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Obstetric-neonatal care during birth and postpartum in symptomatic and asymptomatic women infected with SARS-CoV-2: a retrospective multicenter study

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Article 1 Obstetric-neonatal care during birth and postpartum 2 in symptomatic and asymptomatic women infected 3 with SARS-COV-2: a retrospective multicenter study 4 Rafael Vila-Candel 1.2; Víctor M González-Chordá 3*; Francisco Javier Soriano-Vidal 2.4; Enrique 5 Castro-Sánchez 5.6; Noelia Rodríguez-Blanco 7.8; Ana Gómez-Seguí 9; Laura Andreu-Pejó 3; Cristina 6 Martínez-Porcar ¹⁰; Carmen Rodríguez Gonzálvez ¹¹; Patricia Torrent-Ramos ^{12,13}; Nieves Asensio-7 Tomás 14; Yolanda Herraiz-Soler 15,16; Ramon Escuriet 17,18; Desirée Mena-Tudela 3 8 9 ¹ Department of Nursing, Faculty of Nursing and Podiatry, Universitat de València, València, Spain Department of Obstetrics and Gynaecology, Hospital Universitario de la Ribera, Alcira, Spain. Foundation for the Promotion of 10 Health and Biomedical Research in the Valencian Region (FISABIO), Valencia, Spain; vila_rafcan@gva.es 11 GIENF-281 Nursing Research Group. Nursing Department, Univesitat Jaume I, Castellón, Spain vchorda@uji.es ; pejo@uji.es ; 12 dmena@uji.es 13 4. Department of Obstetrics and Gynaecology, Hospital Lluis Alcanyís, Xativa, Foundation for the Promotion of Health and Bio-14 medical Research in the Valencian Region (FISABIO), Valencia, Spain; soriano_fravid@gva.es 15 ^{5.} College of Nursing, Midwifery and Healthcare, University of West London, Brentford, Middlesex, UK 16 17 6. Health Protection Research Unit in Healthcare-Associated Infections and Antimicrobial Resistance at Imperial College London, 18 London, UK enrique.castrosanchez@uwl.ac.uk 7. Department of Nursing Universidad CEU Cardenal Herrera, Plaza Reyes Católicos, 19, 03204 Elche, Spain 19 ^{8.} Department of Obstetrics and Gynaecology, Hospital Marina Baixa, Spain noelia.2ww@gmail.com 20 Department of Obstetrics and Gynaecology, Hospital Universitario y Politécnico La Fe, Valencia, Spain anagomezse-21 9. 22 gui@gmail.com 23 ^{10.} Department of Paediatrics, Hospital Universitario de la Ribera cmartinezporcar@gmail.com ¹¹ Department of Obstetrics and Gynaecology, Hospital Universitario de Vinalopó, Spain matrona.haptonomia@gmail.com 24 25 12. Preventive Medicine Service, Hospital General de Castellón, 12071 Castellón, Spain 13. Nursing Department, Univesitat Jaume I, Castellón, Spain ptorrent@uji.es 26 14. Department of Obstetrics and Gynaecology, Hospital Universitario y Politécnico La Fe, Valencia, Spain niasto@hotmail.com 27 15. Department of Obstetrics and Gynaecology, Consorcio Hospital General Universitario Valencia. 28 16. Facultat d'Infermeria i Podologia, Universitat de València, Valencia, Spain yolandaherraiz@hotmail.com 29 ^{17.} Ghenders research group. School of Health Sciences Blanquerna, Universitat Ramon Lull, Carrer Padilla 326, 08025 Barcelona, 30 31 Spain 18. Catalan Health Service, Government of Barcelona, Travessera de les Corts 131, 08028 Barcelona, Spain rescuriet@gencat.cat 32 Correspondence: vchorda@uji.es 33 Abstract: This study analyzes the obstetric-neonatal outcomes of women in labour with symptomatic and asymp-34

tomatic COVID-19. A retrospective, multicenter, observational study was carried out between 1 March 2020 and 35 28 February 2021 in eight public hospitals in the Valencian Community (Spain). Chi-square test compared the 36 obstetric-neonatal outcomes and general care for symptomatic and asymptomatic women. 11,883 births were as-37 sisted in participating centers, with 10.9‰ maternities (n = 130) infected with SARS-CoV-2. The 20.8% were symp-38 tomatic and had more complications both upon admission (p = .042) and during puerperium (p = .042), as well as 39 transfer to intensive care unit (ICU). Percentage admission to Neonatal Intensive Care Unit (NICU) was greater 40 among offspring of symptomatic women compared to infants born of asymptomatic women (p = .005). Compared 41 with asymptomatic women, those with symptoms underwent less labour companion (p = .028), less early skin-to-42 skin contact (p = .029) and greater mother-infant separation (p = .005). The overall maternal mortality rate was 0.8%. 43 No vertical transmission was recorded. In conclusion, symptomatic infected women are at increased risk lack of 44 labour companion, mother-infant separation, admission to ICU and to have preterm births and NICU admissions. 45

Keywords: COVID-19; SARS-CoV-2; Obstetric nursing; Neonatal nursing; Delivery; Obstetric

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1. Introduction

Disease due to severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) infection had 50 caused over 4.7 million deaths worldwide by 2021 [1]. Although most countries adopted measures to 51 contain the pandemic, including lockdowns and preventive hygiene protocols [2] as well as vaccination 52 programs wherever vaccines where available [3], SARS-CoV-2 infection remains a significant global 53 health threat. 54

With regard to coronavirus disease-2019 (COVID-19), pregnant women do not seem to be more 55 susceptible to infection than the general population [4]. However, in the event of disease symptoms 56 appear to be more severe, particularly during the third trimester of pregnancy, with more frequent 57 admission to the Intensive Care Unit (ICU) and a greater risk of poorer maternal and neonatal health 58 outcomes (such as preterm birth, caesarean sections, and low birth weight) [5–8]. 59

Routine evidence-based clinical practices of benefit for maternal and childbirth care (labour companion, early skin-to-skin contact, breastfeeding and rooming-in in the maternity) have been modified or interrupted during the pandemic, which could reduce the quality of birth care models [9,10]. Furthermore, vertical transmission seems possible [11], although the mechanisms of such transmission remain unclear [12,13]. Whilst severe events for newborn infants seem rare [13], perhaps thanks to the passive transmission of anti-SARS-CoV-2 antibodies via the transplacental route and in breast milk, there is growing concern about such effects [14,15].

The primary aim of this study was to analyze the obstetric-neonatal outcomes of women in labour 67 with symptomatic and asymptomatic SARS-CoV-2 infection. The study also aimed to describe and contrast the routine care received by these groups of women and their newborns. 69

2. Materials and Methods

2.1. Study population and sampling criteria

A retrospective, multicenter, observational study was carried out based on the review of the clin-72 ical records of pregnant women assisted during labour and birth, with positive real-time polymerase 73 chain reaction (RT-PCR) test result for SARS-CoV-2 in nasopharyngeal exudate at the time of admis-74 sion. The study was carried out in eight state-funded hospitals of the Valencian Community in Spain. 75 These hospitals (four in Valencia, one in Castellón, three in Alicante) were all reference centers for their 76 province, and cared for at least 1,000 deliveries per year, or were located in rural areas with large catch-77 ment populations. Overall, the participating hospitals served one million people and attended ~12,000 78 deliveries in the previous year. The information about the study was disseminated via the regional 79 research network and suitable health care organizations approached by the researchers. The study pe-80 riod was from 1 March 2020 to 28 February 2021. 81

The study population comprised women giving birth in any of the participating hospitals. The study population comprised women giving birth in any of the participating hospitals. The inclusion criteria were: (a) women with a positive RT-PCR test for SARS-CoV-2 RNA in nasopharyngeal exudate performed on hospital admission for labour and birth; and (b) infants born of infected mothers, with RT-PCR testing for SARS-CoV-2 in nasopharyngeal exudate during hospital admission (<48h, not extracted from the placenta or amniotic fluid).

Pregnant women infected with SARS-CoV-2 and admitted to the hospital for medical reasons other than birth were excluded from the study. 88

2.2. Measurements

The research staff at each participating center reviewed the obstetric history, neonatal and post-90 partum outcomes, and general labour care records of all the positive patients assisted during the study 91 period. The variables related to birth and postpartum were collected from the Orion Logis® electronic 92 health records, while the data for mothers and newborns related to follow-up during the first six weeks 93 after birth were obtained from the Abucasis II® health database. Any readmission via the emergency 94 room of mothers or newborns registered at the same hospitals were identified during the 6 weeks from 95 the Abucasis II® database. Both electronic medical records are routinely used by all the health facilities 96 in the Valencian Community, including all the centers participating in the study. The following varia-97 bles were collected: 98

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• Demographic variables: maternal age, country of origin, and the hospital where the birth oc- 99 curred. 100

Obstetric-neonatal variables: Gestational age at the time of birth, parity (primiparous/multipa-101 • rous), previous maternal history of health problems (diabetes mellitus/hypertension/cardiac dis-102 eases/neurological diseases/thrombotic diseases/thyroid diseases/drugs misuse/ COVID-not related in-103 fection diseases), gestational disease (preeclampsia/eclampsia/gestational hypertension/gestational di-104 abetes/hypothyroidism/hyperthyroidism/ COVID-not related infectious diseases), fetal alterations 105 identified by health care providers (preterm birth, small for gestational age/large for gestational age/fe-106 tal growth restriction/congenital abnormality), start of labour (spontaneous/induced/elective caesarean 107 section), type of birth (eutocic, instrumental birth/caesarean section [CS]), cause of CS, maternal com-108 plications prior labour and during puerperium (respiratory, cardiac, neurologic, thrombotic manifes-109 tations, and COVID-related coagulopathy), maternal admission to the intensive care unit (ICU) prior 110 to birth and/or puerperium, cause of maternal admission to the ICU, weight of the newborn, Apgar 111 score at one and five minutes, and umbilical artery pH at birth. Mother to child transmission can occur 112 in different stages, including in utero, intrapartum or postnatal. Our study defined vertical transmis-113 sion in the early postnatal period (<48h) as a positive test for SARS-CoV-2 maternal infection at admis-114 sion, coupled with a confirmed positive test for the newborn [16], infant admission to the neonatal ICU 115 (NICU), and cause of admission to the NICU. 116

Clinical variables: Maternal and newborn symptoms compatible with SARS-CoV-2 infection (fe ver, cough, shortness of breath, fatigue, body aches, headache, anosmia, ageusia, nausea or vomiting,
 diarrhea), time of result of the RT-PCR SARS-CoV-2 test for the mother (ante-, intra- or postpartum),
 the result of the RT-PCR SARS-CoV-2 test for the newborn infant within 48h (positive or negative), and
 follow-up of complications and readmissions (mother/newborn infant, with reasons) during the first
 six weeks after birth. Maternal or newborn death (up to 28 days) if COVID-related.

• Obstetric and neonatal general labour care: late clamping (clamping and cutting the cord at least 123 one minute from birth, or when the umbilical cord stopped pulsating [17]), early skin-to-skin contact 124 [SSC] (defined as prone placing of the naked infant on the mother's bare chest at birth, in the first minute after birth, or very soon afterwards [18]), labour companion, mother-infant separation during hospital admission, the reason for separation. 127

Breastfeeding-related variables: Type of feeding at discharge and 6 weeks postpartum (exclusive breastfeeding, formula feeding, mixed feeding). Exclusive breastfeeding (EBF) was defined as offering
 only breast milk and excluding all other food or fluids, including water. This case definition did, however, allow the infant to receive oral rehydration salts, drops and syrups (vitamins, minerals and medicines) [19]. Mixed feeding was defined as the combination of breastfeeding and formula feed.
 Obstetric and neonatal outcomes were compared between symptomatic and asymptomatic SARS-CoV-2 infected women.

The obstetric outcomes were: Preterm birth < 37 weeks; Fetal growth restriction (birth weight 135 percentile <5); Induced hypertension in pregnancy; Gestational diabetes; CS; Operative birth; ICU ad-136 mission; Maternal complications prior labour/during puerperium COVID-related: cardiac, neurologic, 137 thrombotic, respiratory manifestations; Maternal death 138

The neonatal outcomes were: Small for gestational age (birth weight percentile <10 for babies of the</th>139same gestational age); Large for gestational age (birth weight p>90 for babies of the same gestational140age); Apgar <7 at 5 minutes; NICU admission.</td>141

The obstetric and neonatal general care were compared between symptomatic (participants with SARS-Cov-2 infection and who presented compatible clinical manifestations such as fever, cough or loss of smell, among other signs and symptoms) and asymptomatic (participants with SARS-Cov-2 infection but who did not develop compatible clinical manifestations)women SARS-CoV-2 infected were: Labour companion; Late umbilical cord clamping; Early SSC; Mother-infant separation; EBF (at discharge/6 weeks). Basic descriptive statistics were expressed as the mean ± standard deviation (SD) in the case of149continuous variables and as frequencies and percentages in the case of categorical variables. Normal150data distribution was assessed using the Kolmogorov-Smirnov test.151

The incidence rate was determined using the total number of new positive SARS-CoV-2 cases per 152 1,000 maternities and divided by the number of births during the study period. The chi-square test was 153 used to compare the obstetric-neonatal general care rates according to the different qualitative varia-154 bles, corrected by the Fisher exact test. Likewise, the chi-square test and crude odds ratio (OR) with 155 95% confidence intervals (CIs) were used to compare the different study variables between asympto-156 matic SARS-CoV-2 positive women and women who developed COVID-19 (symptomatic cases). Sta-157 tistical significance was considered for p < .05. Data analysis was performed using the R statistical pack-158 age (version 4.0.5). 159

2.4. Ethical considerations

Patients were not involved in the development of the research questions, the study's design, or the recruitment of participants. Because of the retrospective study design, patient informed consent was not required. All patient data were handled anonymously. The local Ethics Committees approved the study protocols in the eight centers. The ethical principles of medical research that current Spanish legislation contemplated have been considered, and the study was conducted following the Declaration of Helsinki.

3. Results

11,883 births were assisted during the study period in the participating hospitals. We included all168women with SARS-CoV-2 infection admitted to the participating hospitals during the study period169(130, 10.9 per 1,000 maternities). The case distribution according to hospitals is shown in Table 1. Hos-170pital H4 had an incidence of 17.8 per 1,000 maternities, and hospital H8 assisted the largest number of171positive cases. The majority of women were born in Spain (53.8%), with a mean age of 32 ± 5.1 years.172There were not statistically significant differences between symptomatic and asymptomatic women for173any demographic variables (Table 2). There was no loss of any participant.174

Hospital	Total births	Births in women infected with SARS-CoV-2	Incidence
H1	1288	18	14.0
H2	1090	7	6.4
H3	1308	7	5.4
H4	1182	21	17.8
H5	1256	14	11.1
H6	679	11	16.2
H7	920	8	8.7
H8	4160	44	10.6
TOTAL	11,883	130	11.3

Table 1. Births and incidence of women with SARS-CoV-2 infection during the study.

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	Women infected with SARS-CoV-2				
	Asymptomatic	Symptomatic			
Study variables	(n=103; 79.2%)	(n=27; 20.8%)	p *		
	Mean (SD)	Mean (SD)			
Age	31.5 (4.9)	33.9 (5.5)	.05		
	n (%)	n (%)			
Country of origin					
Spain	64 (81.0)	6 (29.0)			
Central and South America	14 (70.0)	15 (30.0)	.287		
Rest of EU countries	12 (80.0)	3 (20.0)			
Africa	9 (81.8)	2 (18.2)			
Asia	4 (80.0)	1 (20.0)			
Hospital of birth					
H8	34 (97.1)	1 (2.9)			
H1	18 (100.0)	0 (0.0)			
H4	15 (71.4)	6 (28.6)			
H5	10 (71.4)	4 (28.6)	.11		
H6	8 (72.7)	3 (27.3)			
H3	7 (70.0)	3 (30.0)			
H2	6 (37.5)	10 (62.5)			

Table 2. Demographic characteristics of women infected with SARS-CoV-2 in the study.

*Chi-square; severe acute respiratory syndrome coronavirus-2 = SARS-CoV-2; EU = European Union; H = Hospital. 183

Regarding the women's characteristics, 50% were primiparous, with a mean gestational age of 39.2 185 \pm 1.58 weeks, and most had no previous maternal, gestational or fetal disease conditions, without sig-186 nificant differences between symptomatic and asymptomatic women (P < 0.05). Positivity for SARS-187 CoV-2 was confirmed before or during labour in 91.5% of cases and 8.5% after birth. 56.2% had laboured 188 spontaneously, with an overall induction rate of 39.2%. Induction of labour was higher, but without 189 significant differences, among symptomatic women (44.4% vs 37.9%; P = .09). The 4.6% of women had 190 an elective-CS, without significant differences between symptomatic and asymptomatic women (P =191 0.09). There were no statistically significant differences between symptomatic and asymptomatic 192 women in terms of maternal (P = .084), gestational (P = .089) or fetal disease conditions (P = .719). 193

In terms of the clinical parameters, 20.8% of women had symptoms upon admission being fever 194 and cough (22.2% each) and headache (18.5%), the most frequent manifestations. Other symptoms were 195 11.1% anosmia, 11.1% dyspnea, 3.7% vomiting, 3.7% ageusia and, 7.4% body aches. Prior to birth, 7.4% 196 of symptomatic women were admitted to the ICU with COVID-related respiratory distress versus none 197 of the asymptomatic women (P = .042); of these women, 3.7% required mechanical ventilation due to 198 dyspnea and COVID-related thrombotic stroke. 7.4% of symptomatic women were admitted to the ICU 199 during the postpartum period compared with 1.9% asymptomatic women (P = .042). Mechanical ven-200 tilation was not required for any asymptomatic women admitted to the ICU. The admissions were not 201 COVID-related (1 preeclampsia, and 1 postpartum hemorrhage). However, both symptomatic women 202 required mechanical ventilation. The mortality rate was 0.8%; among all participants, death was rec-203 orded in a woman with symptoms (specific mortality rate = 3.7%) (Table 3). 204

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Women infected with SARS-CoV				
Verichle	Asymptomatic	Symptomatic		
variable	(103 / 79.2%)	(27 / 20.8%)	p *	
	Mean (SD)	Mean (SD)	_	
Gestational age (weeks)	39.4 (1.4)	38.8 (2.2)	.595	
Apgar 1 minute	9.63 (0.8)	9.56 (1.0)	.694	
Apgar 5 minutes	9.93 (0.4)	9.93 (0.4)	.825	
	n (%)	n (%)		
Parity				
Multiparous	52 (80.0)	13 (20.0)	829	
Primiparous	51 (78.5)	14 (21.5)	.029	
Previous maternal disease				
No	94 (81.7)	21 (18.3)	084	
Yes	9 (60.0)	6 (40.0)	.004	
Gestational disease				
No	88 (82.2)	19 (17.8)	080	
Yes	15 (65.2)	8 (34.8)	.069	
Fetal disease				
No	94 (79.7)	24 (20.3)	710	
Yes	9 (75.0)	3 (25.0)	./13	
Start of labour				
Elective caesarean section	5 (83.3)	1 (16.7)		
Spontaneous	59 (57.3)	14 (51.9)	.09	
Induced	39 (37.9)	12 (44.4)		
COVID-related Maternal co	mplications prior to	labour		
Asymptomatic	103 (100.0)	23 (85.2)		
Respiratory distress	0 (0.0)	3 (100.0)	.002	
Thrombotic stroke	0 (0.0)	1 (100.0)		
Type of birth				
Elective caesarean section	5 (83.3)	1 (16.7)		
Urgent caesarean section	11 (64.7)	6 (35.3)	2(0	
Eutocic	75 (83.3)	15 (16.7)	.269	
Instrumental birth	12 (70.6)	5 (29.4)		
Cause of caesarean section (n=23)				
Other	10 (62.5)	6 (37.5)	200	
NRFHR	7 (87.5)	1 (12.5)	.366	
Maternal complications COV	/ID-related before di	scharge		
No complications	101 (81.4)	23 (18.6)		
Dyspnea	0 (0.0)	1 (100.0)		
Respiratory distress	0 (0.0)	2 (100.0)	.002	
Others	2 (100.0)	0 (0.0)		
Death	0 (0.0)	1 (100.0)		
RT-PCR testing of newbo	orn infant on day 1 of	life		
Positive	0 (0.0)	0 (0.0)	1	
Negative	103 (79.2)	27 (20.8)	1	
Mother required ICU ad	mission prior to lab	our		
No	103 (80.5)	25 (19.5)	.042	

Table 3. Obstetric-neonatal characteristics of the study sample.

Yes	0 (0.0)	2 (100.0)			
Mother required ICU admission before discharge					
No	101 (80.2)	25 (19.8)	042		
Yes	2 (50.0)	2 (50.0)	.042		
Newborn infant required admissi	on to NICU before	e discharge			
No	No 92 (85.2) 16 (14.8)		005		
Yes	14 (56.0)	11 (44.0)	.005		
Mother requiring emergency readmissi	on after discharge	e in first 6 weeks			
No	102 (79.1)	27 (20.9)	1		
Yes	1 (100.0)	0 (0.0)	1		
Newborn infant requiring emergency readmission after discharge in first 6					
weeks					
No	100 (79.3)	26 (20.7)	1		
Yes	3 (75.0)	1 (25.0)	1		
Reason for maternal readmission after discharge in first 6 weeks					
Puerperal fever	1 (100.0)	0 (0.0)	1		
No	102 (79.1)	27 (20.9)	1		
Reason for newborn infant readmission after discharge in first 6 weeks					
Choking	1 (100.0)	0 (0.0)	_		
Non-COVID-19 respiratory infection	0 (0.0)	1 (100.0)	1		
SARS-CoV-2 + (hospital admission)	1 (100.0)	0 (0.0)	1		
SARS-CoV-2 + (emergency room care)	1 (100.0)	0 (0.0)			

*chi-square; severe acute respiratory syndrome coronavirus-2= SARS-CoV-2; NRFHR= non-reassuring fetal heart pattern; RT-PCR= real-time polymerase chain reaction; ICU = Intensive Care Unit; NICU = Neonatal Intensive Care Unit; NICU = Neonatal Intensive 211 Care Unit. 212

None of the newborn infants tested positive for SARS-CoV-2 infection during hospital admission. 213 Organizational issues caused the reasons for admission of newborns to the NICU before discharge 214 (19.2%), and none of them concerned a disease associated with maternal COVID-19. The reasons were 215 separation following protocol active on the date (26.9%), prematurity (23.1%), stabilization to maladaptation after birth (15.4%), hyperbilirubinemia (11.5%), social services/adoption (7.6%), 3.8% sepsis 217 (3.8%), observation following cerebral-vascular event (3.8%), and maternal drug misuse (3.8%). 218

The obstetric and neonatal general care is presented in Table 4. Early SSC occurred in 75.4% of 219 deliveries, and late clamping was performed in 55.6%. Mother-infant separation occurred in 19.2% of 220 the cases, with no clinical indication in 5.4%, and with a maternal accompaniment rate of 53.8%. On the 221 other hand, asymptomatic women had a greater percentage of early SSC (79.6% vs 59.3%; P = .029), a 222 greater labour companion rate (64.1% vs 40.7%; P = .028), and less mother-infant separation (13.6% vs 223 40.7%; P < .001). There were no statistically significant differences in late umbilical cord clamping 224 (asymptomatic = 57.3%; symptomatic = 40.7%; P = .125).

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	Women infected with SARS-CoV-2 (n / %)				
Variable	Asymptomatic (103 / 79.2%)	Symptomatic (27 / 20.8%)	*p		
Labour companion					
No	37 (69.8)	16 (30.2)	.028		
Yes	66 (85.7)	11 (14.3)			
Late umbilical cord clamping					
No	44 (73.3)	16 (26.7)	.125		
Yes	59 (84.3)	11 (15.7)			
Early skin-to-skin contact					
No	21 (65.6)	11 (34.4)	.029		
Yes	82 (83.7)	16 (16.3)			
Mother-infant separation during hospital admission					
No	89 (84.8)	16 (15.2)	<.001		
Yes	14 (56.0)	11 (44.0)			
Reason for mother-infant separation					
No separation	89 (84.8)	16 (15.2)			
Monitoring and control	2 (50.0)	2 (50.0)	<.001		
Other	5 (40.0)	9 (60.0)			
Protocol to date	7 (100.0)	0 (0.0)			
Feeding at discharge					
Formula feeding (maternal decision)	12 (70.6)	5 (29.4)			
Formula feeding (medical recommendation)	1 (25.0)	3 (75.0)	450		
Exclusive breastfeeding	76 (82.6)	16 (17.4)	.450		
Mixed feeding (maternal decision)	6 (75.0)	2 (25.0)			
Mixed feeding (medical recommendation)	8 (88.9)	1 (11.1)			
Feeding at six weeks					
Formula feeding	26 (74.3)	9 (25.7)	108		
Exclusive breastfeeding	55 (79.7)	14 (20.3)	.400		
Mixed feeding	22 (84.6)	4 (15.4)			

Table 4. Obstetric-neonatal general care of the study participants.

* chi-square; SARS-CoV-2 = severe acute respiratory syndrome coronavirus-2.

Concerning the EBF, the percentage at the time of hospital discharge was 70.8%. The EBF rate at 235 six weeks after birth was 53.1%. We recorded no statistically significant differences in the type of feeding at hospital discharge or the type of feeding at six weeks after birth between women with and without COVID-19 symptoms. 238

Table 5 presents the obstetric-neonatal results and care received during labour, birth, and puer-239perium of women infected with SARS-CoV-2. There were differences between symptomatic and240asymptomatic participants. The symptomatic women were 9 times more likely to have a preterm birth241(95%CI: 2.20-41.15), eight times more likely to be admitted to ICU (95%CI:1.52-50.89), and infants were242five times more likely to be admitted to NICU (95%CI:1.96-13.83).243

Regarding general care for symptomatic women, they were more likely to be unaccompanied during labour (95%CI: 1.07-4.19), also markedly likely to experience mother-child separation (95%CI: 1.57-10.36) and twice as likely to experience non-performance of early SSC (95%CI: 1.09-4.06) compared to asymptomatic women. 247

CS was significantly associated to preterm birth (OR = 12.23; 95%CI: 2.79-53.62), admission to ICU 248 (OR = 11.05; 95%CI: 1.88-64.65), and admission to NICU (OR = 5.56; 95%CI: 2.03-15.24). Additionally, 249 mother with preterm birth was associated to ICU admission (OR = 19.66; 95%CI: 3.25-118.77). 250

	Women infected with SARS-CoV-2							
		Asym	ptomatic	Symp	otomatic			
		(103/	/ 79.2%)	(27/	20.8%)			
		n	%	n	%	OR	95% CI	p *
			0	bstetri	c outcome	es		
	<37w	3	33.3	6	66.7	0 52	2.20-	< 001
Pregnancy week	>37w	100	82.6	21	17.4	9.32	41.15	<.001
ICLL admission	No	101	81.5	23	18.5	0 70	1.52-	.005
	Yes	2	33.3	4	66.7	8.78	50.89	
	Neonatal outcomes							
NICU admission	No	91	85.0	16	15.0	5.21	1.96-	<.001
NICU admission	Yes	12	52.2	11	47.8		13.83	
		General care						
Mother-infant separa-	No	89	83.8	16	16.2		1 57	
tion during hospital	V	14	EC O	11 44.0	4.03	1.57-	.005	
admission	res	14	56.0	11	44.0		10.56	
Early skin-to-skin-con- tact	No	21	65.6	11	34.4	2.11 1.09-4.0	1 00 4 06	020
	Yes	82	83.7	16	16.3		1.09-4.06	.029
Labour companion	No	37	69.8	16	30.2	0.11	1 07 4 10	020
	Yes	66	85.7	11	14.3	2.11	1.07-4.19	.028

Table 5. Obstetric-neonatal outcomes and general care of the participants.

*chi-square; OR = crude odds ratio; CI = confidence interval; SARS-CoV-2 = severe acute respiratory syndrome coronavirus-2; EBF = exclusive breastfeeding; ICU = intensive care unit; NICU = neonatal intensive care unit.

4. Discussion

This study identified an increased risk of adverse obstetric-neonatal outcomes (pretern birth and255ICU/NICU admission) and poorer obstetric-neonatal general care (mother-infant separation, not early256SSC, lack of labour companion) among symptomatic SARS-CoV-2 infected pregnant women versus257those without symptoms of the infection.258

In our study, the incidence of infection among women in labour was low (11.3 per 1,000 maternities). In addition, only 20.8% of women in the study developed symptoms consistent with COVID-19, in line with observations by other authors [10,20]. The most common symptoms reported were fever, headache and cough, again in common with other studies [8,20–24].

4.1. Obstetrical-neonatal outcomes

In our series, the induction rate was significantly higher among symptomatic women. This was 264 possibly related to patient care adjustments made by the clinical teams at the labour wards of the different hospitals based on available human and material resources [10]. 266

With an observed increase in the probability of adverse outcomes in symptomatic versus asymp-267 tomatic women, the recorded incidence of CS and preterm births was lower than reported elsewhere 268 [24–27]. This low incidence of CS in our series compared to other studies [2,8,28] may be explained by 269 other factors. Healthcare professionals may have adopted a more expectant attitude in childbirth, 270 driven by a lack of knowledge of this new disease, the risk and concern about infection among the 271 professionals [29–31]. Nevertheless, we found an association between CS and admission to ICU and 272 NICU [32,33]. This may reflect an association towards the indirect impact of SARS-CoV-2 on maternity 273 care and perinatal morbidity [9,24,34]. 274

Even though the percentage of complications was low, as per other studies [8] the risk of an adverse outcome in the prepartum and/or postpartum period increased in symptomatic patients, especially those with severe disease. In addition, as in other studies have shown [5,20,24,30], the maternal mortality rate attributed to COVID-19 (0.8%) was higher. Our study identified no association between maternal background disease and the manifestation of COVID-19 symptoms. However, even with a

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lower reported ICU admission rate [5,12,35], maternal complications associated with the infection and 280 required admission to the ICU were only observed in symptomatic women, with pneumonia and 281 thrombotic stroke being the most frequent conditions. 282

4.2. Obstetric-neonatal outcomes and general care.

Significant differences were observed in maternal labour companion, SSC, and mother-infant separation after birth, with lower rates among the symptomatic women. The benefits of labour compan-285 ionship are already known, with increasing spontaneous vaginal birth, decreased caesarean birth and 286 instrumental birth, and improving general satisfaction with childbirth [36,37]. Even though it may have 287 a negative impact on our study outcomes, it was out of our sphere of analysis. Initially, separation was 288 carried out in all cases driven by the Spanish Society of Neonatology recommendations at the time of 289 the study [9,38]. Both practices, the limited labour companionship and mother-infant separation, may 290 have been influenced how the practice was modified as recommended by infection prevention and 291 control (IPC) guidelines [39,40], driven by the fear of infection and the particularities of the healthcare 292 system [41]. As reported by Coxon et al. [10], such measures may have been adopted in a context of 293 uncertainty, even some medical paternalism [42] regarding the risks for the newborn infants or the 294 professionals; in this regard, it seems that mother-infant separation occurred more often in the early 295 days of the pandemic [10]. 296

Although the results do not show statistically significant differences between groups of women, 297 there is variation in the percentage of breastfeeding between groups. It is observed that symptomatic 298 mothers have a lower percentage of follow-up, less SSC and a higher percentage of mother-infant sep-299 aration. All this can influence the results of breastfeeding [43]. 300

In terms of neonatal outcomes, over 95% of infants born to SARS-CoV-2 positive mothers were in 301 good general condition at birth, as with previous reports [5,44]. However, admission to the NICU was 302 significantly more frequent among infants born to symptomatic mothers. Thus, although the vertical 303 transmission of SARS-CoV-2 is possible, current data suggests that it remains uncommon with uncer-304 tainty about this event's degree and timing of this event [42,45–47]. Only 1.6% of newborn infants were 305 infected in the first month of life, suggesting a lack of vertical transmission after birth in all the infants. 306 Further, this observation would support the data from different studies indicating that horizontal trans-307 mission generally occurs in the home environment [44,47,48]. 308

EBF at discharge was the most frequent type of feeding in both groups and persisted in all the 309 symptomatic women that chose EBF after birth. The possibility of SARS-CoV-2 transmission through 310 breast milk is unclear, and there is no evidence that the virus is viable and transmitted through breast 311 milk [47]. Furthermore, although breastfeeding enables the transmission of immune mechanisms from 312 the mother to the infant [49,50], and thus benefits of breastfeeding may outweigh the potential risk of 313 transmission [13,44], considerations were also required for women to maintain any recommended 314 SARS-CoV-2 infection prevention measures as well as hygienic measures when breastfeeding 315 [48,51,52]. 316

4.3. Strengths and limitations

We are aware that our study has some limitations. Firstly, not all the hospitals of the Valencian 318 Community were included in the study. Even though eight of the 26 hospitals with the most significant 319 number of annual childbirths in our region were represented, the sample size may be small, though we 320 included all positive cases assisted in the participating centers. The magnitude of the OR obtained 321 should be considered in light of the limited sample size, corresponding to obstetrical outcomes and 322 general care. This could have led to overestimating the likelihood of these outcomes. Finally, the study 323 was based on data obtained from electronic care records, with the usual potential for information bias 324 and the quality of the information included in the records. This bias may have been mitigated as rec-325 orded variables were common to all participating centers and the clinical records referred to general 326 birth care. In addition, the use of registry data limited access to variables of interest such as body mass 327 index, ethnicity or economical estatus. 328

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Despite these limitations, our study reflects the scant evidence on the possible differences in obstetric and neonatal outcomes and general care between symptomatic and asymptomatic women infected with SARS-CoV-2. Our study took place in the first year of the COVID-19 pandemic whether the changes that occurred by the Spanish Ministry of Health and Spanish Medical Societies were introduced simultaneously in all the centers, and they could have influenced the results obtained [9]. The findings may inform recommendations for the general care of women in a future health crisis. 329

5. Conclusions

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The symptomatic infected women are at increased risk of admission to ICU and to have preterm 336 births and NICU admissions of their newborns compared with asymptomatic women. Further, symptomatic infected women are increased risk of mother-infant separation, not early SSC and lack of labour 338 companion compared with asymptomatic women. The incidence of SARS-CoV-2 infection among 339 women giving birth was low, and no vertical transmission was recorded in any infants after birth. 340

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