Thieme

Fewer Preterm Births in the First COVID-19 Pandemic Year? An Evaluation of the Berlin Perinatal Data for the Years 2017 to 2020

Weniger Frühgeburten im 1. COVID-19-Pandemie-Jahr? Eine Auswertung der Berliner Perinataldaten der Jahre 2017 bis 2020

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ABSTRACT

Introduction The study analyzes and interprets possible effects of the COVID-19 pandemic on the preterm birth rate. Research questions included: were there fewer preterm births in Berlin in 2020, the first year of the pandemic, compared to the three years before the pandemic? Were there differences in preterm birth rates grouped according to weeks of gestation?

Method The perinatal data of all singleton pregnancies were evaluated with regard to birth rates in Berlin, and the numbers of preterm neonates born in the three pre-pandemic years from 2017 to 2019 were compared to the rate for 2020, the first year of the pandemic.

Results The overall number of singleton pregnancies born in maternity hospitals and labor wards in Berlin decreased in the first year of the pandemic. The percentage of preterm neonates born before 37 + 0 weeks of gestation (GW) was significantly lower in 2020 compared to the three previous years, with significantly more preterm neonates born before 28 + 0 GW and significantly fewer preterm neonates born between 28 + 0 to 35 + 0 GW. In 2020, significantly fewer neonates born before 37 + 0 weeks of gestation were delivered by primary caesarean section. The incidence of induced births was approximately the same.

Conclusions In the first year of the pandemic, a range of social, iatrogenic, and biological factors may have had an impact on preterm birth rates. A Germany-wide evaluation of perinatal data across different German federal states for the period 2020 to 2022 would offer the opportunity to identify the causes of this lower rate of preterm births and determine whether conclusions can be drawn from this which would affect future strategies to reduce preterm birth rates.

ZUSAMMENFASSUNG

Einleitung Mögliche Auswirkungen der COVID-19-Pandemie auf die Frühgeburtenrate sollen analysiert und interpretiert werden. Forschungsfragen sind: Hat es im 1. Pandemiejahr 2020 weniger Frühgeburten in Berlin gegeben als in den 3 unmittelbar vorpandemischen Jahren? Gibt es Unterschiede in der nach Schwangerschaftswochen gruppierten Frühgeburtlichkeit?

Methodik Perinataldatenauswertung aller Einlinge im Hinblick auf die Geburtenraten in Berlin und den Anteil der Frühgeborenen in den 3 präpandemischen Jahren 2017 bis 2019 im Vergleich mit den Raten des 1. Pandemiejahres 2020.

Ergebnisse Die Gesamtzahl der Einlingsgeburten ist im 1. Pandemiejahr in den Berliner Geburtskliniken und -abteilungen zurückgegangen. Der Anteil von Frühgeburten unter 37 + 0 Schwangerschaftswochen (SSW) war 2020 signifikant niedriger als in den 3 Jahren davor, mit signifikant mehr Frühgeburten unter 28 + 0 SSW und signifikant weniger Frühgeburten in der Gruppe 28 + 0 bis 35 + 0 SSW. 2020 wurden signifikant weniger Kinder unter 37 + 0 Schwangerschaftswochen durch eine primäre Sectio geboren. Die Häufigkeit von Geburtseinleitungen blieb in etwa gleich.

Schlussfolgerungen Im 1. Pandemiejahr haben sich möglicherweise verschiedene soziale, iatrogene und biologische Faktoren modellierend auf die Frühgeburtlichkeit ausgewirkt. Eine länderübergreifende, bundesweite Auswertung der Perinataldaten 2020 bis 2022 böte eine Chance, die Ursachen für diese verringerten Frühgeburtenraten zu ermitteln und festzustellen, ob sich daraus Schlussfolgerungen für zukünftige Strategien zur Frühgeburtsverringerung ergeben.

Introduction

The pandemic which began in late 2019 following the spread of the infectious disease known as COVID-19 was caused by the SARS-CoV-2 virus. The effects of the pandemic on peripartum and perinatal outcome data have already been studied in numerous publications and meta-analyses.

Griewing et al. (2022) recently reported an example of the impact of the COVID-19 pandemic on the provision of gynecological and obstetric services by a German tertiary care university hospital [1].

The spread of COVID-19 pandemic and the social and country-specific impact of the pandemic were countered by global lockdown measures (of differing lengths and severity). It may have had a negative impact on overall birth rates and a positive effect on preterm birth rates [2]. A meta-analysis already carried out in 2021, which included 40 studies on this topic, initially found no changes in the rate of preterm births born before the 37th week of gestation in 15 of the included studies [3]. However, the analysis did find significant differences between low-income and high-income countries, with the latter exhibiting a decrease in preterm births (12 studies) and spontaneous preterm births (two studies) [4].

In an article published in 2021 in Lancet Global Health, Ochoa et al. already called upon "the perinatal research community to collaboratively take advantage of the unique natural experiment provided by the COVID-19 pandemic to accelerate progress in maternal and child health globally." Together it would be possible to "learn from experiences from the pandemic and start identifying mechanisms that might contribute to a healthier start for future generations." [5].

To take up this suggestion, after the recent publication of an analysis of Bavarian data [6], the Berlin perinatal data are now being analyzed and interpreted with regard to possible effects of the pandemic on the preterm birth rate. The main question in this context was: were there fewer preterm births in the first year of the pandemic in 2020 in Berlin than in the three years immediately preceding the pandemic? The aim was also to answer two secondary questions: are the differences in the rate of preterm births grouped according to week of gestation (GW) (< 28 + 0 vs. ≥ 28 + 0 GW to < 37 + 0 GW)? Was there a drop in the number of "iatrogenic" (primary/planned caesarean section, induction of labor) preterm births in 2020?

Method

Sample cohort

All singletons born in Berlin hospitals between January 1, 2017 and December 31, 2020 were included in the evaluation. Multiple births were excluded from the outset, as multiple pregnancies are already at higher risk of preterm birth. The focus of the analysis was on the birth rates and the percentage of preterm neonates among singleton births born before 37 + 0 weeks of gestation in the three pre-pandemic years 2017, 2018 and 2019 in Berlin compared with the corresponding rate for 2020, the first year of the pandemic. The data were sourced using the routinely collected data of all hospital births obtained in the context of implementing measures for quality assurance in accordance with § 136 SGB V [Book V of the German Social Code] (previously: perinatal data collection).

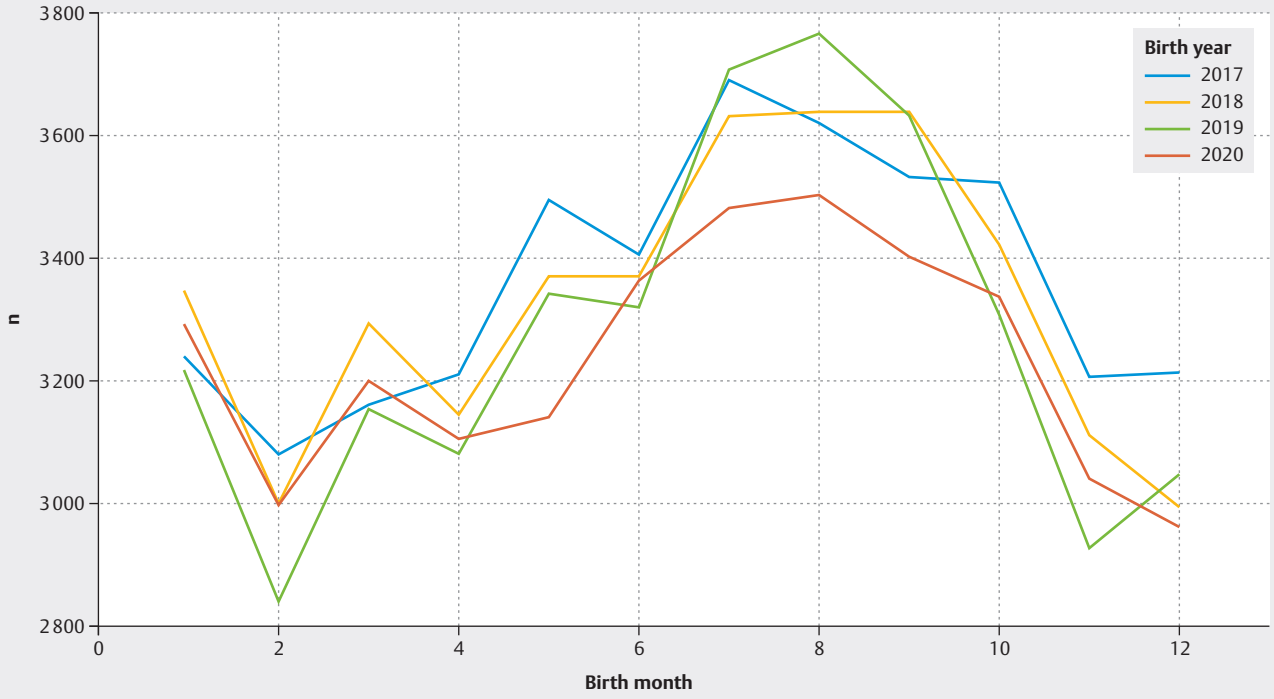
Requirements for data analysis

Data analysis was carried out after being advised by the Steering Committee for Quality Assurance Berlin and the release of the anonymized data obtained as part of hospital-based quality assurance.

This retrospective analysis of registry data complies with the standards outlined in the Berlin Data Protection Law and the guideline of the Charité in Berlin on good scientific practice.

Statistical analysis

Data were evaluated using Python libraries, pandas, SciPy and statsmodels. Fisher-Yates test (Fisher's exact test) was used for statistical inference tests with four field scenarios, and chi-square test to test for one-dimensional homogeneity of distribution. Allocation of data to specific time periods was done using the child's date of birth (in the published annual evaluation of data, the date of the mother's discharge is used as the criterion for allocating data to a specific year). A birth was identified as iatrogenically induced if the infant was delivered either by primary caesarean section or following induction of labor without prior rupture of mem-



▶ **Fig. 1** Comparison of monthly birth rates (singleton neonates only) for the years 2017 to 2020.

branes. A patient was classified as a COVID-19 case if her diagnosis on admission or at discharge was recorded as U07.1 or U07.2.

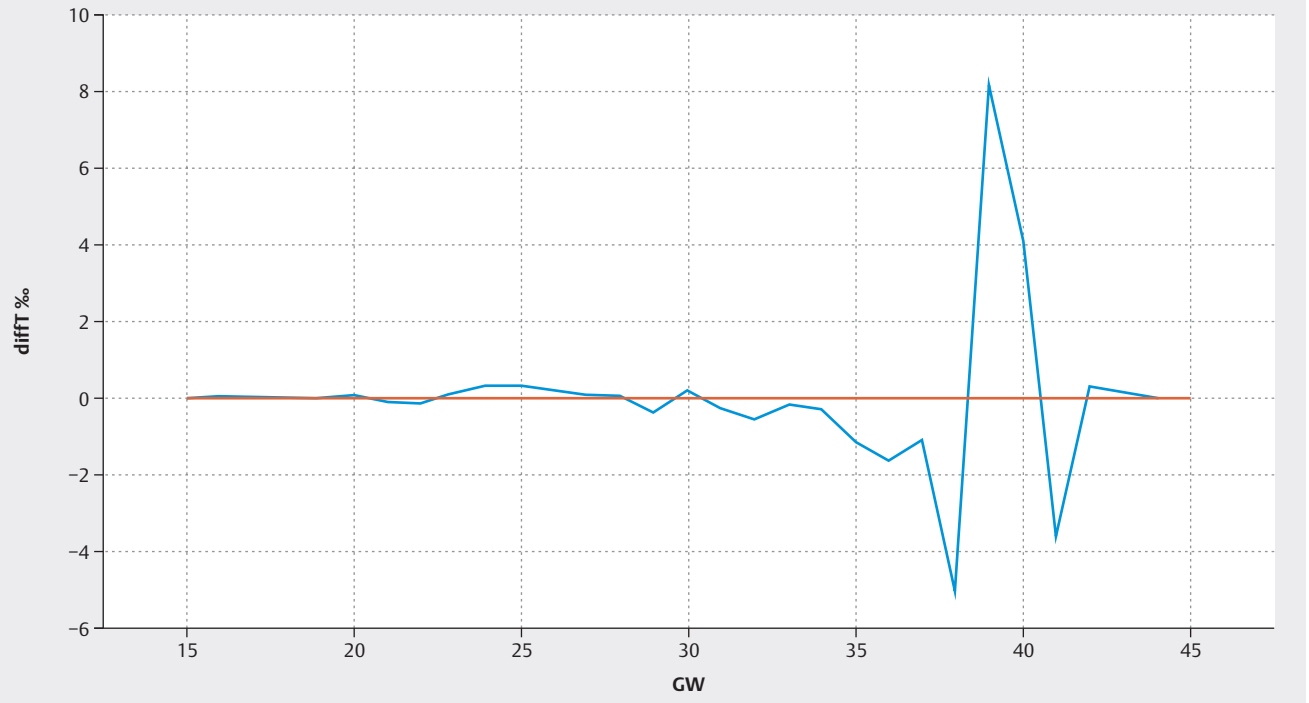
Results

Monthly birth rate and total birth rate

The data of a total of 158368 singleton pregnancies were analyzed. The mean monthly singleton birth rate for the period from January 1, 2017 to December 31, 2020 in Berlin was 3299.3 births per month (95% CI: 3233.7 – 3364.9) with seasonal variations. A total of 119586 infants were born in the three pre-pandemic years (mean: 39862 per year), whereas the number of births in the first year of the COVID-19 pandemic (2020) was 38782. The total number of births (singletons, hospital births only) decreased significantly since 2017: 2017 – 40345; 2018 – 39931, 2019 – 39310, 2020 – 38782 births. The birth rate per month in the first year of the pandemic (2020) differs significantly from the rates for the three pre-pandemic years 2017 to 2019 (chi-square $p = 0.002$). The monthly distributions also differ considerably when 2020 is compared to the period 2017 to 2019: in the summer of 2020, the curve flattens, with around 200 fewer births per month; this level of flattening is not seen in any of the three previous years (▶ **Fig. 1**). Overall, there were fewer births (around 1000 fewer than in the investigated previous three years), although for obvious biological reasons, the decrease in the summer of 2020 cannot be the effect of the pandemic. It can also clearly not be explained by a shift in the location where women give birth, with birth settings migrating to out-of-hospital sites. As ▶ **Table 1** shows, the overall number of births born in an outside-of-hospital setting also decreased slightly in 2020 compared to the previous years.

▶ **Table 1** Number of planned births which began out-of-hospital in Berlin for the years 2017 to 2020 (home births and number of births in midwife-led facilities according to QUAG [The Society for Quality in Out-of-Hospital Births]) [7].

Year	Home births: n (%)	Births in midwife-led facilities: n (%)	Total number of planned births which began out-of-hospital
2020	463 (34.3)	887 (65.7)	1350
2019	358 (25.4)	1051 (74.6)	1409
2018	401 (26.3)	1126 (73.7)	1527
2017	286 (21)	1075 (79)	1361



▶ **Fig. 2** Difference per thousand of the percentage of births per week of gestation for the year 2020 compared to the years 2017 to 2019.

Preterm birth rate

The percentage of preterm singleton births with a gestational age of less than 37 + 0 weeks was significantly lower in 2020 compared to the three previous years (▶ **Table 2**; ▶ **Fig. 2**). Such a significant difference in the preterm birth rate has not been identified for singleton births which occurred in the years 2017–2019 (chi-square test of independence for 2017–2019 $\chi^2 = 1.85$, $p = 0.97$); in contrast to the decreased birth rate, this is a new phenomenon.

When extreme preterm births < 28 + 0 GW and the cohort of preterm neonates born between 28 + 0 and 35 + 0 GW were examined separately, the results showed opposing trends: there was a significant trend to more preterm births in the group born < 28 + 0 GW and, in contrast, significantly fewer preterm births in the group born between 28 + 0 and 35 + 0 GW (▶ **Table 3**).

▶**Table 2** Comparison of preterm birth rates (singleton deliveries) of the years 2017 to 2019 with 2020.

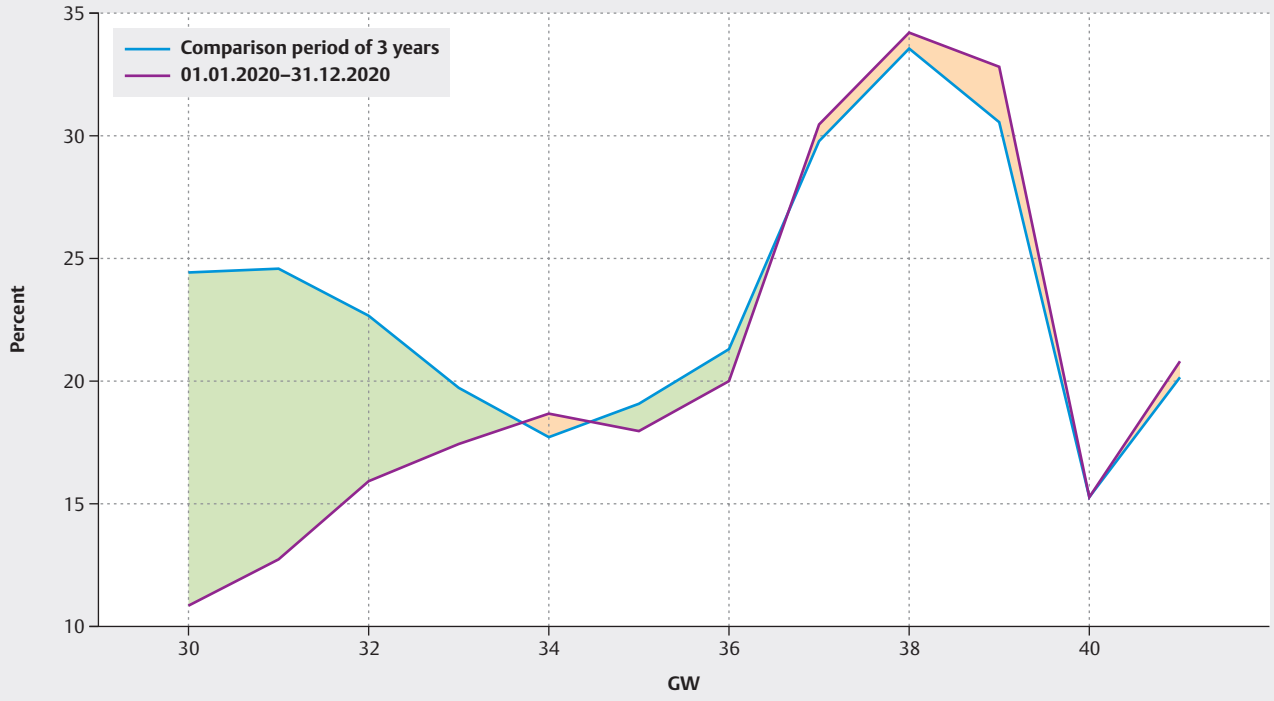
	Total number of births (n)	Preterm births < 37 + 0 weeks of gestation (n/percentage of total births)
1.1.2020 to 31.12.2020 (1 year)	38782	2294/5.92
1.1.2017 to 31.12.2019 (3 years)	119586	7602/6.36

Fisher's exact test, two-sided odds ratio = 1.08, p = 0.002

▶**Table 3** Comparison of preterm singleton birth rates for the subgroups < 28 + 0 and 28 + 0 to < 35 + 0 GW for the years 2017 to 2019 vs. 2020.

	Number of births (n)	Preterm births < 28 + 0 GW (n/percentage of total births)	Preterm births ≥ 28 + 0 to < 35 + 0 GW (n/percentage of total births)
1.1.2020 – 31.12.2020 (1 year)	38782	245/0.63*	777/2.00**
1.1.2017 – 31.12.2019 (3 years)	119586	642/0.54*	2603/2.18**

* Two-sided Fisher's exact test: odds ratio = 0.85; p = 0,03; ** Two-sided Fisher's exact test: odds ratio = 0.92; p = 0.04



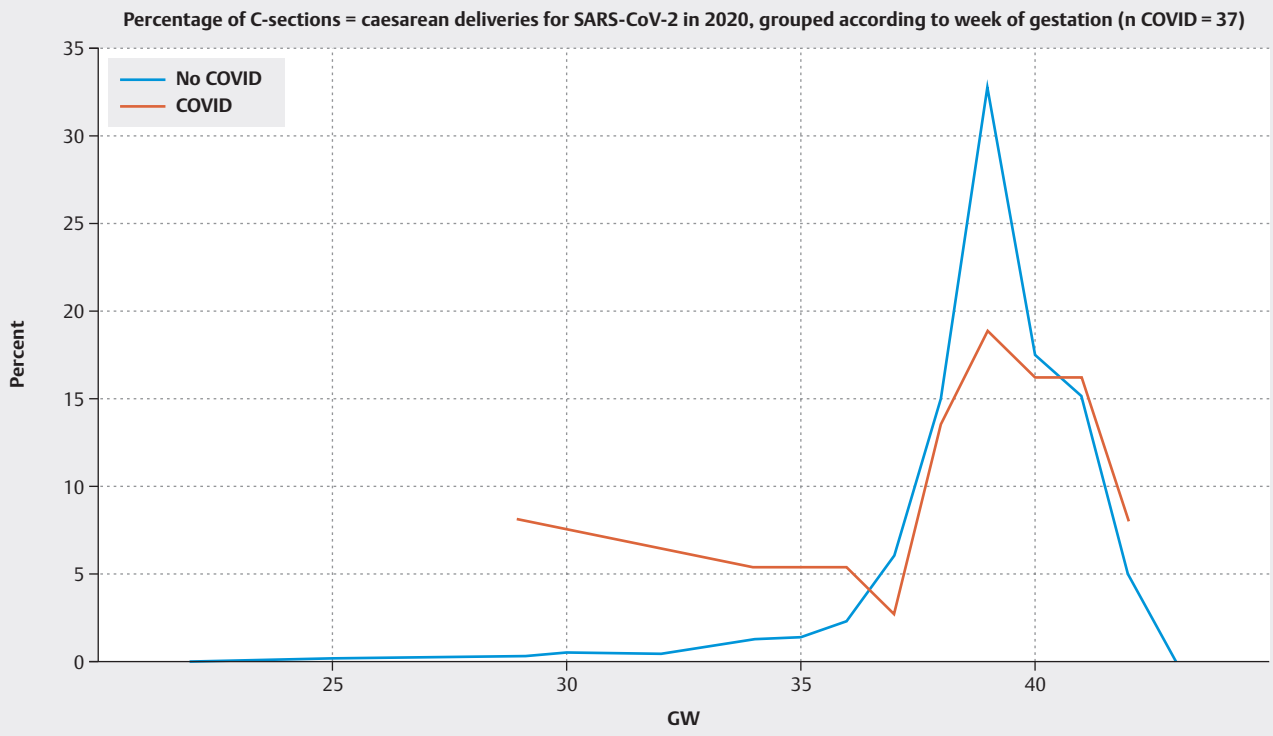
▶ **Fig. 3** Percentage of iatrogenic births according to gestational age and time period (green area: lower rate of iatrogenic births in 2020, orange area: higher rate in 2020). The rate is displayed for 50 births and above in the respective week of gestation.

▶ **Fig. 2** elaborates on this presentation of results. In this graph, the number of births per thousand births differentiated according to week of gestation (GW) was calculated for the period 2017–2019 (p17) and for 2020 (p20). The graph shows the difference between the two groups (diffT = p20–p17) and the difference per week of gestation (GW). It clearly shows the GW areas in which there were fewer preterm births in 2020 compared to the same period in the years 2017 to 2019 (> 30 + 0 GW, increasing by week 37 of gestation), and the periods in which comparatively more preterm births occurred (24 + 0 to 28 + 0 GW). It was noticeable that the drop in preterm births was particularly high closer to the expected date of delivery; correspondingly, there was also a contrary (positive) spike in the difference per thousand around the time of the expected delivery, during which a greater percentage of births (+ 0.5% – + 0.8% in the 39th and 40th GW) occurred in 2020.

Delivery by caesarean section and induction of labor

The percentage of secondary deliveries by caesarean section did not differ significantly between the two periods under comparison (2017–2019 vs. 2020), not even when only the rate of caesarean sections for singleton births before 37 + 0 GW were compared (2020 = 13.86 %; 2017–2019 = 14.52 %; p = 0.21). The total rate of primary caesarean sections, irrespective of the week of gestation, also did not differ between the period from 2017 – 2019 compared to 2020 (p = 0.23); however, significantly fewer infants below the age of 37 + 0 weeks of gestation were born by primary caesarean section (2020 = 5.84 %; 2017–2019 = 7.91 %; p = 0.00).

When births by primary caesarean section and births following induction of labor without prior rupture of membranes were viewed separately, there was a significant decrease in “iatrogenically-induced” preterm births before 35 + 0 weeks of gestation but a significant increase in the number of births between > 35 + 0 and 39 + 0 weeks of gestation. The number of inductions of labor remained approximately the same for both periods, with 482 inductions in 2020 compared to a total of 1483 (494/year) in the three years before the pandemic (p = 0.113) (▶ **Fig. 3**; ▶ **Table 4**).



▶ **Fig. 4** Percentage of caesarean section deliveries in 2020 born to COVID-19 patients compared to other patients whose child was born in 2020 according to the week of gestation (GW) at delivery.

▶**Table 4** Comparison of the rates of iatrogenic births for the two subgroups > 28 + 0 – 35 + 0 and > 35 + 0 – ≤ 39 + 0 weeks of gestation for the years 2017–2019 and in 2020.

	Number of neonates born > 28 + 0 – 35 + 0 and > 35 + 0 – 39 + 0 (n/n)	Iatrogenic births > 28 + 0 – 35 + 0 GW (n/percentage of total births/p (Fisher's exact test)	Iatrogenic births > 35 + 0 – 39 + 0 GW (n/percentage of total births/p (Fisher's exact test)
1.1.2020 to 31.12.2020 (1 year)	834/11 670	137/16.4 %/p = 0.016*	4040/34.61 %/p = 0.0053**
1.1.2017 to 31.12.2019 (3 years)	2790/36 097	562/20.1 %	11 989/33.21 %

COVID infections

According to the data recorded during perinatal data collection, a SARS-CoV-2 infection was detected in 125 of the 38 782 births born in Berlin in 2020. The percentage of primary and secondary caesarean section deliveries in this (small) group was slightly higher compared to the total cohort of other deliveries born in 2020 but the increase was not significant (29.6 % deliveries by caesarean section in COVID-19 patients, 26.7 % in patients with no COVID-19 infection, p = 0.48). A primary or secondary caesarean section before 37 + 0 weeks of gestation was carried out significantly more often in COVID-19 patients (10.3 % for patients without vs. 24.3 % with COVID-19 infection, p = 0.012) (▶ **Fig. 4**).

Discussion

The important findings of our data analysis are:

1. The total number of live-born singletons born in Berlin maternity hospitals and wards decreased in the first year of the pandemic.
2. The percentage of preterm births in the cohort of singleton pregnancies born below the age of 37 + 0 weeks of gestation was significantly lower in 2020 compared to the three previous years, with significantly more preterm neonates delivered before 28 + 0 weeks of gestation and significantly fewer preterm births occurring between 28 + 0 and 35 + 0 weeks of gestation.
3. Significantly fewer infants aged less than 37 + 0 weeks of gestation were born by primary caesarean section in 2020.
4. The incidence of induction of labor remained approximately the same.

Stumpfe et al. (2022) recently reported on the limited impact of SARS-CoV-2-related lockdowns and the consequent decrease in population mobility on the rate of preterm births in Bavaria. They also carried out a secondary analysis of obstetric clinical quality assurance parameters and compared the results for the years 2010 to 2020. They found significantly lower values during both lockdown phases for unadjusted preterm birth rates but did not group their data according to weeks of gestation [6].

What results have been reported by working groups in other European countries and North America, and what are their explanations for the impact of the pandemic on birth rates and preterm birth rates?

A selective search of the literature which we carried out at the end of December 2021 and which only included retrospective cohort and registry studies on indirect consequences of the COVID-19 pandemic on perinatal outcome data showed contradictory findings with regard to pandemic and lockdown-related differences in the prevalence of undesirable pregnancy-related events such as preterm births and stillbirths [8]. The Danish group working group pf Aabakke et al. (2021) found no significant differences in obstetric or neonatal outcomes, nor did Son et al. (2021) in the USA [9, 10]. Simon and colleagues reported in 2021 for the first time about a decrease in preterm births in a large French cohort of non-infected or non-COVID-19-tested pregnant women and concluded that wide-ranging social changes such as lockdown situations could be associated with a positive impact on perinatal morbidity rates [11]. In Australia, Rolnik et al. (2021) reported fewer preterm births in women who had been subjected to strict limitations to contain the spread of the pandemic [12]. Liu et al. (2021) evaluated Canadian data and found a decrease in the number of singleton births occurring in early gestation for the period of the pandemic they were able to review and ascribed it, at least in part, to fewer inductions of labor and fewer caesarean deliveries, which would indicate that this was partially due to iatrogenic causes [13].

According to a review of the literature by Townsend et al. (2021), the planned and unplanned use of antenatal and maternity services decreased during the COVID-19 pandemic in highly developed industrial nations; instead, there was an increase in telemedicine appointments and virtual care [14]. In their review article published in Lancet Global Health, Chmilewska et al. (2021) emphasized that when considering the impact of the COVID-19 pandemic on women's health, the strength and quality of the respective healthcare system in different countries (available resources in low-income vs. industrialized nations) was a significant influencing factor. They included 15 studies in their evaluation and found no changes in preterm birth rates prior to the 37th week of gestation [2]. They did, however, find differences between high-income and low-income countries and noted a decrease in preterm births (12 studies) and of spontaneous preterm births (two studies) in high-income countries [3]. Simon et al. (2022) were of the opinion that interpreting the results on preterm births was difficult, particularly because of the effects of country-specific healthcare measures and restrictions such as lockdowns on non-infected pregnant women [4].

Stansfield et al. (2022) investigated the effects of the COVID-19 pandemic and the repeated lockdowns in Melbourne, Australia, in 2020 and 2021 on the total number of live births and particularly on preterm births in a metropolitan hospital group. They noted a decrease in the total rate of live births after a relaxation of lockdown measures and a strong increase in the number of births in one phase between lockdowns. The percentage and number of preterm births (< 37 + 0 weeks of gestation) decreased at the start of the first lockdown, although the biggest decrease occurred after the end of the second lockdown. Births < 34 + 0 weeks of gestation also decreased, but no significant changes were found for births < 28 weeks of gestation [2]. Stansfield and colleagues (2022) were of the opinion that these changes in the preterm birth rate could be traced back to several factors – including economic instability, decreased access to healthcare services, and changes in health-related behaviors as well as more and better hygiene measures. In addition, the restrictive measures in force may have affected maternal behavior with regard to sleep, smoking and alcohol consumption as well as physical activity and also general mental health and may have led to changes in the rate of preterm births [2].

For the city of New York, which could serve as the best comparison for Berlin, Weinberger et al. reported in 2022 that the total number of births decreased in 2020 compared to 2019, just as it did in Berlin [15]. The rate of extreme preterm births (< 28 + 0 GW) also decreased significantly, dropping from 5.6 (in 2019) to 4.7 per 1000 births in 2020 ($p < 0.0001$), although the rate of "moderate" preterm births (between 28 + 0 and 35 + 0 weeks of gestation) did not change. Weinberger et al. (2022) interpreted these data as suggesting that various biological effects of the SARS-CoV-2 infection and environmental changes occurring during the pandemic had competing impacts on preterm birth rates. A SARS-CoV-2 infection might increase the preterm birth rate by increasing the prevalence of preeclampsia and the number of medically induced preterm births, but the impact on the rate of spontaneous preterm births is not known. The restrictive measures used to limit the pandemic (lockdowns, quarantine, less travel, etc.) may (also) have reduced maternal exposure to infectious agents which could trigger an infection-related preterm birth (Weinberger et al., 2022). According to Weinberger et al. (2022), the effects of the COVID-19 pandemic on the preterm birth rate probably reflect a balance between an increase in preeclampsia-induced preterm births and a decrease in the number of infection-related spontaneous preterm births [15].

In 2022, Dench et al. published a data analysis showing changes in preterm singleton birth rates, using the national birth data of the US National Center for Health Statistics for the years 2010 to 2020 which includes 100 % of all births registered in the United States including home births (a total of 41 394 390 singleton births) [14]. The US data indicate that preterm births decreased after the lockdown in March 2020. The decrease was primarily due to changes in caesarean deliveries or deliveries following induction of labor (iatrogenically induced preterm births). Dench et al. (2022) interpret the slight decrease in preterm births born without caesarean delivery or induction of labor as an indication of the effect of lockdown [16]. Klumper et al. (2021) investigated preterm births during the first phase of the pandemic in The Netherlands and suspected that a pandemic-related reduction in the rate of "iatrogenic" births, i.e., infants delivered by primary

caesarean section or after induction of labor without prior rupture of membranes, was the main reason for the decrease in the number of preterm births [17].

Limitations: The evaluations presented here are based on a secondary analysis of standard data routinely collected in German labor wards, which could negatively affect the quality of the documentation. This also applies to pregnant women identified as having SARS-CoV-2 infection.

Conclusion

A careful interpretation of these initial data which also takes the above-mentioned limitations into consideration and includes internationally published results suggests that in 2020, social and environmental effects of lockdown measures as well as iatrogenic and biological factors affected the rate of preterm births. More data analyses of existing registry data will be needed to determine possible causes for the apparent decrease in the rates of preterm births in the first year of the pandemic and find out whether this will lead to more insights which could be used to shape future strategies to reduce the rates of preterm births. The next step should consist of a detailed and critical evaluation of the routinely collected, extensive perinatal data of all hospital births collected across all of Germany as part of quality assurance, which would include the years 2021 and 2022. An analysis of possible pandemic-related changes in out-of-hospital births would also be very interesting and important.

This pandemic has placed a severe strain on all of society. But if the pandemic provides an opportunity to carry out an in-depth analysis of data that will lead to the detection of important factors which could result in a long-term reduction of preterm births, then we should absolutely take advantage of this unique time and view it as an opportunity “to make something good out of bad.”

Conflict of Interest

The authors declare that they have no conflict of interest.

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