpartum family planning services were significantly affected. In our study, only about half (55.5%) women adopted contraceptives in the postpartum period but were limited to temporary methods like condoms. As per the National Family Health Survey round IV (2015–2016),³³ the state of Punjab has the highest number (75%) of people using contraceptives, female sterilisation being the most used method. Decreased usage can be attributed to the reduced supply of contraceptives due to the lockdown guidelines.

COVID-19 infection among pregnant women

Of the 1374 women approached during this study, 21 were COVID-19 positive. As per the Royal College of Obstetricians and Gynaecologists, pregnant women have a similar likelihood of getting COVID-19 infection compared with healthy adults. However, infected pregnant women may be at increased risk of becoming severely unwell than non-pregnant women, particularly in the third trimester.³⁴ In our study, most pregnant women got infected in the third trimester, around their delivery period, corroborating with other studies.^{35–36} This can be explained by increased exposure to the virus during the visit to health centres for delivery. The current study observed that 76% of the COVID-19-positive patients were asymptomatic, and others had a mild fever, cold and cough symptoms. Similar to the previous studies, the clinical manifestation

of COVID-19 in pregnant women was comparable to their non-pregnant counterparts.³⁷ Only one woman reported shortness of breath. This pattern is similar to findings from a meta-analysis including 87 COVID-19 pregnant women by Kasraeian *et al*, which reported mild or moderate symptoms in 78% of patients.³⁸ Nayak *et al* also observed that 97% of pregnant women were asymptomatic or had mild symptoms.² However, this pattern contrasts with the findings of Barbero *et al*, who studied 91 pregnant women, out of which 40% of women developed pneumonia, 46.2% were hospitalised and 4 patients required critical care.³⁹ Pregnancy complicated with COVID-19 can be due to severe acute respiratory syndrome, disseminated intravascular coagulopathy, renal failure, secondary bacterial pneumonia and sepsis. It can be responsible for spontaneous miscarriages, preterm deliveries, intrauterine growth and fetal demise. Cytokine storm-related COVID-19 at pregnancy can deteriorate fetal development. However, no maternal death was reported due to COVID-19 in our study. The caesarean section rates for the COVID-19 women in our study were around 47%, similar to a previous study but lower than 91%, as discussed by Di Mascio *et al*.⁴⁰ The differences in the rates can be attributed to the varying severity of the disease. Nearly half of the COVID-19-positive pregnant women (42.8%) complained that their pregnancy was not handled appropriately as they had an infection and perceived that the healthcare workers did not provide them with proper treatment.

However, similar to evidence generated by previous studies, there was a high rate of preterm births, and about one-fourth of the neonates (28.5%) born to these mothers required NICU due to preterm birth.²¹ There was no evidence of vertical transmission since none of the newborns was found to be COVID-19 positive similar to recent studies.⁴¹ There is limited data on how pandemic and lockdown has affected the rate of abortions and stillbirths. We observed 3% of abortions in pregnant women, which is in agreement with the study by Nayak *et al*.⁴²

Role of telemedicine services

Women may avoid prenatal care during this pandemic due to infectious symptoms, isolation or treatment for suspected or confirmed COVID-19.⁴³ FIGO had also recommended less in-person contact in pregnancy during the pandemic. To remotely provide prenatal natal or postnatal care, telehealth services were introduced. Telemedicine implies 'healing from distance'.⁴⁴ The Health Ministry rolled out the 'eSanjeevani OPD' platform enabling patient-to-doctor telemedicine owing to the COVID-19 pandemic in April 2020. This has proved a boon in containing the spread of COVID-19 while simultaneously allowing provisions for non-COVID essential healthcare. However, in the present study, only 6.7% were aware of teleconsultation offered by the government, whereas only 3.6% availed these services. This low adoption by our respondents can be attributed to little knowledge among our respondents and their families due to the weak advocacy during the lockdown and minimal access to

modern electronic devices and internet services necessary for availing these services. This is corroborated by the fact that our study population was mainly from the upper lower class, and only 32% of the pregnant women had access to smartphones to use such services. Apart from this, there are many barriers to rapid implementation of prenatal, telehealth visits and may include high start-up costs, integration with existing electronic medical record systems and patient side cost for availing this service.⁴⁵ Apart from the logistic constraints, pregnant women were left on their own when it came to medicine and supplements, and hence the services were not favoured by many. Our findings indicate that all the women availed the audio telemedicine services, which diminishes the scope of physical examination. Furthermore, 77.5% of pregnant women who used telemedicine felt that routine in-person visits are better than telemedicine. A thorough physical examination is impossible and can lead to underestimating or misinterpretation of the diseases emerging during pregnancy. However, we concur with the experiences from the neighbouring country which demonstrates that telemedicine has the potential to offer care and eliminate the inaccessibility of health services in remote areas, provided women have access to smartphones.⁴⁶ Otherwise, it has to be supplemented with trained work staff with telemedicine service setup at the user's end and availability of medicine and investigations at the point of teleconsultations.⁴⁷

Effect of lockdown on nutrition

Our study demonstrates that lack of nutritious diet during lockdown was the most commonly faced problem by pregnant women. This can be attributed to the fact that lockdown also leads to loss of wages, which decreases the spending on nutritious but costly dietary products. Due to the fall in the economy during the COVID-19 crisis, the food items were quite expensive to procure.⁴⁸ According to our present findings, 85.4% (1174) of pregnant women have had to pay extra to procure certain food items. Many pregnant women could not afford to pay extra as it was too heavy on their pockets, and they were deprived of a nutritional diet. Food scarcity in vulnerable populations such as children, pregnant and lactating women should be regulated to cause severe consequences. As per the experts, the ripple effects of the COVID-19 pandemic will negatively affect the food and nutrition security, health and well-being of families with young children and pregnant and lactating women for the years to come.⁴⁹ There is no doubt that the COVID-19 has become a natural experiment illustrating how unprepared the world is to protect populations against hunger, food nutrition and health insecurity during emergencies.⁵⁰

Our study reiterates the significance of the frontline workers highlighted during the pandemic. The ANM and ASHA workers continued their home-visits and provided counselling services in the antenatal and postpartum periods. They also counselled and provided the women with contraceptives they had with them, as a result of which more than half of the women used temporary methods of contraceptives in their postpartum period. Then most of the newborns were vaccinated as per the UIP's schedule. Then, more than half

of the Anganwadi beneficiaries continued to receive their midday meals even during the restrictions, which contributed to a significant portion of their daily caloric requirements. Further training and empowerment of these frontline workers can significantly improve maternal and child health.

There are some potential limitations in the present study. Interviewing the females telephonically may create a barrier between the interviewer and the respondent, as the patient cannot express their opinion compared with face-to-face interviews, apart from recall bias. On the other hand, due to the non-availability of mobile phone networks in some areas, many patients could not be contacted and the problems may remain under-reported. Since it was a time-bound study, we could not assess the long-term impact of COVID-19 infections on maternal and fetal outcomes. As health is a state subject in India, the lockdown effects cannot be generalised to the whole country. Also, the actual impact of lockdown cannot be assessed if the conditions are not compared with either pre-COVID-19 or post-COVID-19 restrictions. While prelockdown data collection is challenging, future studies can compare the restricted period with post-COVID-19 times.

We have some key recommendations emerging from the current study. In the future, before imposing such restrictions, the government should plan continued essential antenatal care and family planning services at well-equipped select centres. The community should be made aware of approaching such centres for maternity services. Round-the-clock transport services should be available to the pregnant women for transport in need of emergency. Telemedicine is a good strategy but needs to evolve, especially for antenatal women in rural areas. The lack of awareness and technology to access this service made it less beneficial for pregnant women. Peripheral health centres have been equipped for telemedicine consultations under the Ayushman Bharat-Health and Wellness programme, which needs advocacy to increase the usage by the beneficiaries. Furthermore, it is recommended to judiciously use the hospital staff to minimise the disruption of the essential services. Lastly, ANM and ASHA workers should be further empowered as they have proved to be a strong pillar of our health system during the pandemic.

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Contributors Lajya Devi Goyal (LDG), Priyanka Garg (PG), and Madhur Verma (MV): conceptualized the study, acquisition of data, developed analytical framework, analyzed the data, interpreted the results, wrote the first draft of the manuscript, and are responsible for the overall content as guarantor. DK, JA: interpreted local policy implications of the results, reviewed and approved the early and advanced

drafts of the manuscript. NK: led the data collection, interpreted the results, and prepared the draft.

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Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval Ethics approval was obtained from the Institutional Ethics Committee of the All India Institute of Medical Sciences, Bathinda, India (IEC/AIIMS/ BTI/033). Explicit verbal consent was obtained from the pregnant women after assuring them of data confidentiality before the interview. Participants had a chance to withdraw from the study before or during the completion of the questionnaire. Participants gave informed consent to participate in the study before taking part.

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Data availability statement Data are available on reasonable request. Data collected from the antenatal women are sensitive and can be shared on request made to the corresponding author.

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