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ORIGINAL ARTICLE

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ABSTRACT

Background: The COVID-19 outbreak caused persons to be reluctant to seek medical care due to fear of contracting the infection.

Objectives: To evaluate the effect of the COVID-19 pandemic on admission rates to the delivery room and the feto-maternal unit, and to assess the effect on the nature of presenting obstetrical complaints to the emergency department.

Study Design: A retrospective cohort study in one medical center. The population was women > 20 weeks pregnant who presented to the obstetrical emergency department with self-complaints during 29 days at the peak of the pandemic outbreak, and a matched group during the exact period in the previous year. We compared between the groups: clinical, obstetrical, and demographic data, including age, area of residence, gravidity, parity, previous cesarean deliveries, high-risk pregnancy follow-up, the last 30 days admissions to the obstetrical emergency department, gestational age, chief complaints, cervical dilatation, cervical effacement, admissions to the delivery room or feto-maternal unit, time from admissions to the delivery room to birth, if applicable, and acute obstetrical complications diagnosed at the emergency department.

Results: During the pandemic outbreak, 398 women met study inclusion criteria, compared to 544 women in the matched period of the previous year. During the COVID-19 period, women visited the obstetrical emergency department at a more advanced mean gestational age (37.6 ± 3.7 vs. 36.7 ± 4.6, $p = .001$). Higher proportions of women in the COVID-19 cohort presented in active labor, defined by cervical dilation of at least 5 cm on admission to the labor ward [37 (9.3%) vs 28 (5.1%), $p = .013$)] and with premature rupture of membranes [82 (20.6%) vs 60 (11.0%), $p < .001$)], and consequently with more admissions to the delivery room [198 (49.7%) vs 189 (34.7%), $p < .001$)]. We also recorded a significant increase in urgent obstetrical events in the emergency department during the recorded COVID-19 pandemic [23 (5.8%) vs 12 (2.2%)), $p = .004$]. However, the rates of neonatal and maternal morbidity did not change. During the outbreak the proportion of visits during the night was higher than during the matched period of the previous year: [138 (34.7%) vs 145 (26.6%)), $p = .008$]. In a multivariate logistic regression, the higher rates of admission to the delivery room during active labor and of urgent events during the pandemic outbreak compared to the matched period in the previous year remained statistically significant.

Conclusions: The pandemic outbreak of COVID-19 caused a behavioral change among women who presented to the obstetrical emergency department. This was characterized by delayed arrival to the obstetrical emergency department and the delivery room, which led to a significant increase in urgent and acute interventions. The change in behavior did not affect the rates of maternal and neonatal morbidity.

Introduction

The recent pandemic outbreak of COVID-19 and its worldwide effects are yet to be seen. Effects on the obstetrical population are unique in several ways. First, due to physiological changes of normal pregnancy [1] and according to knowledge accumulated from infections similar to the COVID-19 [2,3], pregnant women affected by respiratory infection could be at increased risk for pulmonic complications and the need for intensive care admission. However, data more specifically related to COVID-19 infection of pregnant women reported outcomes similar to non-pregnant women [4,5]. Suggestions have recently been published on how to prepare obstetrical units in face of the threatening outbreak [6].

The pandemic outbreak created global awareness alongside social isolation and a decrease in face-to-face communication due to concern from infection. Social media news also enhances these concerns among the population and have played an important role in disseminating lockdown regulations. This has worried medical practitioners and public health functionaries regarding delays in the presentation to emergency medical services that are consequent to fear of contracting COVID-19 infection. Repeated warnings have been publicized that delays could result in increased morbidity and mortality.

Pregnant women engage in multiple interactions with health services during pregnancy and at delivery. During the current healthcare crisis, social media is being used to address pregnancy follow-up [7,8]. However, some of the communication remains through the emergency department (ED) of the obstetrical ward. During normal times, the ED serves as a filter for multiple complaints. Some require further evaluation or supervision at the feto-maternal unit (FMU), some indicate upcoming labor that justifies admission to the delivery room, and some are reassured or referred to community-based medical services.

Therefore, our objective was to compare admissions and outcome data before and during the COVID-19 outbreak. Specifically, we evaluated differences between the periods in presentation characteristics in the obstetrical ED, and in admission rates to the delivery room (which could result in decreased time from admission to delivery) and to the FMU. In addition, we compared rates of acute obstetrical complications diagnosed at the obstetrical ED.

Materials and methods

This was a retrospective comparative cross-sectional study. The first patient with COVID-19 infection was reported in Israel on February 27, 2020. General recommendations for social awareness by the government and ministry of health were initiated at the beginning of March 2020. The relative quarantine started in Israel on March 15, and recommendations changed dynamically according to infection rates over the period. Total lockdown lasted only 24 h, during which the ministry of health, using social media, emphasized to all patients who seek medical help not to refrain from visiting emergency rooms. To evaluate the effect of the recommendations on presentations at the obstetrical ED, we included all pregnant women who presented to the ED during the peak of the pandemic outbreak and the dissipation of government and media recommendations in Israel (March 15, 2020–April 12, 2020). We compared the data to a control group of pregnant women who presented to the obstetrical ED on the same dates in the previous year (March 15, 2019–April 12, 2019). Charts were reviewed by 3 investigators (NK, NC, and WA). Any disagreement was judged and revised by a fourth investigator (YS).

Included in the study were all the women above 20 weeks of pregnancy who presented to the obstetrical ED during the study period due to an obstetrical or nonobstetrical self-complaint. We extracted demographic and obstetrical data. The demographic data included age and area of residence (defined as outside the city of Haifa, or in-city residence). Data on obstetrical history included: parity and previous cesarean deliveries. Data relating to the current pregnancy included: admissions to the obstetrical ER during the last 30 days gestational age, the chief complaint (categorized by those most common: active labor, defined as uterine contractions with cervical dilatation above 5 cm [9]; uterine contractions; premature rupture of membranes; reduced fetal movements; vaginal bleeding; and other nonspecific complaints); high-risk pregnancy follow-up; cervical dilatation; and cervical effacement (only for those who had an indication and were examined). Data relating to the women's behavior and their journeys in the hospital included: timing of the visit to the obstetrical ED (classified as daytime: 7 am to 11 pm and night time 11 pm-7 am); admission to the delivery room or FMU; time from admission to the delivery room, and from the delivery room to birth, if applicable; and. We assessed acute obstetrical complications diagnosed at the ED that could have resulted from a delay in turning to medical services. These included the need for emergent delivery/cesarean section, presentation at the second stage of labor or after delivery, eclampsia, intrauterine fetal death, and imminent preterm delivery. We excluded all the women with missing data and those referred by their physicians after incidental findings at regular surveillance or who were invited for a follow-up visit. Women who were referred by their physicians after presenting with acute complaints such as contractions, vaginal bleeding, and reduced fetal movements were included in the study. Each case of acute obstetrical complications diagnosed in the ED was further assessed for the maternal or neonatal outcome (surgical complication, low Apgar score or PH, a post-surgical complication that required blood products, or re-operation). We entered all the variables that were statistically significant in the univariate analysis into a multivariate logistic
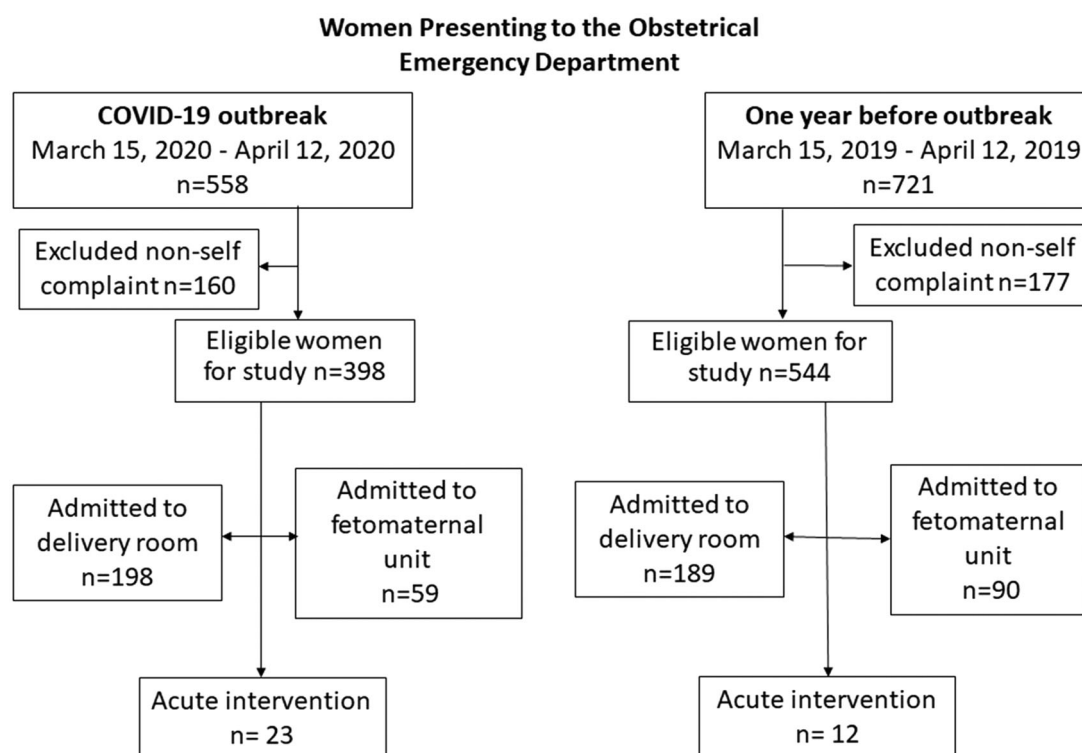
Women Presenting to the Obstetrical Emergency Department

Figure 1. Patient flow of women presenting to the obstetrical emergency department during the COVID-19 outbreak and one year before.

regression model. Accordingly, the following variables were included: gestational age, parity, age residence in city, previous cesarean section, high-risk follow-up, ED visits in the last 30 days, night visits, admission to the delivery room, active labor, and urgent events.

Statistical analyses

Statistical analysis was performed by using IBM statistics (SPSS) vs. 24. The continuous variables were presented by means and standard deviations, or by medians and interquartile ranges. The categorical variables were presented in percentages.

Comparison between the demographical and clinical characteristics between the two time periods was analyzed using the Chi-square test for the categorical variables and the independent t-test or Mann–Whitney, as appropriate, for the continuous variables.

Logistic regression was used to assess the association between the time periods and the outcome of the ED admission, controlled for the different characteristics. The crude and the adjusted odds ratio, along with 95% confidence interval are presented. The generalized estimating equation using the binominal distribution, controlling for repeated measures (few ED admissions for the same woman) revealed very similar results (data not shown). $p < .05$ was considered statistically significant.

Ethical approval

The study was approved on the 5.5.2020 by the institutional review board of Carmel Medical Center (Protocol number 0070-20-CMC).

Results

Patient flow is presented in Figure 1.

We identified 558 women who presented to the obstetrical ED during the selected study period of the pandemic outbreak. From the corresponding, period 1 year before, we identified 721 women who presented to the obstetrical ED. We excluded all the women with missing data and those who presented to follow-up or with nonself-complaints. The resultant cohort comprised 398 women in the pandemic outbreak period and 544 women in the matched period one year before. Table 1 compares basic maternal characteristics between the groups. The mean maternal age was similar in the COVID-19 and control groups (31.4 ± 4.3 and 31.3 ± 4.7, respectively, $p = .68$). The mean gestational week at presentation was higher during the COVID-19 period than in the comparable period in the previous year (37.6 ± 3.7 vs 36.7 ± 4.6, $p = .001$). A higher proportion of women who presented to the obstetrical ED during the COVID-19 period were local rather than regional residents, compared to the

control group (35 vs 27%, $p = .013$). Women who presented to the obstetrical ED during the COVID-19 period were less likely to have visited the ED in the 30 days prior to the study period (114 (28.6%) vs 191 (35.1%), $p = .036$). All other maternal characteristics were balanced between the COVID-19 period and the comparable period.

Table 2 compares the presentation causes and admission characteristics of the women who arrived at the obstetrics ED during the two periods. During the COVID-19 period, active labor ($p = .013$) and premature rupture of membranes ($p < .001$) were more common presenting complaints; however, nonspecific complaints were less common (45 (11.3%) vs 115 (21.1%), $p < .001$). Cervical dilation or effacement on presentation did not differ between the periods. During the COVID-19 period, the proportion of hospital admissions was higher (257 (64.6%) vs 279 (51.3%), $p < .001$), as was the proportion of admissions to the delivery room (198 (49.7%) vs 189

(34.7%), $p < .001$). Significant differences were not found between the groups in the time from delivery room admission to birth (5.7 ± 5.3 vs 6.5 ± 7.0; $p = .2016$), rates of admission to the FMU, and the proportions of women refusing hospitalization. During the COVID-19 period, the proportion of women presenting to the ED with urgent obstetrical events was higher (5.8% vs 2.2%, $p = .004$), and the rate of night visits was higher (138 (34.7%) vs 145 (26.6%)); 0.008).

Multivariate logistic regression showed hazard ratios for admission to the delivery room, active labor, and urgent events during the pandemic outbreak of 1.88 ($p < .001$), 1.83 ($p = .028$), and 2.72 ($p = .007$), respectively.

Complications as a result of an urgent presenting event at the obstetrical ED:

We identified 35 cases. Of these, 11 during the COVID-19 period presented in the second stage of labor (fully dilated) and delivered within minutes in

Table 1. Comparison of demographic and clinical characteristics between pregnant women who presented to the obstetrical emergency department with complaints during the COVID-19 outbreak and one year before.

	COVID-19 outbreak N = 398	One year before the outbreak N = 544	p Value
Maternal age (years)[a]	31.4 ± 4.3	31.3 ± 4.7	.685
Primiparous	153 (38.4%)	190 (34.9%)	.268
Gestational age (weeks)[a]	37.6 ± 3.7	36.7 ± 4.6	.001
Previous cesarean section	46 (11.6%)	67 (12.3%)	.723
High risk follow-up	58 (14.6%)	103 (18.9%)	.079
Haifa residence	140 (35.2%)	150 (27.6%)	.013
Emergency department admission in the previous 30 days	114 (28.6%)	191 (35.1%)	.036

[a]Mean ± std. deviation.

Table 2. Comparison of presentation causes and admission characteristics between pregnant women who presented to the obstetrical emergency department with self-complaints during the COVID-19 outbreak and 1 year before.

	COVID-19 outbreak N = 398	One year before the outbreak N = 544	p Value
Hospitalization	257 (64.6%)	279 (51.3%)	<.001
Admission to the delivery room	198 (49.7%)	189 (34.7%)	<.001
Admission to the fetomaternal unit	59 (14.8%)	90 (16.5%)	.475
Night visits[a]	138 (34.7%)	145 (26.6%)	.008
Presentation cause			
Contractions[b]	169 (42.5%)	239 (43.9%)	.653
Premature rupture of membranes	82 (20.6%)	60 (11.05%)	<.001
Active labor[c]	140 (35.2%)	150 (27.6%)	.013
Premature rupture of membranes ruled out	12 (3.0%)	21 (3.9%)	.486
Vaginal bleeding	22 (5.5%)	33 (6.1%)	.728
Reduced fetal movements	26 (6.5%)	45 (8.3%)	.318
Other[d]	45 (11.3%)	115 (21.1%)	<.001
Home delivery	5 (1.3%)	2 (0.4%)	.139
Cervical dilation on presentation (cm)[e]	1.5 (0.5; 3)	1.5 (0.5; 2.5)	.281
Cervical effacement on presentation (%)[f]	56.1 ± 30.3	56.6 ± 30.3	.821
Time from admission to delivery room until birth (h)[f]	5.7 ± 5.3	6.5 ± 7.0	.201
Urgent events in the emergency department[g]	23 (5.8%)	12 (2.2%)	.004

[a]Between 23 am to 7 pm.
[b]With cervical dilatation of less than 5 cm and without premature rupture of membranes.
[c]Defined as cervical dilation of at least 5 cm.
[d]Abdominal pain, pelvic pressure, back pain, pruritis, trauma, motor vehicle accident, fever, vaginal discharge, edema, headache, blurry vision, weakness, dyspnea, cough, vomiting, nausea, diarrhea, chest pain, urinary symptoms, rectal bleeding, leg pain, and hypertension.
[e]Median (interquartile range).
[f]Mean ± standard deviation.
[g]Presentation in the second stage of labor, delivery within minutes, STAT cesarean section from the emergency room, and home deliveries.

Table 3. Comparison of maternal and neonatal outcomes of women presenting with an urgent event at the obstetrical emergency department during the COVID-19 outbreak and 1 year before.

	COVID-19 outbreak N = 398	One year before the outbreak N = 544	p Value
Second stage of labor	11 (2.7%)	6 (1.1%)	.100
STAT cesarean section	7 (1.7%)	4 (0.7%)	.261
Home delivery	5 (1.3%)	2 (0.4%)	.139
	Urgent events N = 23	Urgent events N = 12	
Postpartum infection	1 (4.3%)	1 (8.3%)	.779
NICU[a] admission	2 (8.6%)	2 (16.6%)	.889
Umbilical artery PH < 7.1	0 (0%)	1 (8.3%)	.742
Apgar at 5 min < 7	0	0	NS
Respiratory distress requiring support	1 (4.3%)	0 (0%)	.742

[a]Neonatal intensive care unit.

the obstetrical ED or the delivery room. In addition, seven women were transferred to the operation room for STAT cesarean section and five home deliveries were recorded. In the matched period one year before, we documented six women who presented in the second stage of labor (fully dilated), four STAT cesarean sections, and two home deliveries.

No significant differences were observed between the periods regarding maternal outcomes, including surgical and obstetrical intra and postpartum complications; nor neonatal outcomes including Apgar scores, umbilical artery blood gases, neonatal intensive care admissions, or respiratory complications (Table 3).

Discussion

This retrospective cross-sectional cohort study showed less obstetrical ED visits during the COVID-19 period than during the parallel period in the previous year. However, the mean gestational age of the pregnant women presenting to the ED was greater in the former than the latter. During the period of the pandemic outbreak, the proportion of women presenting in active labor was greater; consequently, the number of admissions to the delivery room was also greater than in the matched period 1 year before. During the COVID-19 period, more women presented to the obstetrical ED with urgent events that necessitated acute intervention; nonetheless, no significant impact on maternal or neonatal outcomes was observed.

During the March–April COVID-19 outbreak in Israel, recommendations to the population emphasized social distancing; and at certain points also restricted quarantine was issued, including one day of total lockdown. However, throughout the period, outpatient clinics continued their regular follow-ups, and no restrictions were made on pregnant women regarding emergent or follow-up visits; these concurred with healthcare activity worldwide [10], As mentioned above, governmental and healthcare authorities, using the media, urged patients requiring medical treatment not to refrain from coming to emergency care rooms.

This study showed a significant and expected decrease in ED visits during the COVID-19 period, compared to the previous year. Nonetheless, rates of admissions to the obstetrics ED, and specifically to the delivery room, were significantly increased. During the COVID-19 period, women presented to the obstetrical ED at a significantly advanced pregnancy week and were more often in active labor or premature rupture of membranes. Together, these factors led to a significant increase in the rate of admission to the delivery room; however, cervical dilation, effacement, and time to delivery remained unchanged. Although characteristics of the women from the two time periods were comparable, in regard to parity, age, and a history of a cesarean section, other factors that could be relevant to the time to delivery were not assessed, such as fetal weight and the use of epidural analgesia.

We also observed a significant increase in the visits of women who lived closer to the hospital, compared to outside the city. This may reflect the impact of social distancing recommendations. It may also be seen in a positive way and represent resource optimization expressed by workload reduction in level Ⅲ hospitals coping with the COVID-19 pandemic. Rates of admission to the FMU were similar between the COVID-19 and the control groups. This indicates that the ongoing hospitalization rate for nonemergent reasons did not change. Rates of nonspecific complaints (mostly not related to pregnancy) were decreased during the COVID-19 period; this suggests that women avoided coming to the obstetrical ED unless they expected being in active labor. Moreover, the fact that the mean gestational age of the women presenting to the ED was greater in the pandemic period can be seen as a desired phenomenon especially in light of the similar maternal and neonatal outcomes.

The decrease observed in visits to the obstetrical ED due to fewer on-going follow-up is understandable

in an outbreak situation. A significant decrease in the rates of admission for acute coronary syndrome during the pandemic outbreak was recently reported in northern Italy [11]. This paralleled an increase in outpatient cardiac arrest [12], thus highlighting the danger of delaying treatment. It was recently reported that a collateral effect of COVID-19 was a decrease of approximately 39% in the number of patients who received evaluations for acute stroke in the United States [13]. We observed an increased rate of women presenting with situations that justified urgent interventions; however, neonatal and maternal morbidity did not increase.

Pregnant women are a unique population. On one hand, most are healthy and young. On the other hand, they are obligated to their health and wellbeing, and to that of their fetus. The decrease in obstetrical ED visits might reflect confusion regarding recommendations, fear from exposure to potential COVID-19 carriers, and therefore the individual risk/benefit strategies. Not all recommendations in the media regarding populations at risk were clear enough, and it is natural that young healthy women would prefer to restrain from ED areas during the pandemic outbreak. Importantly, the line between adhering to quarantine instructions including social distancing, and between possible morbidity due to delay in presenting to medical services, is very thin, and not always clear to the general population. Despite its single institute setting, our study might reflect the mentality of the obstetrical population and its tendency, in the situation of a pandemic, to reduce visits to obstetrical ED. Medical authorities might use these observations and others, to understand a general referral pattern of pregnant women, during a general crisis. This may promote efficient use of resources such as to address increased night visits and urgent events that could require immediate intervention. On the other hand, while the outbreak continues, authorities should consider ways to decrease potentially dangerous avoidance, anxiety, and unnecessary visits, by the use of telemedicine, and by concentrating the treatment of COVID-19 patients in specialized centers.

This is the first study to assess the impact of the pandemic outbreak on emergent visits of pregnant women to the obstetrical ED. Albeit, the retrospective design is a limitation of the study, and the possibility of selection bias arises due to the exclusion of women with missing data. Moreover, our study is a single-center cross-sectional view. We do not have information as to whether similar trends were observed in other delivery rooms in the region, or in outpatient clinics.

Though unlikely, decreased rates observed at our center could have been compensated by increased rates of visits in other obstetrical EDs or clinics. We also do not have information on the rates of regional home deliveries, which could contribute to the entire picture of social distancing. Since total maternal and neonatal outcomes were not objectives of this study, we did not compare differences in maternal and neonatal morbidity that were not related to acute events in the obstetrical ED.

In a large single-institute cross-sectional study, we showed that the pandemic outbreak of COVID-19 caused pregnant women to delay their arrival to the obstetrical ED and delivery room. This led to a significant increase in urgent acute interventions, without an increase in the rates of severe maternal and neonatal morbidity. Larger nationwide studies are needed. In addition, a third period, after the COVID-19 pandemic, should eventually be compared, to verify if the rates of visits to obstetrical ED will return to rates known prior to the COVID-19 outbreak.

Acknowledgments

Disclosure statement

Author's contributions

Nir Kugelman: Conceptualization, data curation, project administration, investigation, writing- original draft, writing – review, and editing.

Ofer Lavie: Conceptualization, methodology, project administration, writing – review, and editing.

Wisam Assaf: Data curation, resources, investigation.

Nadav Cohen: Data curation, resources, investigation.

Lena Sagi-Dain: Data curation, investigation, formal analysis, methodology.

Mordehai Bardicef: Supervision, methodology, writing – review, and editing.

Reuven Kedar: Supervision, writing – review, and editing.

Amit Damti: Investigation, methodology, writing – review, and editing.

Yakir Segev: Conceptualization, data curation, project administration, investigation, writing- original draft, writing – review and editing, supervision.

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