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

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Abstract

Background

A growing body of studies on the indirect effect of the COVID-19 pandemic on stillbirths shows mixed and context-dependent evidence, even within high-income countries. We examined possible changes in the stillbirth rate in Germany during the first COVID-19 lockdown.

Methods

We used population-level data on live and stillbirths occurring between January 1995 and July 2020 and applied negative binomial regression to estimate the yearly and monthly stillbirth rate in this period. We compared the actual stillbirth rate to the expected figure for the first seven months of 2020, based on prediction intervals derived from the detected time trend.

Findings

We detected a steady increase in stillbirths in Germany since 2013, which was preceded by a declining (1995-2004), and then plateauing (2005-2012) stillbirth rate. The stillbirth rate for January 2020 through July 2020 (4·148) was slightly lower than the stillbirth rate in the same period in 2019 (4·242). Furthermore, all monthly stillbirth rates during the first half of 2020 lie inside the 95% prediction interval of expected stillbirth rates for this period. Thus, stillbirths in Germany have neither increased nor decreased during the country's first COVID-19 lockdown period.

Interpretation

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 seven months of 2020 were not higher than expected. Our results suggest that stillbirth rates have neither increased nor decreased during the first-wave COVID-19 lockdown in this high-income setting. Further studies on the causes of the increasing stillbirth trend in Germany are needed, however.

Funding statement

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Research in context

Evidence before this study

Before conducting this study, we searched Google Scholar for studies published since January 1, 2020 with the search terms: “stillbirth COVID-19”, “pregnancy output COVID-19”, and “fetal death COVID-19”. We selected all studies that observed the indirect effect of the pandemic on stillbirths in full hospital, regional, and country populations. We found one meta-study and ten single-country studies, all of which focused on the first COVID-19 wave. Studies documented mixed evidence due to diverse contexts, data selections, and methodologies. For high-income countries, three register-data based studies showed no pandemic-related increases in the stillbirth rates, while six hospital-based studies documented increases in stillbirths, and one did not. Most studies compared stillbirth rates during the first wave of the pandemic with short-term pre-pandemic rates without assessing indirect pandemic effects in the light of longer-term trends. No previous study documented the indirect effect of the COVID-19 pandemic on stillbirth rates in Germany and, furthermore, no study has documented trends in stillbirth rates for Germany since 2012.

Added value of this study

Our study is the first to provide evidence of the indirect effect of COVID-19 on stillbirths in Germany and to assess stillbirth rates during the first wave of the pandemic in the context of longer-term trends. Furthermore, we documented trends in the stillbirth rate in Germany since 1995, uncovering a previously unknown upward trend since 2013.

Implications of all the available evidence

Population-level increases in stillbirths may be of no immediate concern in European high-income countries during times of lockdowns with low infectious COVID-19 activity, even though shifts in certain hospitals or regions may have occurred as suggested by other studies. The indirect effect of the COVID-19 pandemic on stillbirth rates thus appears to be context dependent. This suggests that SARS-CoV-2 virus activity, pandemic control measures, health care systems, population health, or other factors are important moderators of COVID-19 lockdowns on perinatal outcomes. Moreover, perinatal health outcomes observed during the pandemic need to be assessed in the context of previous trends related to these outcomes and evaluated in light of the expected numbers of the perinatal event of interest during the pandemic, based on previous trends. Finally, further research is needed to investigate the causes of the detected rise in the German stillbirth rate that occurred over the last decade.

Introduction

As in many other countries affected by the COVID-19 pandemic, the German federal and state governments responded to increasing numbers of COVID-19 cases and deaths by taking drastic public health measures intended to slow down the transmission rate 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 following three 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, 2020 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 since the pandemic’s early stages that the COVID-19 measures might disrupt the delivery of health services, including reproductive and maternal health care services, and it 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

A 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 stillbirth rates have increased during the pandemic, in particular in low- and middle-income countries, but not in high-income settings.³ Indeed, several hospital-based studies from low-, middle- but also high-income countries have reported a

rise in stillbirths during the pandemic. There is evidence, based on nine hospitals in Nepal and four hospitals in western India, that the risk of stillbirths has significantly increased 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 2020 to June 2020) to the pre-pandemic period (October 2019 to January 2020), found an increase in stillbirth incidence from 2.38 per 1000 births to 9.31 per 1000 births; none of which were associated with known COVID-19 infections.⁶ Higher stillbirth rates during the pandemic were also reported in studies that made allowances for seasonal variations in live births and stillbirths. A study based on one hospital in Israel indicates a significant increase in stillbirth rates in the beginning of the pandemic (February 21, 2020 to April 30, 2020) compared to the corresponding periods from 2017 to 2019.⁷ Another study, based on a hospital discharge database from the Lazio region in Italy, reported an increase in stillbirth rates when comparing the period March 2020 to May 2020 with the corresponding period in 2019.⁸

In contrast, no evidence for an increase in stillbirths was found in a study based on data from two Philadelphia (USA) hospitals that compared stillbirth rates for the period March 2020 to June 2020 with the same months in 2018 and 2019 (pre-pandemic).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 April 2020 to June 2020 compared to the same months in 2019,¹⁰ or when a longer pre-pandemic period of up to five 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 selectivity issues in the studies using hospital data; findings from the representative population-level studies likely are more robust. Nonetheless, most previous studies that explored the indirect effect of the COVID-19 pandemic on stillbirths focused on comparing stillbirth rates during the pandemic to relatively short pre-pandemic periods, ranging from one to five years prior to the pandemic. To account for random fluctuations in the number of stillbirth events and for pre-pandemic trends in stillbirth rates, particularly in high-income countries where stillbirths are rare events, it is, however, of great importance to consider longer-term trends related to stillbirths when assessing potential changes in stillbirth rates during the pandemic. Stillbirth rates 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, predicted by taking longer stillbirth time trends into account. Therefore, our study aims at assessing the indirect effect of the COVID-19 pandemic on stillbirths in Germany by comparing the observed stillbirth rate in March 2020 to June 2020 with the expected stillbirth rate considering long-term trends in stillbirths since 1995, using full population data from statistical offices.

Methods

Population-based data

The data for pre-pandemic stillbirth rates 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 number of births for the whole of Germany and for each federal state from January 2020 to July 2020 was 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 until 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, we collected data on the monthly number of stillbirths from 1995 until 2019 for Thuringia to enable us to exclude Thuringia's live births and stillbirths from our analysis.³³⁻⁵⁰

Associated analyses

We deducted the monthly live and stillbirths for Thuringia from the data for Germany as a whole to analyze the trends in stillbirths for Germany. Thuringia was excluded due to data availability constraints.

We then compared the observed monthly number of stillbirths per 1000 births in January 2020 through July 2020 with a) the observed number of stillbirths and b) the predicted number of stillbirths for the same time period. The prediction is based on the stillbirth trend detected in the data from January 1995 through December 2019. The prediction rests on a Generalized Additive Model (GAM),^{51,52} where we assume that the number of stillbirths follows a negative binomial distribution.^{53,54} The total number of births, i.e. 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 stillbirth trend 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 ($\mu_1, \mu_2, \mu_3, \dots, \mu_7$) from the GAM for January, February, March, ..., July 2020 and the estimate for parameter θ , which controls the level of overdispersion.

Results

Table 1 shows a descriptive comparison between the observed stillbirth rate for the periods January to July 2019 and 2020 respectively. A slight decrease in the observed stillbirth rate is indicated in the time window of January 2019 to July 2019 (4·242) when compared with the same time window in 2020 (4·148). We compared the descriptive stillbirth rate for 2020 with the 2019 rate only because we could not control the effect of the definition change in 2018 in our descriptive results.

Figure 1 displays stillbirth rates in Germany from January 1995 until July 2020. Panel A shows annual observed and estimated stillbirth rates, with 95% confidence intervals around the estimated means. The stillbirth rate in Germany has continuously decreased between 1995 and 2006, but then plateaued until 2012. However, a reversal of this trend occurred in 2013; an ongoing and statistically significant increase in the stillbirth rate has occurred since. Between 2012 and 2018, the stillbirth rate in Germany has increased by 7·608 percent. Panels B and C display the monthly stillbirth rate from January 1995 until July 2020. The estimates in panel C reflect the control for seasonality in live birth and stillbirth rates, whereas the estimates in panel B do not. Monthly stillbirth rates in 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 pandemic's impact. Note that predicted stillbirth rates for 2020 are slightly higher than estimates in previous years, given the increasing trend over time in German stillbirths. The seasonal pattern of observed stillbirths for 2020 shows similarities with the pattern observed in 2019, with high peaks in May and March and a lower stillbirth rate in the other months.

A

Annual Observed and Estimated Stillbirths per 1,000 Births in Germany 1995–2019

B

Observed and Estimated Monthly Stillbirths per 1,000 Births in Germany 1995–2019 Observed and Predicted Monthly Still Births per 1,000 Births in Germany Jan–Jul 2020

C

Observed and Estimated Monthly Stillbirths per 1,000 Births in Germany 1995–2019 Observed and Predicted Monthly Still Births per 1,000 Births in Germany Jan–Jul 2020 (incl. Seasonality)

Figure 1: Panel A: Annually observed and estimated stillbirth rates for Germany except Thuringia, from 1995 until 2019, estimated by a negative binomial model in a Generalized Additive Model framework controlling for definition change. Panel B: Monthly observed, estimated and predicted stillbirth rates 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. Panel C: Monthly observed, estimated and predicted stillbirth rates 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 and seasonality¹⁶⁻⁵⁰

Table 1 displays monthly predicted stillbirth rates for 2020 in Germany, excluding Thuringia. Supplementary Tables 2 and 3 display the annual and monthly stillbirth estimations until 2019.

Year	Month	Observed Stillbirth rate	Predicted Stillbirth rate (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	4.29 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	Average Jan to Jul	4.242	...
2020	Average Jan to Jul	4.148	...

Table 1: Monthly observed and predicted stillbirth rates with seasonality for Germany, except Thuringia, 2019 to 2020, predicted by a negative binomial model in a Generalized Additive Model framework controlling for definition change and seasonality, estimated ‘overdispersion-theta’ being 1029.215¹⁶⁻⁵⁰

Discussion

This study examines stillbirth rates 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, we compared observed stillbirth rates in January 2020 to July 2020 with a) observed stillbirth rates in 2019 and b) estimated stillbirth rates for the first half of 2020, which we derived from modeling stillbirth trends since 1995. Our analyses used full population data (except for the state of Thuringia) obtained from German statistical offices. We found that stillbirth rates have neither increased nor decreased during the first wave of the COVID-19 pandemic and associated lockdown in Germany. The observed stillbirth rate in January 2020 to July 2020 was slightly lower than in the corresponding period in 2019. However, all monthly stillbirth rates observed in the first half of 2020 lie within the 95% confidence interval of expected stillbirth rates for this period.

Our results corroborate 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, our findings show the importance of accounting for underlying trends in stillbirth rates when assessing potential pandemic-related changes. We detected an increasing and previously undocumented population-level trend in the stillbirth rate in Germany since 2013. In our analyses, findings on stability in stillbirth rates during the first pandemic wave are robust, regardless of whether we compare average rates from 2020 to those in 2019, or whether we compare monthly observed stillbirth rates with expected monthly rates based on estimates using long-term trends in stillbirth rates. However, declining (or increasing) trends in stillbirth rates that may have been present pre-pandemic in other countries or regions should nonetheless be factored in when assessing indirect pandemic effects on stillbirth rates and other perinatal outcomes. An increase in late fetal death rates from 2008 to 2012 in Germany was also reported by Schwarz et al.,⁵⁸ based on routine perinatal hospital data covering 98.5 percent 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 stillbirth trend in Germany is needed. It should, for instance, examine whether the increase in stillbirth rates after 2012 is also related to increases in maternal age, and whether it may be caused by increasing proportions of pregnancies conceived with the help of assisted reproduction technology, which appears to have a slightly elevated risk of stillbirths.⁵⁹

The major strength of our study lies in the full-coverage population-level data. The data reflects the total population of Germany instead of selected hospitals only. It is therefore representative of perinatal outcomes in the whole country. Furthermore, the extensive data coverage of monthly rates from 1995 to 2020 enabled us to analyze indirect pandemic effects on stillbirths in the context of the long-term trend in Germany, which revealed a previously undocumented ongoing and significant increase in the country’s stillbirth rate since 2013. Our monthly estimates further enabled us to correct for seasonality in expected live and stillbirth rates.

Despite its strengths, our study has limitations. The aggregated level data does 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 of the women, the gestation week, or maternal illnesses is available. This information is important to analyze group-specific pandemic impacts. Further, we can only measure the indirect effect of the pandemic and the lockdown because no information on the incidence of COVID-19 cases is available in our sample. 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 is provisional, and may not be 100% accurate. The preliminary data for the live and stillbirths in 2020 reflects the month of report and not by month of event. 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 we are currently using. However, it is unlikely that the total number of stillbirths in the first half of 2020 will change, and our results 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 we made allowances for the definition change, it should be mentioned that it is best to compare the data from 2020 with the data from 2019.

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

Finally, our findings are context dependent. Germany has a high-quality health care system that provides extensive medical services to almost all pregnant women.⁶² Furthermore, the German Board and College of Gynecology and Obstetrics appealed in April 2020 to pregnant woman to go to hospital when needed and to not decline necessary clinic visits, which could result in poor pregnancy outcomes like stillbirths. Expecting parents were urged not to risk the health of mothers and unborn children due to fear of infection at the hospital.⁶³ These factors may have contributed to the stability of stillbirth rates during the first wave of the pandemic in Germany.

Data sharing

Annual and monthly observed and estimated stillbirth rates on country level in Germany, except for the state of Thuringia, can be found in Tables 3 and 4 in the appendix. Complete annual and monthly live birth counts are available from the German Federal Statistical Office. Stillbirth counts were provided by states' statistical offices through data requests; they need to remain confidential and cannot be shared.

Authors' contributions

MSK, NN, and MK conceptualized the study. MSK collected and prepared the data. MSK, NN and MK verified the data. RR did 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 the authors had the final responsibility for the decision to submit it for publication.

Conflict of interest

We declare that we have no conflicts of interests.

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