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CLINICAL ARTICLE

Obstetrics

# Stillbirths in Germany: On the rise, but no additional increases during the first COVID-19 lockdown

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## Abstract

**Objective:** To examine possible changes in the rate of stillbirths in Germany during the first COVID-19 lockdown.

**Methods:** Population-level data of live births and stillbirths occurring between January 1995 and July 2020 were used and negative binomial regression was applied to estimate the rate of stillbirths in this period. The actual rate was compared to the expected figure for 2020.

**Results:** A steady increase in stillbirths was detected in Germany since 2013. The stillbirth rate for January to July 2020 (4.148) was slightly lower than that of the same period in 2019 (4.242). Furthermore, all monthly rates of stillbirths during the first half of 2020 lie inside the 95% prediction interval of expected stillbirth rates for this period.

**Conclusion:** A growing body of studies on the indirect effect of the COVID-19 pandemic on stillbirths shows mixed and context-dependent evidence. In contrast to other European countries, stillbirth rates have been on the rise in Germany in the last decade. However, stillbirth rates during the first half of 2020 were not higher than expected. The results suggest that stillbirth rates have not changed during the first-wave COVID-19 lockdown in this high-income setting. However, further studies on the causes of the increasing trend in stillbirths in Germany are needed.

**KEYWORDS**
COVID-19, fetal death, Germany, lockdown, stillbirth

## 1 | INTRODUCTION

As in many other countries affected by the COVID-19 pandemic, the German federal and state governments responded to increasing numbers of cases of COVID-19 and deaths by taking drastic public health measures intended to slow down the rate of transmission of the SARS-CoV-2 virus. During the pandemic's first wave, large parts of public life were shut down from March 22, 2020, for the next 3 months. To keep intensive care beds available, the German government ordered hospitals to postpone non-emergency procedures and surgeries. First comparisons of hospitalizations during the pandemic (March 16 to April 5, 2020) and pre-pandemic (corresponding dates in 2019) periods, based on data from one of the largest insurance companies in Germany, indicate a decrease of 16% in pregnancies, births, or postpartum-related hospitalizations and a decrease of 14% in hospitalizations related to diseases of the fetus or the newborn.[1]

Scholars expressed concerns from the early stages of the pandemic that the COVID-19 measures might disrupt the delivery of

health services, including reproductive and maternal healthcare services, and would reduce care-seeking behavior. The scientific community consequently called for studies on the indirect effect of COVID-19 on perinatal and maternal outcomes in general and on stillbirths in particular.[2]

One year later, evidence from the growing body of studies investigating the possible correlation between COVID-19 lockdown measures and stillbirths reflects mixed results. A recently published meta-analysis indicates that the rates of stillbirths have increased during the pandemic, particularly in low- and middle-income countries, but not in high-income settings.[3] Indeed, several hospital-based studies from low-, middle-, and high-income countries have reported a rise in the rate of stillbirths during the pandemic. There is evidence that the risk of stillbirths significantly increased in some hospitals in Nepal and India during the lockdown in the spring of 2020 compared to the weeks before the lockdown.[4,5] Similarly, a study comparing the incidence of stillbirths based on data from one hospital in London during the pandemic (February to June 2020) to the pre-pandemic period (October 2019 to January 2020), found an increase in the incidence of stillbirths from 2.38 per 1000 births to 9.31 per 1000 births, none of which were associated with known COVID-19 infections.[6] A study based on one hospital in Israel indicated a significant increase in the rates of stillbirths in February to April 2020, compared to the corresponding periods in 2017 to 2019.[7] Another study, based on a database of hospital discharges from the Lazio region in Italy, reported an increase in stillbirth rates when comparing the period of March to May 2020 with the corresponding period in 2019.[8]

In contrast, no evidence for an increase was found in a study based on data from two Philadelphia (USA) hospitals that compared rates of stillbirths for the period of March to June 2020 with the corresponding periods in 2018 and 2019.[9] This finding is in line with the four available studies on stillbirths in high-income countries based on population-level data. There was no evidence of increases in stillbirths in England, regionally or nationally, in the period of April to June 2020 compared to the same period in 2019,[10] or when a longer pre-pandemic period of up to 5 years was taken into account in studies on the Castilla y León region in Spain,[11] Sweden,[12] and Austria.[13]

These mixed results on stillbirths in high-income countries may be caused by issues of selectivity in the studies using hospital data; findings from the representative population-level studies are likely more robust. Nonetheless, most previous studies that explored the indirect effect of the COVID-19 pandemic on stillbirths focused on comparing rates of stillbirth during the pandemic to relatively short pre-pandemic periods, in the range of 1–5 years before the pandemic. To account for random fluctuations in the number of stillbirth events and for pre-pandemic trends in the rates of stillbirths, particularly in high-income countries where stillbirths are rare, it is, however, important to consider longer-term trends of stillbirths when assessing potential changes during the pandemic. The rates of stillbirths in most high-income countries have continually declined in the last few decades, despite differences in overall stillbirth burdens and the magnitude of decline.[14,15] This means that assessments of pandemic-related changes in stillbirths in 2020 would ideally be based on comparing the observed numbers of stillbirths during a specific 2020 pandemic time window with the expected number of stillbirths for the same period. Therefore, the aim of the present study was to assess the indirect effect of the COVID-19 pandemic on stillbirths in Germany by comparing the observed rate of stillbirths in January to July 2020 with the expected rate considering the long-term trends in stillbirths since 1995, using full population data from statistical offices.

## 2 | MATERIALS AND METHODS

The data for pre-pandemic rates of stillbirths in Germany was gathered from the Federal Statistical Office.[16,17] They provided the total number of live and stillbirth events in Germany on a monthly basis from 1990 up to 2019, as well as the monthly number of live births for each federal state. The monthly provisional numbers of births for the whole of Germany and for each federal state from January to July 2020 were also provided by the Federal Statistical Office. Since the official statistics for stillbirths are not compiled until the summer of the following year, the provisional figures for stillbirths had to be obtained from the statistical offices of the respective federal states.[18–32] With the exception of Thuringia, the number of stillbirths from January to July 2020 were provided by the statistical offices of each federal state. All numbers for 2020 are preliminary figures. Since the statistical office of Thuringia did not provide stillbirth data for 2020, data were collected on the monthly number of stillbirths from 1995 until 2019 for Thuringia to enable the exclusion of Thuringia's live births and stillbirths from the present analysis.[33–50]

The observed monthly rate of stillbirths in January through July 2020 was then compared with the following: (1) the observed rate of stillbirths in 2019; and (2) the predicted number of stillbirths for the same time period. The prediction is based on the trend in stillbirths detected in the data from January 1995 through December 2019. The prediction rests on a Generalized Additive Model (GAM),[51,52] where it is assumed that the number of stillbirths follows a negative binomial distribution.[53,54] The total number of births, that is, stillbirths and live births combined, serves as a (log) offset. This offset does not only take care of changes in the underlying population structure, but also eliminates the effect of different lengths of months. The GAM contains two smooth components: one for the secular trend of stillbirths observed over time, and one for the seasonal component, to adjust for seasonality in both the occurrence of births and stillbirths. Both smooth components are estimated using P-splines,[55] which are widely used to estimate, smooth, and analyze mortality.[56,57] The definition of what counts as a stillbirth has changed twice in Germany during the observation period.[17] Therefore, an indicator variable measures whether the old definition (January 1995 to October 2018) or the new definition (November 2018 to date) of stillbirths was in use. Prediction intervals were derived analytically using the quantile function of the negative binomial

distribution with the seven estimates for the mean (μ1, μ2, μ3, ..., μ7) from the GAM for January, February, March,..., July 2020 and the estimate for parameter θ, which controls the level of overdispersion. All statistical analyses were performed using R (R Foundation for Statistical Computing, Vienna, Austria). Ethical approval from an institutional review board and informed consent from any participants were not needed, because the data were de-identified and (soon to be) publicly available data on the occurrence of stillbirths from statistical offices. Such data do not constitute human subject research.

## 3 | RESULTS

Table 1 shows a descriptive comparison between the observed rate of stillbirths for the periods January to July 2019 and 2020, respectively. A slight decrease in the observed rate of stillbirths is indicated in the time window of January to July 2019 (4.242) when compared with the same time window in 2020 (4.148). The descriptive stillbirth rate for 2020 was compared with the rate for 2019 because the potential effect of the definition change for 2018 in the descriptive results could not be controlled for.

Figure 1 displays the rates of stillbirths in Germany from January 1995 until July 2020. Figure 1a shows annual observed and estimated stillbirth rates, with 95% confidence intervals around the estimated means. The rate of stillbirths in Germany continuously decreased between 1995 and 2006, but then plateaued until 2012. However, a reversal of this trend occurred in 2013; an ongoing increase in the rate of stillbirths has occurred since.

Between 2012 and 2018, the rate of stillbirths in Germany increased by 7.608%. Figures 1b,c displays the monthly rate of stillbirths from January 1995 until July 2020. The estimates in Figure 1c reflect the control for seasonality in the rates of live births and stillbirths, whereas the estimates in Figure 1b do not. The monthly rates of stillbirths from January 2020 to July 2020 lie in the 95% prediction interval for both types of predictions. Hence, the rate of stillbirths in Germany in the first half of 2020 has been neither higher nor lower than the expected rate without the impact of the pandemic. Note that predicted rates of stillbirths for 2020 are slightly higher than estimates in previous years, given the increasing trend over time in German stillbirths.

Table 1 displays monthly predicted rates of stillbirths for 2020. Tables S1 and S2 display the annual and monthly estimations of stillbirths until 2019.

**TABLE 1** Monthly observed and predicted rates of stillbirths with seasonality for Germany, except Thuringia, 2019 to 2020[a]

| Year | Month | Observed rate of stillbirths | Predicted rate of stillbirths (95% CI) |
|---|---|---|---|
| 2020 | Jan | 3.694 | 4.248 (3.677–4.846) |
| 2020 | Feb | 3.901 | 4.113 (3.551–4.706) |
| 2020 | Mar | 4.674 | 4.170 (3.607–4.758) |
| 2020 | Apr | 3.981 | 4.265 (3.694–4.858) |
| 2020 | May | 4.617 | 4.290 (3.735–4.869) |
| 2020 | Jun | 4.158 | 4.207 (3.658–4.781) |
| 2020 | Jul | 3.993 | 3.966 (3.443–4.499) |
| 2019 | Mean Jan to Jul | 4.242 | ... |
| 2020 | Mean Jan to Jul | 4.148 | ... |

[a]Rates were predicted by a negative binomial model in a Generalized Additive Model framework controlling for definition change and seasonality, estimated "overdispersion-theta" being 1029.215.[16–50]

## 4 | DISCUSSION

The present study examines the rates of stillbirths in Germany before and during the first wave of the COVID-19 pandemic. To assess whether the pandemic has indirectly affected the occurrence of stillbirths, observed rates of stillbirths from January 2020 to July 2020 were compared with the observed rates of stillbirths in 2019 and the predicted rates of stillbirths for the first half of 2020, which were derived from modeling trends of stillbirths since 1995. The analyses used full population data (except for the state of Thuringia) obtained from German statistical offices. It was discovered that rates of stillbirths neither increased nor decreased during the first wave of the COVID-19 pandemic. The observed rate of stillbirths from January to July 2020 was slightly lower than in the corresponding period of 2019. All monthly rates of stillbirths observed in the first half of 2020 lie within the 95% confidence interval of expected rates for this period.

The present results corroborate the findings from the few other available studies on high-income countries based on population-level data, which have detected no increase in stillbirths during the first wave of the COVID-19 pandemic.[9–13] Furthermore, the findings of the present study show the importance of accounting for underlying trends in the rates of stillbirths when assessing potential pandemic-related changes. An increasing and previously undocumented population-level trend was detected in the stillbirth rate in Germany from 2013 onward. In these analyses, the findings on stability in stillbirth rates during the first pandemic wave are robust, regardless of whether mean rates from 2020 were compared to those in 2019, or monthly observed rates of stillbirths were compared with expected monthly rates based on estimates using long-term trends in stillbirth rates. However, declining (or increasing) trends in the rates of stillbirths that may have been present before the pandemic in other countries or regions should be factored in when assessing indirect effects of the pandemic on the rates of stillbirths and other perinatal outcomes. An increase in the rates of late fetal death from 2008 to 2012 in Germany was also reported by Schwarz et al. [58], based on routine perinatal hospital data covering 98.5% of births in Germany. They found a correlation between an overall increase in maternal age and neonatal morbidity.[58] Further research on the causes of the ongoing increasing trend in stillbirths in Germany is needed. It should, for instance, examine whether the increase in the rate of stillbirths after 2012 is related to increases in maternal age, and whether

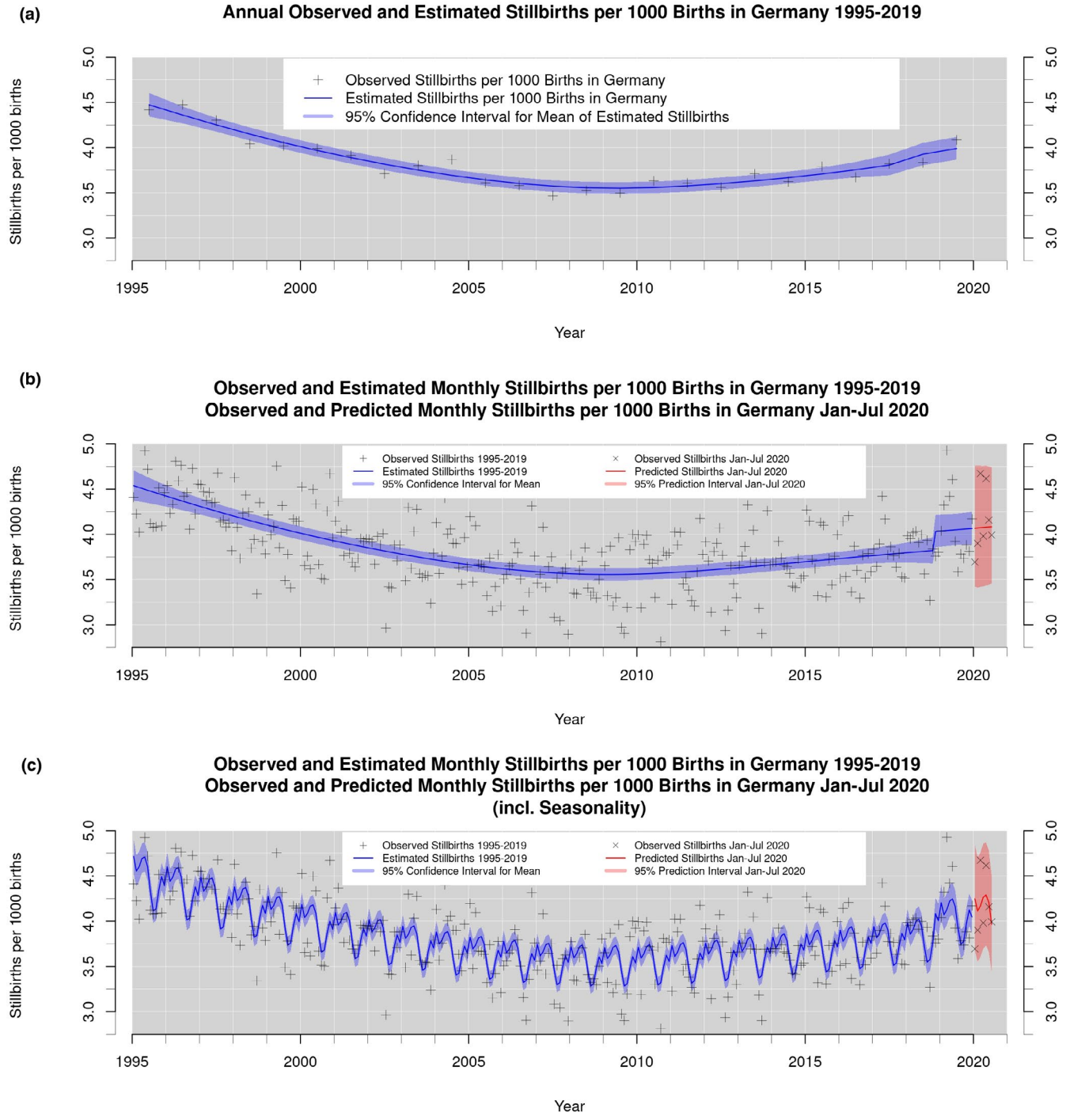


**FIGURE 1** (a) Annually observed and estimated rates of stillbirths for Germany, except Thuringia, from 1995 until 2019, estimated by a negative binomial model in a Generalized Additive Model framework controlling for definition change; (b) monthly observed, estimated, and predicted rates of stillbirths for Germany, except Thuringia, from 1995 until 2020, estimated and predicted by a negative binomial model in a Generalized Additive Model framework controlling for definition change; (c) monthly observed, estimated, and predicted rates of stillbirths for Germany, except Thuringia, from 1995 until 2019, estimated by a negative binomial model in a Generalized Additive Model framework controlling for definition change and seasonality[16-62]

it may be caused by increasing proportions of pregnancies conceived with the help of assisted reproduction technology, which have a slightly elevated risk of stillbirths.[59]

The major strength of the present study lies in the full-coverage population-level data. The data reflect the total population of Germany instead of selected hospitals only. Furthermore, the extensive data coverage of monthly rates from 1995 to 2020 made it possible to analyze the indirect effects of the pandemic on stillbirths in the context of the long-term trend in Germany, which revealed a previously undocumented ongoing increase in the

country's rate of stillbirths since 2013. The monthly estimates also made it possible to correct for seasonality in expected rates of live births and stillbirths.

Despite its strengths, the present study has some limitations. The aggregated level data do not provide information that allows for analyses of the distribution or causes of the stillbirths. Hence, no detailed information on the mothers or pregnancies, such as age, week of pregnancy, or maternal illnesses, is available. Further, only the indirect effect of the pandemic and the lockdown can be measured because no information on the incidence of cases of COVID-19 is available in the present data. Women with COVID-19 infection may carry a double burden; studies show that they run an increased risk of stillbirth, which could be due to either the direct effect of an infection or the indirect effect of the pandemic.[60] Further, the data are provisional, and may not be 100% accurate. The preliminary data for live births and stillbirths in 2020 reflect the month they were reported and not the month they occurred. Thus, the monthly distribution of stillbirths in the final data, which will be published in the summer of 2021, may vary slightly from the provisional data that are currently used. However, it is unlikely that the total number of stillbirths in the first half of 2020 will change, and the results of the present study should therefore not be affected.[21] Another limitation is the restricted comparability between the years before and after Germany's change of the definition of stillbirth in November 2018. Even though allowances were made for the change of definition, it should be mentioned that it is best to compare the data from 2020 with the data from 2019.

No changes were documented in the rates of stillbirths during the first wave of the COVID-19 pandemic in Germany, but it should be noted that the present study only covers the period until the end of July 2020. In Germany, the rate of total documented cases of COVID-19 infection during the first wave was low, while the number of infections during the second and subsequent waves (which started after the observation window period in the present study) was higher, and the healthcare system was more affected.[61] It will be important to analyze the potential changes in the rate of stillbirths when more data become available in the summer of 2021.

Finally, the findings of the present study are context dependent. Germany has a high-quality healthcare system that provides extensive medical services to almost all pregnant women.[62]

Furthermore, in April 2020, the German Board and College of Gynecology and Obstetrics appealed to pregnant woman to go to hospital when needed and to not decline necessary clinic visits, which could result in poor pregnancy outcomes such as stillbirths.[63] These factors may have contributed to the stability of the rates of stillbirths during the first wave of the COVID-19 pandemic in Germany.

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## CONFLICTS OF INTEREST

The authors have no conflicts of interest.

## AUTHOR CONTRIBUTIONS

MSK, NN, and MK conceptualized the study. MSK collected and prepared the data. MSK, NN, and MK verified the data. RR performed the data analysis and visualized the results. MSK wrote the first draft of the manuscript. All authors contributed to the subsequent drafts and to the final manuscript. All authors had full access to all the data in the study and all authors had the final responsibility for the decision to submit it for publication.

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## REFERENCES

1. Günster C, Drogan D & Hentschker C, et al. WIdO-Report: Trends in hospital case rates during the coronavirus lockdown. By ICD diagnosis chapters and selected treatment occasions. 2020; Berlin. Accessed June 11, 2021. https://hermes.wido.de/fileadmin/Dateien/Bilder/News/2020_06_WIdO-Report_FZ-Entwicklung_Lockdown.pdf
2. Homer CSE, Leisher SH, Aggarwal N, et al. Counting stillbirths and COVID 19—there has never been a more urgent time. *Lancet Glob Health*. 2020;9(1):e10e11.
3. Chmielewska B, Barratt I, Townsend R, et al. Effects of the COVID-19 pandemic on maternal and perinatal outcomes: a systematic review and meta-analysis. *Lancet Glob Health*. 2021;9(6):e759-e772.
4. Kc A, Gurung R, Kinney MV, et al. Effect of the COVID-19 pandemic response on intrapartum care, stillbirth, and neonatal mortality outcomes in Nepal: a prospective observational study. *Lancet Glob Health*. 2020;8(10):e1273–e1281.
5. Kumari V, Mehta K, Choudhary R. COVID-19 outbreak and decreased hospitalization of pregnant women in labour. *Lancet Glob Health*. 2020;8(9):e1116-e1117.
6. Khalil A, von Dadelszen P, Draycott T, Ugwumadu A, O'Brien P, Magee L. Change in the incidence of stillbirth and preterm delivery during the COVID-19 pandemic. *Am Med Assoc*. 2020;324(7):705.
7. Mor M, Kugler N, Jauniaux E, et al. Impact of the COVID-19 pandemic on excess perinatal mortality and morbidity in Israel. *Am J Perinatol*. 2021;38(4):398-403.
8. De Curtis M, Villani L, Polo A. Increase of stillbirth and decrease of late preterm infants during the COVID-19 pandemic lockdown. *Atch Dis Child Fetal Neonatal Ed*. 2020;106(4):456.
9. Handley SC, Mullin AM, Elovitz MA, et al. Changes in preterm birth phenotypes and stillbirth at 2 Philadelphia hospitals during the SARS-CoV-2 pandemic, March-June 2020. *JAMA*. 2021;325(1):87-89.
10. Stowe J, Smith H, Thurland K, Ramsay ME, Andrews N, Ladhani SN. Stillbirths during the COVID-19 pandemic in England, April-June 2020. *JAMA*. 2021;325(1):86-87.
11. Arnaez J, Ochoa-Sangrador C, Caserío S, et al. Lack of changes in preterm delivery and stillbirths during COVID-19 lockdown in a European region. *Eur J Pediatr*. 2021;180(6):1997-2002.

12. Pasternak B, Neovius M, Söderling J, et al. Preterm birth and stillbirth during the COVID-19 pandemic in Sweden: a Nationwide cohort study. *Ann Intern Med*. 2021.
13. Farr A, Falcone V, Wagner M. Commentary to: Pasternak, et al. 2021. Ann Intern Med 2021, Vienna.
14. Blencowe H, Cousens S, Jassir FB, et al. National, regional, and worldwide estimates of stillbirth rates in 2015, with trends from 2000: a systematic analysis. *The Lancet Global Health*. 2016;4(2):e98-e108.
15. Smith LK, Hindori-Mohangoo AD, Delnord M, et al. Quantifying the burden of stillbirths before 28 weeks of completed gestational age in high-income countries: a population-based study of 19 European countries. *Lancet*. 2018;392(10158):1639–1646.
16. Federal Statistical Office (Destatis). Live births: federal states, months, sex. Wiesbaden: Federal Statistical Office (Destatis) 2020. Accessed November 11, 2020. https://wwwgenesis.destatis.de/genesis//online?operation=statistic&code=12612&levelindex=1&levelid=1610367596593#abreadcrumb
17. Federal Statistical Office (Destatis). *Total Stillbirths in Germany*. Federal Statistical Office (Destatis); 2020, [Data request].
18. Berlin-Brandenburg Statistics Office. *Total Stillbirths in Berlin and the State of Brandenburg in 2020 by Month*. Berlin-Brandenburg Statistics Office; 2020, [Data request].
19. Bavarian State Office of Statistics. *Stillbirths by Month in 2020*. Bavarian State Office of Statistics; 2020, [Data request].
20. Hessian State Statistical Office. *Data Request Stillbirths 2020*. Hessian State Statistical Office; 2020, [Data request].
21. State Office for Statistics of Lower Saxony. *Stillbirths in Lower Saxony*. State Statistical Office of Lower Saxony; 2020, [Data request].
22. State Office for Information and Technology North Rhine-Westphalia. Stillbirths - district-free cities and districts – month (as of 2000). Düsseldorf: State Office for Information and Technology North Rhine-Westphalia 2020. Accessed January 1, 2020. https://www.landesdatenbank.nrw.de/ldbnrw/online#astructure
23. Mecklenburg-Western Pomerania Statistical Office. Natural population movement in Mecklenburg-Western Pomerania. 1st quarter 2020. Schwerin: Statistical Office of Mecklenburg-Western Pomerania. 2020. Accessed October 20, 2020. https://www.laiv-mv.de/Statistik/Zahlen-und-Fakten/Gesellschaft-&-Staat/Bevölkerung
24. Mecklenburg-Western Pomerania Statistical Office. Natural population movement in Mecklenburg-Western Pomerania. 2nd Quarter 2020. Schwerin: Statistical Office of Mecklenburg-Western Pomerania. 2020. Accessed October 20, 2020. https://www.laiv-mv.de/Statistik/Zahlen-und-Fakten/Gesellschaft-&-Staat/Bevölkerung
25. Mecklenburg-Western Pomerania Statistical Office. Natural population movement in Mecklenburg-Western Pomerania. 3rd quarter 2020. Schwerin: Statistical Office of Mecklenburg-Western Pomerania. 2020. Accessed October 20, 2020. https://www.laiv-mv.de/Statistik/Zahlen-und-Fakten/Gesellschaft-&-Staat/Bevölkerung
26. Saarland Statistical Office. *Data on Natural Population Movement. Stillbirths Saarland 2017–2020*. Statistisches Amt Saarland; 2020, [Data request].
27. State Statistical Office of Baden-Württemberg Stillbirths by Month From 2000 to 2020 (Preliminary Figures). Statistical Office of Baden-Württemberg;2020. [Data request].
28. Bremen State Statistical Office. *Stillbirths by Month in the State of Bremen*. Bremen State Statistical Office; 2020. [Data request].
29. State Statistical Office of the Free State of Saxony. *Stillbirths of the Free State of Saxony 2017 to July 2020 by Reporting Month*. State Statistical Office of the Free State of Saxony; 2020. [Data request].
30. Statistical Office for Hamburg and Schleswig-Holstein. *Number of Stillbirths in Schleswig-Holstein by Month of Birth*. Statistical Office for Hamburg and Schleswig-Holstein; 2020. in 2017 to 2020.[Data request].
31. Rhineland-Palatinate State Statistical Office. Stillbirths in Rhineland-Palatinate by month 2017–2020. Rhineland-Palatinate Statistical Office; 2020, [Data request].
32. Saxony-Anhalt State Statistical Office. Stillbirths in Saxony-Anhalt 2017–2020. Statistisches Landesamt Sachsen-Anhalt; 2020, [Data request].
33. Thuringian State Office for Statistics. *Stillbirths in Thuringia in the Years 1991 to 2002 by Month*. Thuringian State Office for Statistics; 2020. [Data request].
34. Thuringian State Office for Statistics. *Natural Population Movement in Thuringia 2019*. Thuringian State Office for Statistics; 2020 https://statistik.thueringen.de/webshop/webshop.asp?ansicht=-frersch&ve=01201
35. Thuringian State Office for Statistics. *Natural Population Movement in Thuringia 2018*. Thuringian State Office for Statistics; 2019 https://statistik.thueringen.de/webshop/webshop.asp?ansicht=-frersch&ve=01201
36. Thuringian State Office for Statistics. *Natural Population Movement in Thuringia 2017*. Thuringian State Office for Statistics; 2018 https://statistik.thueringen.de/webshop/webshop.asp?ansicht=-frersch&ve=01201
37. Thuringian State Office for Statistics. *Natural Population Movement in Thuringia 2016*. Thuringian State Office for Statistics; 2017 https://statistik.thueringen.de/webshop/webshop.asp?ansicht=-frersch&ve=01201
38. Thuringian State Office for Statistics. *Natural Population Movement in Thuringia 2015*. Thuringian State Office for Statistics; 2016 https://statistik.thueringen.de/webshop/webshop.asp?ansicht=-frersch&ve=01201
39. Thuringian State Office for Statistics. *Natural Population Movement in Thuringia 2014*. Thuringian State Office for Statistics; 2015 https://statistik.thueringen.de/webshop/webshop.asp?ansicht=-frersch&ve=01201.
40. Thuringian State Office for Statistics. *Natural Population Movement in Thuringia 2013*. Thuringian State Office for Statistics; 2014. https://statistik.thueringen.de/webshop/webshop.asp?ansicht=-frersch&ve=01201
41. Thuringian State Office for Statistics. *Natural Population Movement in Thuringia 2012*. Thuringian State Office for Statistics; 2013. https://statistik.thueringen.de/webshop/webshop.asp?ansicht=-frersch&ve=01201
42. Thuringian State Office for Statistics. *Natural Population Movement in Thuringia 2011*. Thuringian State Office for Statistics; 2012. https://statistik.thueringen.de/webshop/webshop.asp?ansicht=-frersch&ve=01201
43. Thuringian State Office for Statistics. *Natural Population Movement in Thuringia 2010*. Thuringian State Office for Statistics; 2011. https://statistik.thueringen.de/webshop/webshop.asp?ansicht=-frersch&ve=01201
44. Thuringian State Office for Statistics. *Natural Population Movement in Thuringia 2009*. Thuringian State Office for Statistics; 2010. https://statistik.thueringen.de/webshop/webshop.asp?ansicht=-frersch&ve=01201
45. Thuringian State Office for Statistics. *Natural Population Movement in Thuringia 2008*. Thuringian State Office for Statistics; 2009. https://statistik.thueringen.de/webshop/webshop.asp?ansicht=-frersch&ve=01201
46. Thuringian State Office for Statistics. *Natural Population Movement in Thuringia 2007*. Thuringian State Office for Statistics; 2008. https://statistik.thueringen.de/webshop/webshop.asp?ansicht=-frersch&ve=01201
47. Thuringian State Office for Statistics. *Natural Population Movement in Thuringia 2006*. Thuringian State Office for Statistics; 2007. https://statistik.thueringen.de/webshop/webshop.asp?ansicht=-frersch&ve=01201

48. Thuringian State Office for Statistics. *Natural Population Movement in Thuringia 2005*. Thuringian State Office for Statistics; 2006. https://statistik.thueringen.de/webshop/webshop.asp?ansicht=-frersch&ve=01201
49. Thuringian State Office for Statistics. *Natural Population Movement in Thuringia 2004*. Thuringian State Office for Statistics; 2005. https://statistik.thueringen.de/webshop/webshop.asp?ansicht=-frersch&ve=01201
50. Thuringian State Office for Statistics. *Natural Population Movement in Thuringia 2003*. Thuringian State Office for Statistics; 2004. https://statistik.thueringen.de/webshop/webshop.asp?ansicht=-frersch&ve=01201
51. Hastie TJ, Tibshirani RJ. *Generalized Additive Models*. Chapman & Hall; 1990.
52. Wood S. *Generalized Additive Models: An Introduction with R*. Chapman & Hall; 2006.
53. Cameron AC, Trivedi PK. Regression Analysis of Count Data. 2nd ed. Cambridge University Press; 2013.
54. Lawless JF. Negative binomial and mixed Poisson regression. *Can J Stat*. 1987;15:209-225.
55. Eilers PHC, Marx BD. Flexible smoothing with B-splines and penalties. *Stat Sci*. 1996;11(2):89-102.
56. Camarda CG. MortalitySmooth: an R package for smoothing Poisson counts with P-splines. *J Stat Softw*. 2012;50(1):1-24.
57. Currie ID, Durban M, Eilers PHC. Smoothing and forecasting mortality rates. *Stat Model*. 2004;4:279-298.
58. Schwarz C, Schäfers R, Loytved C, et al. Temporal trends in fetal mortality at and beyond term and induction of labor in Germany 2005–2012: data from German routine perinatal monitoring. *Arch Gynecol Obstet*. 2016;293(2):335-343.
59. Bay B, Boie S, Kesmodel US. Risk of stillbirth in low-risk singleton term pregnancies following fertility treatment: a national cohort study. *BJOG*. 2019;126(2):253-260.
60. Khalil A, Kalafat E, Benlioglu C, et al. SARS-CoV-2 infection in pregnancy: A systematic review and meta-analysis of clinical features and pregnancy outcomes. *EClinicalMedicine*. 2020;25:100446.
61. German Interdisciplinary Association for Intensive Care and Emergency Medicine (DIVI) e.V. Number of reported COVID-19 cases treated with intensive care. Germany; 2021. Accessed April 12, 2021. https://www.intensivregister.de/-/aktuelle-lage/zeitreihen
62. Federal Statistical Office (Destatis). Statistics on births. Quality report on birth statistics, 2014 - 2015. 2017. Accessed April 12, 2021. https://www.destatis.de/DE/Methoden/Qualitaet/Qualitaetsberichte/Bevoelkerung/geburt en.pdf?__blob=publicationFile
63. German Board and College of Gynecology and Obstetrics. COVID-19: no fear of hospital treatment or hospital births. Press release of the German Society of Gynecology and Obstetrics. (DGGG). German Board and College of Gynecology and Obstetrics. 2020. Accessed January 26, 2021. https://www.dggg.de/fileadmin/documents/Weitere_Nachrichten/2020/20200422_GBCOG_COVID-19_Keine-Angst-vor-Klinikgeburten.pdf

## SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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