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Perinatal and postpartum care during the COVID-19 pandemic: A nationwide cohort study

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Abstract

Background: This study aimed to analyze perinatal outcomes and adverse events during the COVID-19 pandemic's first wave to help direct decision making in future waves.

Methods: This study was an epidemiological cohort study analyzing comprehensive birth registry data among all 80 obstetric departments in Austria. Out of 469 771 records, 468 348 were considered eligible, whereof those with preterm delivery, birthweight <500 g, multiple fetuses, fetal malformations and chromosomal anomalies, intrauterine fetal death, maternal cancer, HIV infection, and/or inter-hospital transfers were excluded. Women who delivered between January and June 2020 were then classified as cases, whereas those who delivered between January and June 2015-2019 were classified as controls. Perinatal outcomes, postpartum hospitalization, and adverse events served as outcome measures.

Results: Of 33 198 cases and 188 225 controls, data analysis showed significantly increased rates of labor induction, instrumental delivery, obstetric anesthesia, NICU transfer, and 5-min Apgar score below 7 during the COVID-19 period. There was a significantly shorter length of postpartum hospitalization during the COVID-19 period compared with the non-COVID-19 period (3.1 ± 1.4 vs 3.5 ± 1.5 days; $P < .001$). Significantly more women opted for short-stay delivery during the COVID-19 period (3.7% vs 2.4%; $P < .001$). Those who delivered during the COVID-19 period were also more likely to experience postpartum adverse events (3.0% vs 2.6%; $P < .001$), which was confirmed in the logistic regression model (odds ratio, 2.137; 95% confidence interval, 1.805-2.530; $P < .001$).

Conclusions: Perinatal and postpartum care during the first wave of the COVID-19 pandemic differed significantly from that provided before. Increased

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rates of adverse events underline the need to ensure access to high-quality obstetric care to prevent collateral damage.

KEYWORDS
COVID-19, pandemic, perinatal outcomes, pregnancy

1 | INTRODUCTION

In December 2019, the first cases of pneumonia of unknown etiology detected in Wuhan city, China, were reported. Consequently, Chinese authorities identified and sequenced a new type of coronavirus, namely, severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2).

Within a few weeks, the coronavirus disease (COVID-19) had spread internationally. On March 12, 2020, the World Health Organization (WHO) declared the coronavirus outbreak to be a global pandemic.[1] Health care systems responded rapidly to the new pandemic and urgent adjustments were made. Priority was given to patients requiring urgent treatment, whereas non-essential outpatient follow-ups and surgeries were postponed.[2] In Austria, inpatients were not permitted visitors, except fathers of neonatal infants who could attend during labor and delivery, or those visiting inpatient children or patients receiving palliative care.[2] Perinatal societies subsequently published recommendations for pregnancy care during the COVID-19 pandemic that included the deferral of routine follow-up in low-risk pregnancies, the reduction of prenatal diagnostic examinations,[3] and prioritization of examinations for high-risk pregnancies.[4] Furthermore, media reports indicated a larger demand for deliveries with a short hospital stay, as well as for home births.[5,6]

To date, limited data concerning perinatal and postpartum care during the COVID-19 pandemic are available, and studies have focused on the management of women with COVID-19 rather than on its effects on clinical routine.[7-10] However, in Austria, it appeared to our team that the perinatal management differed from that provided prior to the pandemic. Women during this period appeared to prefer to leave the hospital soon after delivery, or to opt for a non-institutional delivery. The predominant reason for this was most likely because of reported concerns surrounding SARS-CoV-2 contagion during hospitalization, and because visitor restrictions had been widely implemented at a time when families had a strong desire to be together. However, , no data were available to support or refute our impressions.

Apart from the direct effects of COVID-19, an evaluation of how the pandemic affected pregnancy, labor, and childbirth is also necessary. Many physicians and midwives encouraged women without health issues to opt for short-stay delivery to reunite family members more quickly and to reduce the degree of capacity utilization on labor and delivery wards; whether this form of patient management had any negative effects is yet to be determined. As such, the purpose of this study was to investigate the effects of the first wave of the COVID-19 pandemic in Austria on perinatal care with special emphasis on postpartum hospitalization and adverse events. Relevant information concerning the effects of management adaptations during these challenging times might provide insights into managing pregnancy and childbirth more effectively during future waves of SARS-CoV-2 or similar pandemics.

2 | METHODS

2.1 | Ethical statement

The study was conducted in accordance with the Declaration of Helsinki and the Good Clinical Practice guidelines. The study was approved by the Ethics Committee of the Medical University of Vienna (reference number 1637/2020). Because of the retrospective study design, patient informed consent was not required. All patient data were handled anonymously.

2.2 | Data acquisition

In this retrospective cohort study, data were obtained from the Austrian Perinatal Registry, which collects data on a quarterly basis to ensure adequate data control and quality. The registry collects comprehensive perinatal information and outcomes from all 80 obstetric departments in Austria, including tertiary centers with neonatal intensive care, neonatal intermediate care, and primary care units for low-risk pregnancies. In Austria, short-stay deliveries are defined as institutional deliveries where the mother and newborn are both discharged within 24 hours after delivery. Information about home birth (defined as any kind of noninstitutional delivery) was not available for this analysis, as there is no central registry for home births in Austria.

2.3 | Outcome measures

The primary study objective was to compare the duration of hospitalization and adverse event rates throughout the first six months of the first wave of the COVID-19 pandemic in 2020 with the same six months of every year from 2015 to 2019. The duration of hospitalization was defined as the length of hospital stay (in days). The presence or absence of an adverse event postpartum, defined as from childbirth to 42 days postpartum, served as the primary outcome and included the following: retained placenta, maternal infection or sepsis, postpartum hysterectomy, blood transfusion, and surgical revision. Perinatal outcomes (birthweight, APGAR score at 5 minutes, umbilical cord arterial pH, umbilical cord base excess, NICU transfer) and the rate of short-stay delivery served as secondary outcomes.

2.4 | Study groups

The period between January 1 and June 30, 2020, was defined as the COVID-19 period, and women who delivered during this period were considered cases. In contrast, the period between January 1 and June 30 in the years from 2015 to 2019 was defined as the non-COVID-19 period, and women who delivered during this period were considered controls. Assignment to one of the study groups was not associated with an individual's COVID-19 status, which remained unknown for both groups. Because of their potential effect on the outcomes, we excluded cases and controls with a gestational age before 37 weeks and 0 days and/or a birthweight below 500 g, as well as those with multiple fetuses (ie, twins or more), fetal malformations, chromosomal anomalies, intrauterine fetal death, maternal cancer or HIV infection, and those with interhospital transfer.

2.5 | Statistical analyses

Continuous variables were either calculated as mean ± standard deviation (SD), or as median and interquartile range (IQR), depending on the presence or absence of a normal distribution. Categorical variables were calculated using absolute and relative frequencies. A Mann-Whitney *U* test was applied to assess the magnitude of effect of the study group on the quantitative outcomes. Dichotomous variables were analyzed using chi-squared or Fisher's exact tests. A logistic regression model was used to evaluate the effect of the study group on the primary outcome. Maternal and neonatal parameters that showed significance in the univariate analysis (ie, parity, delivery mode, episiotomy, high-grade perineal tears, induction of labor, birthweight, and gestational age at delivery) were included as potentially confounding variables in this model. In addition, maternal age was included in the null model. The odds for the occurrence of postpartum adverse events were estimated following backward stepwise variable selection. The removal of respective variables was determined using the probability of the likelihood-ratio statistic, which was based on a maximum partial likelihood estimation. Two-sided *P*-values below .05 were considered statistically significant. A power analysis was not performed because of the study's explorative character. Data were analyzed using SPSS version 26.0 for Windows (IBM Corp.).

3 | RESULTS

In total, 469 771 deliveries were recorded during the entire study period, of which 468 348 deliveries were considered eligible for the analyses. Of these, 423 320 fulfilled the inclusion criteria, and 201 897 were excluded because of delivery between June and December. This led to a COVID-19 period group with 33 198 cases and a non-COVID-19 period group with 188 225 controls. The inclusion criteria for the cases and controls, before and during the first wave of the COVID-19 pandemic in Austria are shown in Figure 1.

When comparing descriptive characteristics, women in the COVID-19 period group were older (30.7 ± 5.1 years vs 30.5 ± 5.3 years, $P < .001$) and had a higher mean parity (0.88 ± 1.24 vs 0.87 ± 1.18, $P < .001$) than those in the non-COVID-19 period group. Women in the COVID-19 period group showed an increased labor induction rate (22.8% vs 20.1%, $P < .001$).

The mean length of postpartum hospitalization was significantly shorter during the COVID-19 period than during the non-COVID-19 period (3.1 ± 1.4 days vs 3.5 ± 1.5 days, $P < .001$), as shown in Figure 2. The proportion of short-stay deliveries was higher in the COVID-19 period group compared with the non-COVID-19 period group (3.7% vs 2.4%, $P < .001$). Analysis of postpartum adverse events showed an increased rate in the COVID-19 group compared with the non-COVID-19 group (3.0% vs 2.6%, $P < .001$). In particular, women in the COVID-19 group were more likely to receive blood transfusion (0.5% vs 0.2%, $P < .001$). Figure 3 summarizes the adverse events in both groups.

Analysis of perinatal outcomes showed that women in the COVID-19 period group had higher rates of epidural anesthesia in cases of vaginal delivery (17.1% vs 15.6%, $P < .001$), and that there was no significant difference in the occurrence of high-grade perineal tears (1.6% vs

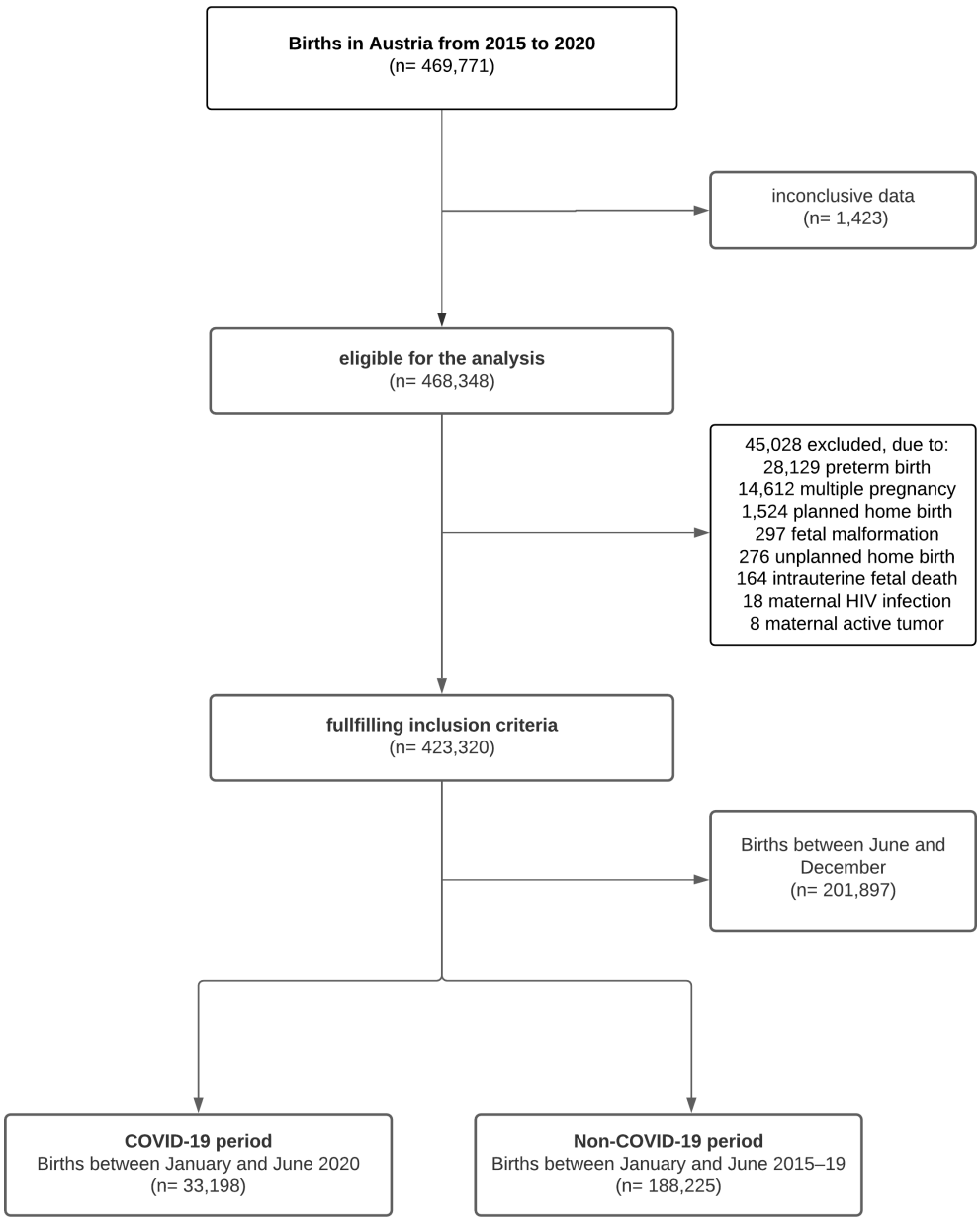

FIGURE 1 Inclusion criteria of 33 198 cases and 188 225 controls with delivery during or prior to the first wave of the COVID-19 pandemic in Austria

1.6%, $P = .911$) between the groups. No significant difference was found with regard to the rate of spontaneous vaginal delivery (64.6% vs 65.0%, $P = .139$). However, there was a higher rate of instrumental delivery (8.2% vs 7.6%, $P < .001$) among women who delivered during the COVID-19 period.

Analysis of neonatal outcomes showed that term infants born during the COVID-19 period had a significantly higher birthweight (3425 ± 475 g vs 3412 ± 452 g, $P < .001$), a higher mean arterial umbilical cord-pH (7.34 ± 2.63 vs 7.27 ± 0.08, $P < .001$), and a lower base excess in the umbilical cord artery (−4.47 ± 4.18 vs −4.57 ± 3.54, $P < .001$) compared with the controls. The rate of term infants with an Apgar score below 7 at 5 minutes (0.8% vs 0.6%, $P < .001$), as well as of those with transfer to the Neonatal Intensive Care Unit (NICU) (4.2% vs 3.9%, $P = .003$), was significantly higher during the COVID-19 period, compared with the non-COVID-19 period. These findings were not statistically significant in the multivariate model (data not shown). Perinatal outcomes in both groups are shown in Table 1.

In the logistic regression model, we considered delivery during the COVID-19 period as an independent risk factor for the occurrence of postpartum adverse events. After considering potential confounders, we found that the overall risk for adverse events was still increased

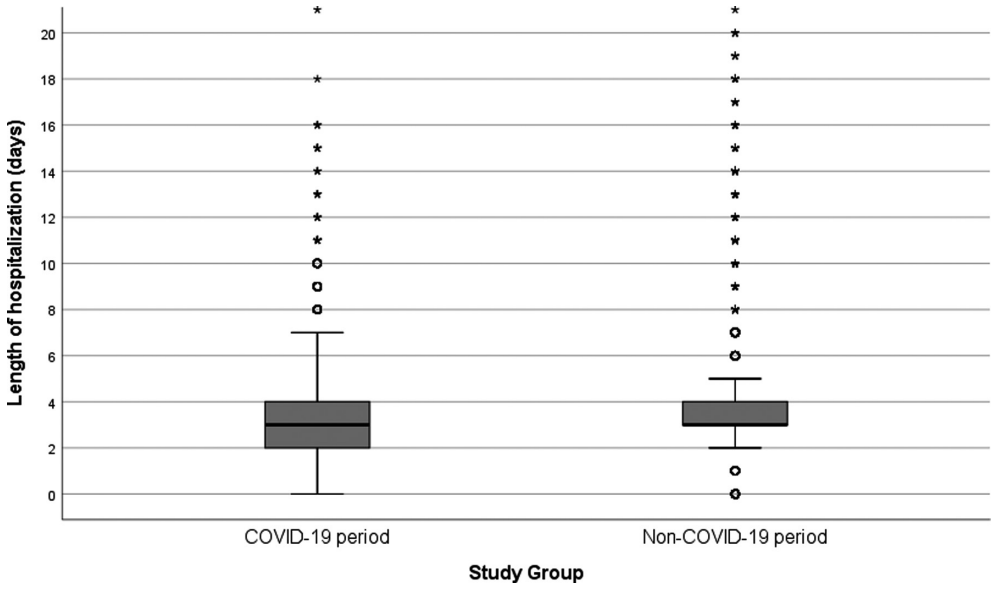

FIGURE 2 Duration of postpartum hospitalization of 33 198 cases and 188 225 controls with delivery during or before the first wave of the COVID-19 pandemic in Austria (Boxplots show the 25th, 50th, and 75th percentiles of hospitalization in days after delivery, stratified by the study group)

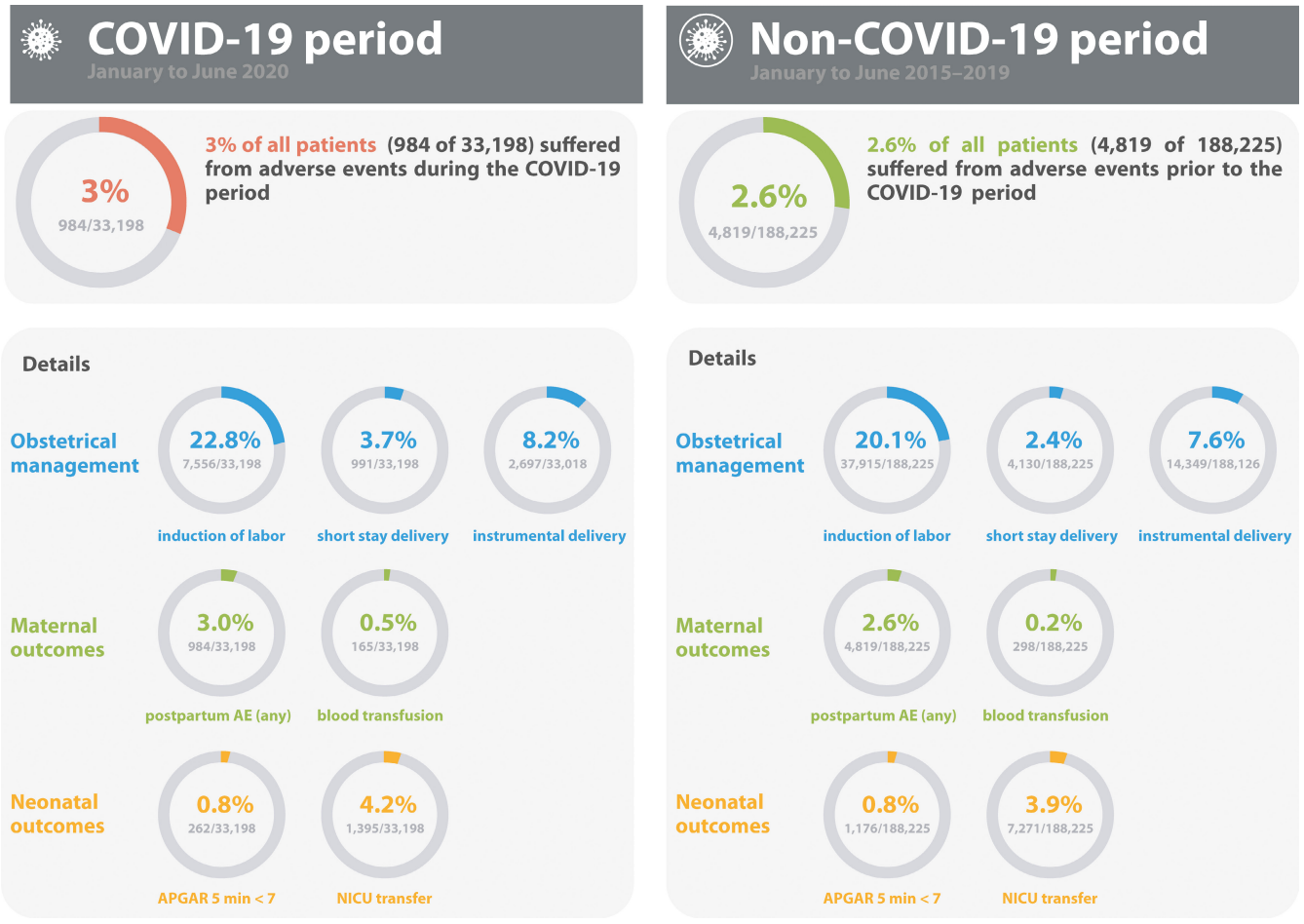

FIGURE 3 Adverse events in 33 198 cases and 188 225 with delivery during or prior to the first wave of the COVID-19 pandemic in Austria (AE, adverse event; NICU, neonatal intensive care unit) [Color figure can be viewed at wileyonlinelibrary.com]

TABLE 1 Maternal characteristics and perinatal outcomes of 33 198 cases and 188 225 controls with delivery during or prior the first wave of the COVID-19 pandemic in Austria

	COVID-19 period		Non-COVID-19 period		
Variable	**N**	**% Mean ± SD**	**N**	**% Mean ± SD**	***P***
Maternal age (years)	33 198	30.7 ± 5.1	188 225	30.5 ± 5.3	<.001
Parity	33 198	0.88 ± 1.24	188 225	0.87 ± 1.18	<.001
Gestational age at delivery[a]	33 198	39.3 ± 1.14	188 225	39.3 ± 1.15	.273
Induction of labor	7556	22.8	37 915	20.1	<.001
Short-stay delivery	991	3.7	4130	2.4	<.001
Postpartum hospitalization (days)	33 198	3.1 ± 1.4	188 225	3.5 ± 1.5	<.001
Mode of delivery[b]	33 018	100.0	188 126	100.0	.003
Vaginal	21 319	64.6	122 261	65.0	.139
Instrumental	2697	8.2	14 349	7.6	.001
Cesarean section	9002	27.3	51 516	27.4	.652
Anesthesia (any)	21 954	66.1	110 056	58.5	<.001
General	1670	5.0	11 060	5.9	<.001
Epidural	5675	17.1	29 349	15.6	<.001
Spinal	6766	20.4	38 202	20.3	.723
Episiotomy	3107	9.4	19 797	10.5	<.001
High-grade perineal tears	525	1.6	2961	1.6	.911
Uterine rupture	12	0	61	0	.729
Amniotic fluid embolism	7	0	18	0	.068
Pulmonary embolism	2	0	15	0	.709
Neonatal gender	33 198	100.0	188 225	100.0	.410
Male	16 916	51.0	96 501	51.3	.291
Female	16 268	49.0	91 662	48.7	.306
Undefined	14	0	62	0	.402
Apgar 5 min <7	262	0.8	1176	0.6	<.001
Birthweight (g)[a]	33 198	3 425 ± 475	188 225	3412 ± 452	<.001
Head circumference (centimeter)	33 198	34.9 ± 3.8	188 225	34.8 ± 9.0	<.001
Umbilical cord arterial pH	33 198	7.34 ± 2.63	188 225	7.27 ± 0.08	<.001
Umbilical cord base excess	33 198	−4.47 ± 4.18	188 225	−4.57 ± 3.54	.001
NICU transfer	1395	4.2	7271	3.9	.003
Postpartum adverse event (any)[c]	984	3.0	4819	2.6	<.001
Retained placenta	836	2.5	4430	2.4	.069
Infection or sepsis	3	0	25	0	.526
Hysterectomy	14	0	67	0	.564
Blood transfusion	165	0.5	298	0.2	<.001
Surgical revision (any)	31	0.1	134	0.1	.172
Perineal surgical revision	4	0	10	0	.155
Abdominal surgical revision	27	0.1	126	0.1	.320

Note: Abbreviations: N, number; NICU, neonatal intensive care unit; SD, standard deviation.

[a]Cases and controls with delivery <37 + 0 wk and/or <500 g birthweight were excluded.

[b]Missing cases without available data were excluded.

[c]Multiple selection per patient were allowed.

for women who delivered during the COVID-19 period compared with women who delivered during the non-COVID-19 period (odds ratio [OR] 2.137; 95% confidence interval [CI], 1.805-2.530; $P < .001$), as shown in Table 2.

4 | DISCUSSION

4.1 | Main findings

In this large birth registry study, we aimed to investigate the effects of the first wave of the COVID-19 pandemic in Austria on perinatal and postpartum care. Our findings indicate that perinatal and postpartum care differed significantly from that provided before. In particular, women preferred to leave the hospital sooner during the COVID-19 pandemic, as shown in an increased rate of short-stay delivery and a significantly shorter hospitalization period postpartum. However, delivery during the COVID-19 pandemic increased the risk of postpartum adverse events, which remained statistically significant after adjustment for potential confounders. We consider our finding an indicator of the collateral damage that occurred because of adaptations in management during the COVID-19 pandemic. Our findings regarding short-stay delivery and hospitalization supported our initial clinical impressions. Previous studies have shown similar shortened hospitalization times during the COVID-19 pandemic.[11,12] However, we could not clearly identify the causal reasons for the changes in hospitalization time. It seems reasonable that the change made to perinatal and postpartum management whereby only a single accompanying person was allowed to be present during or after birth was a factor influencing these parameters.

4.2 | Implications for policymakers

Postpartum care during the COVID-19 pandemic in Austria appears to be comparable to that provided elsewhere, where regulations for accompanying persons have also been implemented.[12,13] One rationale for modifying regulations during the pandemic involved the risk of transmitting SARS-CoV-2 between the mother, the newborn, visitors, and medical staff. Consequently, hospitals worldwide adapted their management plans for peripartum care and visitors, including new fathers, and it was expected that these modified guidelines during lockdown measures would be followed. Although measures taken during the pandemic appear to have contributed to a low risk of SARS-CoV-2 transmission in the wards, these measures also resulted in a shorter length

TABLE 2 Multivariate logistic regression for experiencing a postpartum adverse event during the first wave of the COVID-19 pandemic in Austria

Variable	Odds ratio	95% confidence interval	*P*
Study group			
Non-COVID-19 period	Reference		
COVID-19 period	2.137	1.805-2.530	<.001
Parity	1.076	1.010-1.146	.023
Mode of delivery			
Vaginal	Reference		
Instrumental	1.301	0.995-1.701	.055
Cesarean section	1.134	0.940-1.367	.188
Episiotomy			
No	Reference		
Yes	1.501	1.176-1.917	.001
High-grade perineal tear			
no	Reference		
yes	1.794	1.170-2.751	.007
Induction of labor			
No	Reference		
Yes	1.664	1.412-1.961	<.001
Anesthesia (any)			
No	Reference		
Yes	2.545	2.054-3.152	<.001

of hospital stay postpartum. This finding is of particular interest, since women in the COVID-19 group were more likely to receive blood transfusion, which would suggest prolonged hospitalization in this group. In general, our findings indicate that the risk of adverse events significantly increased during the COVID-19 pandemic, with a two fold increase in postpartum adverse events in women who delivered during this period. Particular obstetric conditions, such as labor induction, instrumental delivery, and obstetric anesthesia, which are likely to be associated with each other, might have increased the risk for postpartum adverse events during the COVID-19 pandemic. With regard to obstetric anesthesia, there are currently no evidence-based guidelines available on how to adapt labor and delivery units in response to COVID-19, and neither epidural nor spinal anesthesia rates have been reported to have changed during the pandemic.[14] Induction of labor, however, has been associated with a lower risk of cesarean birth in nulliparous low-risk pregnant women in some studies and shown no effect on neonatal outcomes.[15] Whether this is applicable to high-risk pregnant women remains unclear.[16-19] In our study, we observed higher rates of labor induction during the COVID-19 period, but we did not perform a subgroup analysis stratifying between low- and high-risk pregnant women. Both, the higher rate of labor induction and instrumental delivery that we report for the pandemic period, could be results of the general uncertainty and nervousness among health care professionals in perinatal care that we were experiencing during that time, for example, to keep intensive care capacities free for women who might be presenting with COVID-19.

Previously published studies have reported a higher home birth rate during the pandemic.[20] Many midwives responded to the needs of pregnant women, often implementing additional measures to improve health care during home birth. Home birth, however, has repeatedly been associated with perinatal adverse events.[20-24] An increase in planned and unplanned home births was reported in Austria during the first wave of the pandemic.[5] The overall effects of this increased home birth rate are unknown, considering no central registries for home births are available, and were therefore not available for our analyses. Given the increase in home birth, it seems likely that concerns raised by women, for example, regarding virus transmission during hospitalization or personal isolation after delivery, could have also resulted in an increased interest in early discharge from the ward and for short stay.[6] Indeed, health care providers need to respect the individual rights of each service user to make their own medically informed decision about delivery, and exercise their professional responsibility in selecting suitable candidates for any kind of non-institutional delivery.[20,21] In response to this need, midwives and physicians published practice guidelines concerning the practice of noninstitutional delivery during the COVID-19 pandemic.[25,26]

4.3 | Strengths and limitations

To our knowledge, our study is the first to describe collateral damage in perinatal care during the COVID-19 pandemic, in the context of modifications that were taken in response to the pandemic and the coronavirus lockdown. Our findings support the need for further in-depth analyses, including large prospective studies to evaluate clinical management during such challenging times. For future research, collaboration with birth registries from other countries is required to determine whether, for example, the increase in adverse events and its association with the COVID-19 period that we observed in our study was causal. Even though no analysis assessing the causality between impaired maternal and neonatal outcomes in response to the adapted management during the pandemic has been performed, our findings have concerning implications. There is an urgent need to clarify relevant causal factors and, given the ongoing pandemic, perinatal management needs to be continuously re-evaluated and adapted in response to the actual situation.

Our study has several limitations. First, this was a retrospective study. Despite the large numbers of cases and controls, we are unable to draw causal implications or correlations from our data. Second, although we adjusted for potentially confounding variables, some individual and social factors that might have influenced our findings were not be included in the model. For this study, we decided to exclude cases with preterm birth, as they would have likely been associated with a longer hospital stay. Comparing preterm birth rates during the pandemic and the prepandemic period was not the purpose of this study; however, our preliminary analyses showed no significant difference between these periods which is in line with Pasternak and colleagues.[27,28] Home birth data were excluded, as the data entry for home births in Austria is not part of the nationwide perinatal registry and, more importantly, because these data are incomplete, making it impossible to further elaborate on these cases. Lastly, although the first wave of the pandemic was relatively small with a low overall number of patients affected in Austria, it is still possible that some patients in the COVID-19 period group were SARS-CoV-2 positive, and this could also have influenced our results. Although this is very unlikely, as the number of SARS-CoV-2-positive women during the first pandemic wave was extremely low in Austria, it

would still have been beneficial to document and report the individual SARS-CoV-2 status. At the time of this writing, however, this variable has not yet been added to our national birth registry.

4.4 | Conclusions

Perinatal and postpartum care during the first wave of the COVID-19 pandemic in Austria differed significantly from that provided in the five years before. Although the duration of postpartum hospitalization was significantly shorter and more women opted for short-stay delivery, we found that the risk of experiencing postpartum adverse events during the pandemic doubled. In addition, we found impaired neonatal outcomes during the COVID-19 pandemic. These findings should inform future perinatal management, to maintain high-quality perinatal care during the ongoing pandemic.

AUTHOR CONTRIBUTIONS

MW, VF, and AF wrote the manuscript; SBN performed the statistical analyses; HL and SBN interpreted the data and results; HK and AB provided clinical support; and ID was responsible for the acquisition of data. All authors critically revised and approved the final version of the manuscript.

ETHICAL APPROVAL

The study was conducted in accordance with the Declaration of Helsinki and the Good Clinical Practice guidelines. Approval was received by the Ethics Committee of the Medical University of Vienna (reference number 1637/20). Because of the study's retrospective character, the ethics committee waived the need for informed consent of the study subjects. All patient data were de-identified before analyses.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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