

Original Article

The Effects of COVID-19 on Maternal and Fetal Health

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Abstract

Background: Studies on the maternal and fetal effects of Covid 19 have a small sample and mostly include data from 2020.

Objective: The study aimed to determine the maternal and fetal effects of COVID-19 within the two-year period from the onset of the pandemic.

Methodology: This study was planned as a retrospective descriptive study. It was conducted in a training and research hospital. The sample consisted of 176 pregnant women and 68 newborns diagnosed with COVID-19 between March 11, 2020 and February 11, 2022. Data were collected from patient registry files.

Results: Among pregnant women, 15.3% were immigrants and 18.8% experienced complications related to COVID-19. In terms of hospitalization, 4.0% of the women were admitted to the intensive care unit, and mechanical ventilation was utilized by 2.8%. Out of the total number of women, 38.6% gave birth. The majority of these births, 73.5%, were delivered via cesarean section. Concerning the newborns, 8.8% were intubated, 22.0% were hospitalized in the intensive care unit, 4.4% tested positive for COVID-19, and 51.5% were fed with formula. Pregnant women with a low gestational week had higher rates of having cesarean section ($p<0,05$). Compared to Turkish women, the incidence of COVID-19 complications was higher in immigrant women, and the rate of breastfeeding their newborns was lower ($p<0,05$).

Conclusion: Cesarean section rate is high in COVID-19, there is a relationship between premature birth and cesarean section. The rate of feeding with formula are higher in babies of pregnant women with COVID-19. The rate of COVID-19 complications and feeding their baby with formula are higher in immigrant women.

Keywords: breastfeeding, COVID-19, newborn, pregnant women, immigrants

Introduction

The COVID-19 virus emerged in December 2019 and spread rapidly all over the world, and its widespread deadly effects caused the World Health Organization (WHO) to declare a state of emergency on January 30, 2020 (Bekmezci & Karakoc 2020). COVID-19 disease was transmitted quickly and easily, causing severe consequences. 6,495,110 people died all over the world due to COVID-19 (World Health Organization 2022).

Since pregnancy is considered a risky period for many infections, the widespread and deadly

COVID-19 infection in pregnant women has increased concerns. Physiological, mechanical and immunological changes related to pregnancy may affect COVID-19 sensitivity and severity during pregnancy (Jamieson & Rasmussen 2021).

Decreased lung capacity, increased heart rate and oxygen consumption, edema of the respiratory tract mucosa, and the development of pregnancy-related immunosuppressive state may increase respiratory tract complications due to viral infections during pregnancy (Bekmezci & Karakoc 2020). As a result, not

only the pregnant but also the baby can be harmed by the effects of the COVID-19 infection. Studies on this subject report that COVID-19 increases the possibility of being admitted to intensive care, needing invasive ventilation and extracorporeal membrane oxygenation, and dying in pregnant women and that it causes fetal distress, abortion, dyspnea, and preterm delivery (Panahi, Amiri & Pouy 2020; Jamieson & Rasmussen 2021). There are studies on the maternal and fetal effects of COVID-19.

However, these studies have both small samples and their data were collected mostly in 2020. Many mutations have developed in the SARS-CoV-2 virus that causes COVID-19, new variants have emerged and these variants have affected the course of the disease (Demir 2022). It is also likely that COVID-19 will become endemic, so there is a need for continuous data collection on the effects of COVID-19 in pregnancy (Jamieson & Rasmussen 2021).

Systematic review studies revealed that pregnant women with COVID-19 generally show good clinical outcomes; however, they state that studies with large samples are needed (Bekmezci & Karakoc 2020; Panahi, Amiri & Pouy 2020). To this end, this study was planned with a single center larger sample in order to determine the maternal and fetal effects of COVID-19 within two years from the beginning of the pandemic. This study aimed to determine the maternal and fetal effects of COVID-19. This study will provide up-to-date data on the possibility of COVID-19 becoming endemic and provide clues for prenatal care and follow-up in future pandemics.

Methodology

This retrospective and single-center study was conducted in a Training and Research Hospital on the European side of Istanbul. The hospital was a COVID-19 reference hospital and patients diagnosed with COVID-19 were referred to this hospital from the surrounding hospitals. The sample of the study consisted of pregnant women who were diagnosed with COVID-19 and hospitalized in the gynecology service of the hospital between March 11, 2020 and February 11, 2022, and their babies born

while they are in hospital. Pregnant women who were hospitalized and discharged in the same day due to curettage and similar reasons were not included in the sample. Study data were obtained from the hospital's information management system and pregnant/newborn patient registry files.

The data form was prepared by the researchers in line with the literature and consisted of 24 questions.

In the introductory information form, there were six questions aimed at obtaining the age, education level, gestational week, chronic diseases and similar information of the pregnant woman. Six more questions were included in order to obtain information about the conditions of pregnant women, such as COVID-19 symptoms, treatment status, and complication development.

There were also four questions aimed at obtaining data about gestational week at birth, type of delivery and similar delivery.

Another eight questions in the data form aimed to obtain information about the newborn regarding their height, weight, apgar score and so on.

Data Collection: A list of patients diagnosed with COVID-19 between March 11, 2020 and February, 11 2022 and hospitalized in the hospital's obstetrics service was created through the hospital's information management system. The patient files of the patients in the list were accessed through the archive and the specified data were recorded in the data form.

The data of the babies of the women whose birth information was obtained through the pregnant records were accessed by scanning the patient archive files in the nursery room.

Data Analysis: Descriptive statistics was carried out to calculate percentage, number, mean, and minimum-maximum values. The distribution of the data was evaluated with the Kolmogorov-Smirnov test. Chi-square, Fisher's exact test and Mann-Whitney U were used for data analyses.

Ethical Considerations: Institutional permission was obtained from the hospital where the research would be conducted, and ethics committee approval (2021/77) from Istanbul Kultur University Ethics Committee on November 25, 2021.

Results

The current study analyzed data from 176 women and 68 newborns. The average age of the women was calculated to be 30.49 ± 5.73 , with the youngest participant being 18 and the oldest 47. Out of the women studied, 27 (15.3%) were foreign nationals. In terms of education, 41 women (23.3%) had completed primary school or lower, 65 (36.9%) had completed secondary school or high school, 19 (10.8%) were university graduates, and the education level of 51 (29.0%) was unknown. A chronic disease was reported in 29 (16.5%) of the women, including hypertension, diabetes, asthma, or thyroid diseases.

The majority of the women, 69.9%, were multiparous, and of these women, 63 (51.2%) had previously given birth via cesarean section, with 22 (17.9%) having delivered three or more times. The average gestational week at hospitalization was 32.10 ± 6.20 , with a minimum of 16 weeks and a maximum of 40 weeks.

Table 1 shows COVID-19 data of women. The most common reason for women to apply to the hospital was the positive COVID-19 test with 80.7%, followed by gestational problems (early membrane rupture, preeclampsia, hypertension, spotting bleeding, not feeling fetal movements) with 43.2%, and difficulty in breathing with 40.9%. The most common COVID-19 symptom in women was muscle pain with 46.0%, followed by cough with 44.9% and dyspnea with 27.3%. Treatment was applied to 87.5% of the women, the most common being anticoagulant treatment with 84.7%.

Complications related to COVID-19 (respiratory syndrome, intra-uterine fetal distress) developed in 18.8% of women. Non-stress test (NST) was nonreactive in three (1.7%), 4.0% were hospitalized in the intensive care unit, and mechanical ventilation was used for 2.8%. Sixty-eight (38.6%) of the women gave birth during their hospital stay. The average gestational week of those who gave

birth was recorded as 36.66 ± 2.88 , with a minimum of 26 weeks and a maximum of 40 weeks. Out of the women who gave birth, 35.3% delivered before 37 weeks of gestation and 73.5% had cesarean section births. Of the women who had a cesarean section, 72.22% had previously given birth via cesarean section, with 63.2% having indications such as dyspnea, fetal distress, respiratory syndrome, or position anomaly. Fortunately, none of the women experienced postpartum complications.

At the first minute after birth, the Apgar score of 16 infants (23.5%) was below seven (ranging from 0 to 9). At the fifth minute, the Apgar score of three babies (4.4%) was below seven (ranging from 5 to 10). There were no cases of neonatal death, but health issues such as hyperbilirubinemia, dyspnea, thrombocytopenia, and intrauterine growth retardation were observed in 35.3% of the newborns. Six (8.8%) of the newborns required intubation and 15 (22.0%) were hospitalized in the intensive care unit. Three (4.4%) of the newborns were diagnosed with COVID-19.

In terms of feeding, 48.5% of the infants were fed breast milk, while 51.5% were fed with formula or a combination of formula and breast milk (23.5% with both breast milk and formula, 28.0% with formula only).

Table 2 presents the data on the comparison of women's individual characteristics with COVID-19 prognosis, birth and newborn data. The rate of having cesarean section, having a health problem in the newborn, and feeding the newborn with formula / formula + breast milk was higher in pregnant women with a low gestational week at the time of hospitalization and delivery ($p < 0.05$). Compared to Turkish women, the incidence of COVID-19 complications was higher in immigrant women, and the rate of breastfeeding the newborn was lower ($p < 0.05$). None of the women with chronic disease needed intensive care and mechanical ventilation.

Table 1 COVID-19 data of women

Reason for admission to hospital^a	n (%)
COVID-19 test positive	142 (80.7)
Gestational causes ^b	76 (43.2)
Dyspnea	72 (40.9)
Tachycardia	64 (36.4)
Cough	54 (30.7)
Pain	32 (18.2)
Fever	29 (16.5)
Sputum	18 (10.2)
COVID-19 symptoms^a	n (%)
Muscle pain	81 (46.0)
Cough	79 (44.9)
Dyspnea	48 (27.3)
Fever	45 (25.6)
Weakness	44 (25.0)
Sputum	21 (11.9)
Lung Computed Tomography ground glass image	18 (10.2)
Throat ache	13 (7.4)
Diarrhea	3 (1.7)
Loss of taste	2 (1.1)
Treatment of pregnant women^a	154 (87.5)
Antiviral therapy	33 (18.8)
Antibiotic therapy	84 (47.7)
Anticoagulant therapy	149 (84.7)
Oxygen therapy	65 (36.9)

^a More than one option could be marked. ^b Premature rupture of membranes, preeclampsia and so on.

Table 2 Comparison of women's individual characteristics and COVID-19 prognosis, birth and newborn data

	COVID-19 complication		The need for intensive care		The need for mechanical ventilation		Type of birth		Health problem in newborn		Newborn feeding			
	Yes	No	Yes	No	Yes	No	Vaginal Birth	Cesarean Section	Yes	No	Breast milk	Formula / Breast milk+ formula		
	n (%)													
Age	Mean ± SD	30.49±5.73	33 (18.8) 30.66±5.49	143 (81.2) 30.45±5.80	7 (4.0) 33.85±6.84	169 (96.0) 30.35±5.66	5 (2.8) 31.40±4.39	171 (97.2) 30.46±5.77	18 (26.5) 31.00±5.56	50 (73.5) 31.82±6.02	24 (35.3) 32.29±6.75	44 (64.7) 31.22±5.38	33 (48.5) 31.30±4.96	35 (51.5) 31.88±6.68
			p:0.93 ^a		p:0.18 ^a		p:0.62 ^a		p:0.73 ^a		p:0.69 ^a		p:0.62 ^a	
Gestational week at hospital admission	Mean± SD	32.10±6.20	32.36±5.55	32.04±6.36	28.85±5.01	32.23±6.22	29.20±5.71	32.18±6.21	37.72±2.32	35.92±3.33	34.00±3.92	37.70±1.60	37.87±1.61	35.00±3.65
			p:0.91 ^a		p:0.09 ^a		p:0.21 ^a		p:0.02 ^a		p:0.00 ^a		p:0.00 ^a	
Gestational week at birth	Mean ± SD	36.66±2.88	22.48±17.4 9	12.45±17.6 4	13.71±17.3 0	14.36±18.0 7	13.00±18.0 8	14.37±18.0 4	37.83±2.45	36.24±2.93	34.50±3.55	37.84±1.47	38.09±1.52	35.31±3.21
			p:0.03 ^a		p:0.05 ^a		p:0.24 ^a		p:0.03 ^a		p:0.00 ^a		p:0.00 ^a	
Nationality: Turkish / Other (Immigrant)	n (%)	149 (84.7) 27 (15.3)	24 (16.1) 9(33.3)	125 (83.9) 18 (66.7)	5 (3.4) 2 (7.4)	144 (96.6) 25 (92.6)	4 (2.7) 1 (3.7)	145 (97.3) 26 (96.3)	14 (25.0) 4 (33.3)	42 (75.0) 8 (66.7)	17 (30.4) 7 (58.3)	39 (69.9) 5 (41.7)	31 (55.4) 2 (16.7)	25 (44.6) 10 (83.3)
			p:0.03 ^b		p:0.29 ^c		p:0.57 ^c		p:0.71 ^c		p:0.96 ^c		p:0.01 ^b	
Parity: primipara multiparous	n (%)	53 (30.1) 123 (69.9)	11 (20.8) 22(17.9)	42 (79.2) 101 (82.1)	2 (3.8) 5 (4.1)	51 (96.2) 118 (95.6)	1 (1.9) 4 (3.3)	52 (98.1) 119 (96.7)	5 (26.3) 13 (26.5)	14 (73.7) 36 (73.5)	7 (36.8) 17 (34.7)	12 (63.2) 32 (65.3)	11 (57.9) 22 (44.9)	8 (42.1) 27 (55.1)
			p:0.65 ^b		p:0.64 ^c		p:0.52 ^c		p:0.98 ^b		p:0.86 ^b		p:0.33 ^b	
Chronic disease status: Yes No	n (%)	29 (16.5) 147 (83.5)	5 (17.2) 28 (19.0)	24 (82.8) 119 (81.0)	0 (0) 7 (4.8)	29 (100) 140 (95.2)	0 (0) 5 (3.4)	29 (100) 142 (96.6)	4 (28.6) 14 (25.9)	10 (71.4) 40 (74.1)	4 (28.6) 20 (37.0)	10 (71.4) 34 (63.0)	5 (35.7) 28 (51.8)	9 (64.3) 26 (48.1)
			p:0.82 ^b		p:0.27 ^c		p:0.40 ^c		p:0.54 ^c		p:0.39 ^c		p:0.28 ^b	
Current gestational problem: Yes No	n (%)	39 (22.2) 147 (83.5)	9 (23.1) 24 (17.5)	30 (76.9) 113 (82.5)	2 (5.1) 5 (3.6)	37 (94.9) 132 (96.4)	1 (2.6) 4 (2.9)	38 (97.4) 133 (97.1)	6 (31.6) 12 (24.5)	13 (68.4) 37 (75.5)	10(52.6) 14 (28.6)	9 (47.4) 35 (71.4)	8 (42.1) 25 (51.0)	11 (57.9) 24 (49.0)
			0.43 ^b		0.48 ^c		p:0.69 ^c		0.55 ^b		0.06 ^b		0.51 ^b	

SD: Standard Deviation ^a Mann-Whitney U ^b Chi-square ^c Fisher's exact test

Discussion

There are various studies in the literature on the effects of COVID-19 on maternal and fetal health (Bekmezci & Karakoc 2020; Engjom et al. 2021). However, this study is of unique value in that it covers the two-year pandemic period, was conducted in one of the reference hospitals for pregnant women with COVID-19, and has a large sample compared to previous studies. This study will provide up-to-date data on the possibility of COVID-19 becoming endemic and provide clues for prenatal care and follow-up in future pandemics.

Each trimester of pregnancy has its own changes and risks, and in which trimester the pregnant woman is hospitalized with the diagnosis of COVID-19 is crucial for the follow-up of the pregnant woman. This study found the average gestational week at hospitalization as the third trimester, and the current literature supports this finding (Salem, Katranji & Bakdash 2021; Medeiros et al. 2022; Kosovali, Tezcan & Mutlu 2022). It is recommended to follow up more closely the infectious diseases that progress with respiratory distress in pregnant women in the third trimester.

Immigrants are among the vulnerable groups and are likely to have problems in accessing information and reproductive health services during the pandemic. In this study, a small number of migrant pregnant women were also among the pregnant women diagnosed with COVID-19. In the study of Engjom et al. (2021) it was reported that having an immigrant background is a risk factor for COVID-19 infection during pregnancy. However, Engjom et al. while 64.3% of pregnant women with a diagnosis of COVID-19 were immigrants, a low rate of 15.3% of pregnant women with a diagnosis of COVID-19 were diagnosed with COVID-19 in this study (Engjom et al. 2021). Existing literature has reported that immigrant women's utilization of health services decreased, and a delay in health care was observed during the pandemic (Lusambili et al. 2020; Mardin et al. 2020; Bisnauth et al. 2022). Although the number of immigrant women in this study was low, the incidence of COVID-19

complications was higher in immigrant women compared to Turkish women. This suggests the need for closer monitoring of pregnant immigrants, who are a vulnerable group.

Existing literature reports that pregnant women with COVID-19 face more complications than non-pregnant women (Allotey et al. 2020; Jamieson & Rasmussen 2021; Engjom et al. 2021). However, in this study, the rate of intensive care and mechanical ventilation use by women is much lower than in the current literature. While the need for intensive care was 4.0% in this study, Engjom et al. (2021) reported this rate as 21.4% in a study conducted with 21 pregnant women. Ferlibas's study no difference was found between pregnant women with COVID-19 infection and without COVID-19 infection in terms of need for intensive care and mechanical ventilation (Ferlibas 2021). This may be related to the sample size of the studies and the variant of the COVID-19 infection at the time it was conducted. The studies' reporting that the intensive care needs of pregnant women in the COVID-19 Delta variant have increased also supports this idea (Kosovali, Tezcan & Mutlu 2022).

Existing studies report that COVID-19 infection is associated with chronic health problems such as existing diabetes, hypertension, and pregnancy-related problems such as preeclampsia, with serious complications such as need for intensive care, mechanical ventilation, and maternal death (Allotey et al. 2020; Jamieson & Rasmussen 2021; Vouga et al. 2021). Although this study found complications such as respiratory syndrome and intrauterine fetal distress in approximately one fifth of the pregnant women, this finding was not associated with the current chronic disease status and gestational problem of the pregnant woman. Maternal death has never occurred. Moreover, surprisingly, none of the patients with chronic diseases needed intensive care and mechanical ventilation. It is thought that this may be due to the careful follow-up of pregnant women with chronic diseases -because they are more risky- by health personnel. The fact that the need for intensive care and mechanical ventilation was found to be lower in this study compared to the existing studies, the absence of

maternal and infant deaths, and the fact that none of the women developed postpartum complications support this finding (Allotey et al. 2020; Jamieson & Rasmussen 2021).

Existing studies report that COVID-19 infection increases the cesarean delivery rate (Bekmezci & Karakoc 2020; Engjom et al. 2021; Vouga et al. 2021). The rate of cesarean section reached in this study is much higher than the rate of cesarean section in Turkey, which is 53%. The fact that the gestational weeks of the pregnant women who had cesarean delivery were lower than those who had vaginal delivery suggests that COVID-19 infection is associated with preterm birth and cesarean section. Existing literature reports that pregnant women with Covid-19 are at high risk of giving birth prematurely, and in this study, one-third of women gave birth prematurely (Allotey et al. 2020).

The systematic review of Bekmezci and Karakoc reports that the newborn apgar score is normal (Bekmezci & Karakoc 2020). However, this study revealed that almost a quarter of newborns had an apgar score below seven in the first minute. However, the rate of infants with apgar scores below seven at the fifth minute decreased to 4.4%. In parallel with this finding, problems such as hyperbilirubinemia, dyspnea, thrombocytopenia, and intrauterine growth retardation were observed in one third of newborns. Existing studies have reported stillbirths and neonatal deaths associated with COVID-19 but stillbirth and neonatal death were not found in this study (Allotey et al. 2020; Engjom et al. 2021; Vouga et al. 2021; Villar, Ariff & Gunier 2021). However, 8.8% of the newborns were intubated and more than one-fifth were followed up in the intensive care unit. It is recommended that the babies of pregnant women diagnosed with COVID-19 be followed closely.

The relevant literature reports that the transmission of COVID-19 to the newborn is rare. The systematic review of Bekmezci and Karakoc found that only one of the eight studies had a rate of 2.2% transmission of COVID-19 to the newborn (Bekmezci & Karakoc 2020; Angelidou et al. 2021). In this study, a diagnosis

of COVID-19 was made in 4.4% of infants. There is no evidence to support transmission of the virus through the placenta or breast milk (Medeiros et al. 2022). Adequate postpartum hygiene and contact measures must be followed to minimize the risk of COVID-19 transmission to the newborn, which may occur through contact with the mother after birth.

The existing literature strongly recommends that if the health of the mother and her baby allow, the mother with COVID-19 should breastfeed her baby by taking appropriate protective measures (Perez-Bermejo, Peris-Ochando & Murillo-Llorente 2021; Vassilopoulou et al. 2021). It is even recommended to give the expressed milk to the baby or to feed the baby with donor milk if the mother's health condition does not allow direct breastfeeding (Perez-Bermejo, Peris-Ochando & Murillo-Llorente 2021). The Turkish Ministry of Health recommends that COVID-19 positive mothers breastfeed their children by wearing a mask and paying attention to the hygiene rules, but if the mother uses medication due to COVID-19, she should express her milk but not give the baby, and start breastfeeding the child again after the drug treatment is finished (Republic of Turkey Ministry of Health 2021). About one-fifth of the women in this study received antiviral therapy, and more than half of them used formula for infant feeding. The 2018 Turkey Demographic and Health Survey data stated that the rate of feeding only breast milk for 0-1 month-old children is 59%, and only breast milk use has been questioned in this study (2018 Turkey demographic and health survey). This retrospective study looked at whether infants were given formula from newborn records, but could not question the administration of additional fluids such as water and herbal tea. Even in this case, the proportion of infants fed formula is higher than in the general population. Breast milk has been proven to have positive effects on infectious diseases in premature births as well as in many cases (Perez-Bermejo, Peris-Ochando & Murillo-Llorente 2021). It is recommended that health personnel constantly inform pregnant and lactating women about breast milk, and ensure that they have access to up-to-date information

on the subject, in order to benefit from the miraculous effects of breast milk in pandemics, especially in the future pandemics that may affect pregnant and puerperal women.

Breast milk is recommended for preterm babies as well as healthy newborns (Yu et al. 2021). This study found that infants with a low gestational week at birth had higher rates of formula feeding. Breastfeeding problems may occur in premature babies due to the separation of the mother and the baby and the baby's difficulty in sucking (Yu et al. 2021). Almost a quarter of the babies in this study remained in intensive care, and the mother and baby were separated. In addition, health problems were seen in one third of the babies. It is thought that this situation increases the rate of feeding with formula in preterm babies. The existing literature provides evidence that the breastfeeding rate in premature infants can be increased by providing a suitable environment for breastfeeding and developing family-centered practices (Yu et al. 2021). It is suggested to provide training on breastfeeding of premature babies by their mothers, to provide a suitable environment for breastfeeding/milking, and to support mothers in breastfeeding their babies by taking protective measures against infection, especially during pandemic periods.

Compared to Turkish women, the rate of breastfeeding for newborns was lower in immigrant women. A study conducted by Deger et al. in Turkey reported that the rate of feeding the babies of Syrian immigrants with only breast milk in the general population (%28,1) is lower than that of Turkish women (%34,1) (Deger, Ertem & Cifci 2020). However, the rate of breastfeeding (16.7) in this study is much lower than in the Deger et al. study (Deger, Ertem & Cifci 2020). It is recommended that immigrants, who are a vulnerable group during possible future pandemic periods, should also be supported in breastfeeding, especially during the postpartum period when they are more sensitive.

Conclusions: In the COVID-19 pandemic, especially the third trimester is risky in terms of hospitalization and pregnant women should be

followed closely during this period. Cesarean section rate is high in COVID-19, and there is a relationship between preterm birth and cesarean section. Since the babies of pregnant women with COVID-19 have higher rates of health problems and formula feeding, these babies should be followed more closely. It is recommended that health personnel constantly support pregnant and lactating women about breastfeeding, and ensure that they have access to up-to-date information, in order to benefit from the miraculous effects of breast milk in pandemics, especially in the future pandemics that may affect pregnant and puerperal women. The incidence of COVID-19 complications and the rate of feeding their baby with formula are higher in immigrant pregnant women. These women and babies should be followed more closely, and they should be especially supported in terms of breast milk and breastfeeding. By learning lessons from the COVID-19 pandemic, we should be prepared for future pandemics.

Limitations: This study was conducted retrospectively, and therefore, the data are limited to patient records. In addition, it was carried out using the data of the hospitalized pregnant women, who were diagnosed with COVID-19, and their babies, it does not include the data of those who were not hospitalized.

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