

Resilience in the time of crisis: A review of the maternal, perinatal and reproductive health effects of COVID-19 in South Africa

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Background. The COVID-19 pandemic had a profound effect on the health sector globally and in South Africa (SA).

Objective. To review the effects of COVID-19 on maternal, perinatal and reproductive health outcomes and service utilisation in SA.

Methods. Three routine national data collection systems were sourced: the District Health Information System, the Saving Mothers reports of the National Committee on Confidential Enquiry into Maternal Deaths and the Saving Babies reports from the National Perinatal Morbidity and Mortality Committee using data from the Perinatal Problem Identification Program.

Results. There were 35% and 8% increases in maternal and stillbirth mortality rates, respectively, in 2020 and 2021, which correlated with the COVID-19 waves. However, in 2022, rates returned to pre-COVID levels. Antenatal visits and facility births showed little change, but there was a shift to more rural provinces. The use of oral and injectable contraceptives and termination of pregnancy services decreased markedly in 2020 and 2021, with a sustained shift to long-acting reversible contraceptives. The increase in maternal deaths was predominantly due to COVID-19 respiratory complications, but also an increase in obstetric haemorrhage. Stillbirths increased significantly (10%) for birthweights between 2 000 g and 2 499 g, categorised mostly as unexplained stillbirths or preterm labour, but no increase in neonatal deaths was observed. Administrative avoidable factors increased by 24% in the 2020 - 2022 triennium, but there was no increase in patient/community level or healthcare provider-related avoidable factors during the pandemic years.

Conclusion. COVID-19 caused a marked increase in maternal death and stillbirth rates in 2020 and 2021 due to both direct effects of the virus and indirect effects on functioning of the health system. The continued, although modified, health-seeking behaviour of women and the rapid return to pre-COVID-19 mortality rates demonstrates enormous resilience in women and the health system.

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International literature predicted increases in maternal and perinatal mortality during the COVID-19 pandemic if routine and emergency maternity services were not maintained or used by pregnant women.^[1]

The pandemic started in South Africa (SA) during the first quarter of the 2020/21 financial year (FY) and there were four waves; quarter 1 (Q1) (April - June 2020) and Q2 (July - September 2020) constituting the first wave, with the peak of infections in July; Q3 (October - December 2020) and Q4 (January - March 2021) constituting the second wave, with the peak in January 2021. Qs 1 and 2 of FY 2021/2022 constituted the third wave, with the peak in July 2021, and Qs 3 and 4 of FY 2021/2022 the fourth wave, with the peak in January 2022. The Alpha variant of the SARS-CoV-2 virus predominated in wave 1, the Beta variant in wave 2, the Delta variant in wave 3 and the Omicron variant in wave 4.

From April to June 2020, a very restrictive 'lockdown' was imposed in SA, with the aim of reducing transmission while the health services were strengthened and plans made to manage the pandemic. Vaccination became available for pregnant women in late 2021.

In SA, a review based on District Health Information System (DHIS) data published in the *South African Health Review* in December 2021 reported a 35% increased maternal mortality rate (MMR), and 8% increased stillbirth rate in the first two waves of the pandemic compared with the previous year.^[2] There was a profound

effect on reproductive health service utilisation, but antenatal care visits were maintained despite an initial drop during severe lockdown, and facility births were stable.

This review will report on DHIS data in the second and subsequent year of the pandemic.

Data from Saving Mothers and Saving Babies reports are now available for 2020, 2021 and 2022 for maternal and perinatal mortality. These reports can be compared with DHIS data trends. In addition, these two data sources provide information on cause of death and avoidable factors.^[3-7]

Objective

To describe the impact of the COVID-19 pandemic on maternal and perinatal mortality and use of maternal and reproductive health services by comparing data for 2020 to 2022 with the years prior to the pandemic.

Methods

Three national data collection systems were sourced. The DHIS in SA collects data on the usage and outcome of health services offered by the public sector. It contains no individual patient data and relies on aggregated data submitted monthly from public facilities from ward and clinic registers. Data pertaining to maternal and reproductive health service utilisation and outcomes were accessed

and downloaded from this database by one of the authors for April 2020 - March 2022. These included data on outcomes (number and rates of maternal and perinatal deaths) and service utilisation (visits for initiating antenatal care, births in facilities, visits for contraceptive prescriptions and termination of pregnancy (TOP) services).

Saving Mothers reports for 2020, 2021, 2022 and the 2020 - 2022 triennium, produced by the National Committee on Confidential Enquiry into Maternal Deaths (NCCEMD), were sourced to provide maternal death numbers, causes and avoidable factors. The NCCEMD data usually report on a larger number of maternal deaths than DHIS because they have a more comprehensive reporting system, which includes deaths from private facilities and also those known to have occurred outside facilities. The Saving Babies reports for 2020, 2021 and 2022, which sourced data from the Perinatal Problem Identification Program (PIIP) database, were used to provide corresponding data on perinatal deaths, numbers, causes and avoidable factors.

Results

Maternal mortality

DHIS data are shown in Fig.1. The downward-pointing arrows correspond to the peak of infections during each of the four waves of the pandemic.

Fig. 1 shows the institutional monthly maternal mortality rate (maternal deaths per 100 000 live births, institutional maternal mortality ratio; iMMR) per quarter from April 2019 to March 2022. Prior to the onset of the pandemic, the iMMR was 95.5 for the 2019/2020 FY. The peaks of iMMR in the second and third waves are clearly shown and coincide with peaks of infection. The highest iMMRs, >150, occurred in quarter 2 (July - September) of FY 2021/2022 (Delta variant) and quarter 4 (January - March) of FY 2020/2021 (Beta variant). Overall, in

financial years 2020/2021 and 2021/2022, there was an increase in iMMR of 35%. In the fourth wave (Omicron), the iMMR was 98.8, similar to pre-pandemic levels.

Data of iMMR per calendar year from the Saving Mothers reports produced by the NCCEMD are shown in Table 1, with 2019 as a pre-COVID-19 comparison. They show similar values and trends to the DHIS data.

During 2020 and 2021, the iMMR was 30% and 47%, respectively, higher than for

the pre-pandemic year 2019, when it was 98.8. However, the iMMR declined to 109.6 in 2022, which is closer to the iMMR in the previous triennium.

Annual trends in iMMR from 2005 are shown in Fig. 2.

Causes of maternal death (NCCEMD)

Table 2 shows the primary obstetric cause of maternal death for 2020 - 2022, and Table 3 describes the number of deaths directly due to COVID complications per province.

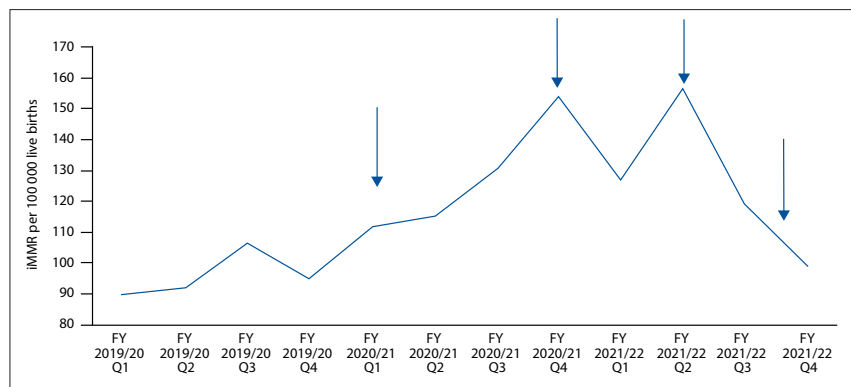


Fig. 1. South Africa: institutional maternal mortality ratio (iMMR) per quarter, April 2019 - March 2022 (District Health Information System). (FY = financial year; Q = quarter.) (HPD = hypertensive disorder of pregnancy; OH = obstetric haemorrhage; Ec = ectopic pregnancy; Misc = miscarriage; PRS = pregnancy-related sepsis; AR = anaesthetic complications; Emb = embolism; AC = acute collapse; NPRI = non-pregnancy-related infection; M&S = medical and surgical disorders; Unk = unknown.)

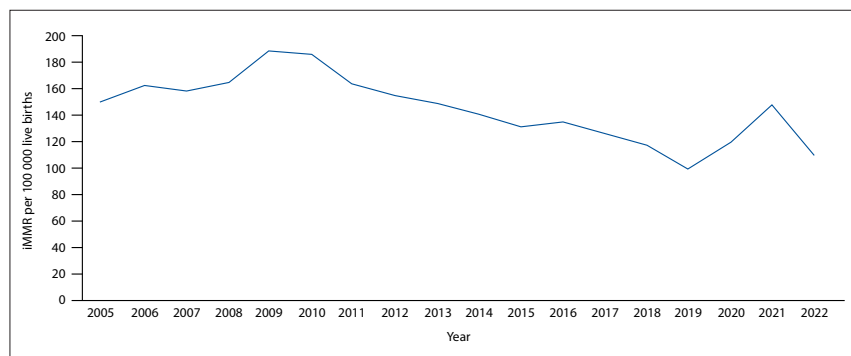


Fig. 2. South Africa: institutional maternal mortality ratio (iMMR) 2005 - 2022 (National Committee on Confidential Enquiry into Maternal Deaths).^[6]

Table 1. Institutional monthly maternal mortality rate per year, 2019 - 2022 (National Committee on Confidential Enquiry into Maternal Deaths)

Region	2019	2020	2021	2022
Eastern Cape	110.3	146.7	138.0	128.9
Free State	144.8	183.7	232.3	116.2
Gauteng	100.5	112.8	150.1	121.7
KwaZulu-Natal	82.2	116.4	128.8	87.8
Limpopo	126.2	118.1	144.2	114.7
Mpumalanga	84.1	103.2	174.5	137.4
North West	125	130.6	188.5	116.8
Northern Cape	133.1	104.3	190.9	117.4
Western Cape	50.8	93.3	102.3	70.8
South Africa	98.8	119.2	148.4	109.7

The most common cause of maternal death in all 3 years was non-pregnancy-related infections (NPRI). The increase was marked in 2020 and 2021, with COVID pneumonia being the major subcategory. Also in these 2 years, obstetric haemorrhage deaths increased from previous years and were the second most common cause. In 2022, the pattern of causation was similar to previous annual reports. KwaZulu-Natal, Gauteng, Western Cape and Eastern Cape provinces were particularly affected by the pandemic.

Fig. 3 compares iMMR per year starting from 2017, so that pre-pandemic iMMRs can

be compared with the pandemic years (2020 and 2021) for primary obstetric cause.

The marked increase in NPRI iMMR in 2020 and 2021 is noted, as well as the increase in obstetric haemorrhage (OH) iMMR. Both returned to pre-pandemic rates in 2022.

Avoidable factors for maternal deaths (NCCEMD)

Saving Mothers reports provide information on the preventability of maternal deaths as assessed by independent maternal death assessors according to patient/community level, administrative and healthcare

provider-related factors. These are shown in Tables 4, 5 and 6. Table 4 shows the overall avoidability of deaths for 2020 - 2021 (categories 3 and 4 combined). There were 58% potentially preventable deaths in 2020: 56% in 2021, 59% in 2022; and 57.4% in 2020 - 2022, compared with 62.4% in the previous triennium. The reduction of deaths assessed to be potentially avoidable was probably due to the high numbers of COVID pneumonia deaths, which were thought not to have been preventable. However, when further analysed by year and type of avoidable factor, there was an increase in administrative avoidable

Table 2. Primary obstetric causes of maternal deaths (MDs), 2019 - 2022

Primary obstetric problem	MDs 2019, n (%), N = 978	MDs 2020, n (%), N = 1 197	MDs 2021, n (%), N = 1 489	MDs 2022, n (%), N = 969
Medical and surgical disorders	154 (15.7)	183 (15.3)	190 (12.8)	140 (14.4)
Non-pregnancy-related infections*	197 (20.1)	322 (27) [†]	561 (37.7) [‡]	180(18.6) [§]
Ectopic pregnancy	37 (3.8)	36 (3)	33 (2.2)	34 (3.5)
Miscarriage	56 (5.7)	49 (4.1)	54 (3.6)	63 (6.5)
Pregnancy-related sepsis	45 (4.6)	63 (5.3)	68 (4.6)	56 (5.8)
Obstetric haemorrhage	179 (18.3)	200 (16.7)	237 (15.9)	162 (16.7)
Hypertensive disorders of pregnancy	192 (19.6)	185 (15.5)	188 (12.6)	166 (17.1)
Anaesthetic complications	20 (2.0)	21 (1.8)	17 (1.1)	39 (4.0)
Adverse drug reactions	9 (0.9)	13 (1.1)	6 (0.4)	7 (0.7)
Embolism	24 (2.5)	33 (2.8)	43 (2.9)	40 (4.1)
Acute collapse – cause unknown	32 (3.3)	15 (1.3)	36 (2.4)	21 (2.2)
Miscellaneous	12 (1.2)	4 (0.3)	3 (0.2)	8 (0.8)
Unknown	21 (2.2)	73 (6.1)	53 (3.6)	53 (5.5)

*Includes COVID-19 deaths.
[†]Includes 124 COVID-19 deaths in 2020.
[‡]Includes 369 COVID-19 deaths in 2021.
[§]Includes 12 COVID-19 deaths in 2022.

Table 3. COVID-19 deaths per province for each year and the whole triennium, 2020 - 2022^[6]

Cause of death	EC	FS	GAU	KZN	LIM	MPU	NW	NC	WC	Total
NPRI/COVID-19 2020	30	1	12	40	1	7	4	2	27	124
NPRI/COVID-19 2021	32	17	78	89	43	33	20	14	43	369
NPRI/COVID-19 2022	3	1	3	4	0	1	0	0	0	12
NPRI/COVID-19 2020 - 2022	65	19	93	133	44	41	24	16	70	505

EC = Eastern Cape; FS = Free State; GAU = Gauteng; KZN = KwaZulu-Natal; LIM = Limpopo; MPU = Mpumalanga; NW = North West; NC = Northern Cape; WC = Western Cape provinces; NPRI = non-pregnancy-related infection.

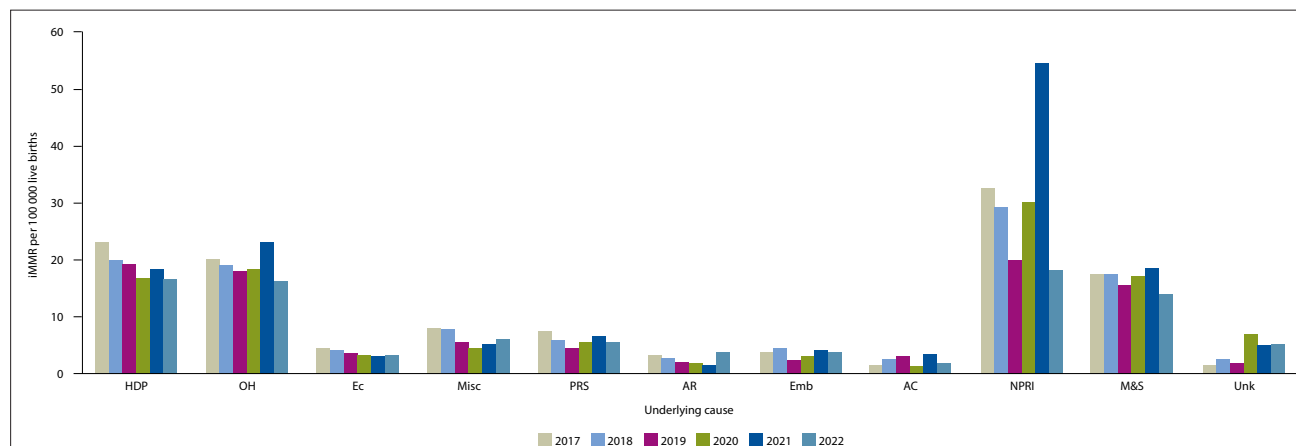


Fig. 3. Institutional maternal mortality ratio (iMMR) per primary obstetric cause of maternal death 2017 - 2022. (HPD = hypertensive disorder of pregnancy;

Table 4. Avoidability of deaths during pregnancy, childbirth and the puerperium (DDPCP) 2020 - 2022 compared with 2017 - 2019^[6]

Category of avoidability	2020 (DDPCP = 1 183), n (%)	2021 (DDPCP = 1 497), n (%)	2022 (DDPCP = 993), n (%)	2020 - 2022 (DDPCP = 3 673), n (%)	2017 - 2019 (DDPCP = 3 289), n (%)
No suboptimal care identified	401 (33.9)	528 (35.3)	320 (32.2)	1 249 (34)	924 (28.1)
Suboptimal care, no impact on outcome	96 (8.1)	132 (8.8)	87 (8.8)	315 (8.6)	312 (9.5)
Suboptimal care, possible impact on outcome	408 (34.5)	538 (35.9)	333 (33.5)	1 279 (34.8)	1 021 (31.0)
Suboptimal care, probable impact on outcome	278 (23.5)	299 (20)	253 (25.5)	830 (22.6)	1 032 (31.4)

Table 5. Avoidable factors 2020 - 2022, compared with 2017 - 2019

Factor	2020 - 2022	2017 - 2019
Patient-oriented problem		
Avoidable factor identified	1 777	1 669
No avoidable factor	1 623	1 405
Lack of information	400	287
Assessable cases	3 334	2 787
Proportion of avoidable cases	48.7	59.9
Administrative problem		
Avoidable factor identified	1 757	n/r
No avoidable factor	1 702	n/r
Lack of information	330	193
Assessable cases	3 404	n/r
Proportion of avoidable cases	50.0	n/r
Resuscitation problem		
Avoidable factor identified	1 591	1 538
No avoidable factor	1 779	1 523
Lack of information	385	257
Assessable cases	3 349	2 804
Proportion of avoidable cases	53.1	54.9

n/r = not relevant as classification changed with respect to staffing categories.

the COVID-19 pandemic affected health system functioning.

For healthcare provider factors, in community health centres 42.1% of maternal deaths were potentially avoidable in 2020 - 2022 compared with 39.3% in the previous triennium; 65.3% at district hospitals compared with 69.4% in 2017 - 2019; 57.3% at regional hospitals compared with 59% in 2017 - 2019; and 42.5% at tertiary/central hospitals compared with 40.2% in 2017 - 2019.

Perinatal mortality

Stillbirth rates

Fig. 4 presents DHIS data and shows monthly stillbirth rates (SBRs) prior to and during the COVID-19 pandemic. There were rises in SBR corresponding with peaks of infection in the second and third COVID-19 waves. The SBR in FY 2019/2020 was 20.4 per 1 000 births, compared with 21.9 in 2020/2021 and 21 in 2021/2022, representing increases of 7.4% and 3%, respectively.

Early neonatal death rates (ENNDR) from the DHIS showed minimal change between the pre-COVID-19 and COVID-19 financial years; it was 10.0 deaths per 1 000 births in FY 2019/2020, 10.0 in FY 2020/2021 and 10.1 in 2021/2022.

Fig. 5 shows DHIS perinatal mortality rates (PNMR) per quarter from April 2019 to March 2022, which combines the SBR and ENNDR. They were 30/1 000 in FY 2109/2020, 32/1 000 in FY 2020/2021 and 30.8/1 000 in FY 2021/2022, representing increases of 6.6% and 2.6%, respectively, when compared with the pre-COVID-19 financial year.

PPIP data allow for in-depth analysis of birthweight categories. The PPIP data from the corresponding financial years shows that the increase in the PNMR was mainly in the birthweight group 2 000 - 2 499 g in FY 2020 - 2021. There was an overall decrease in the neonatal death rate (12.7%) and an overall increase in the SBR of almost 5%. The changes in the mortality rates for each birthweight category are shown in Table 7.

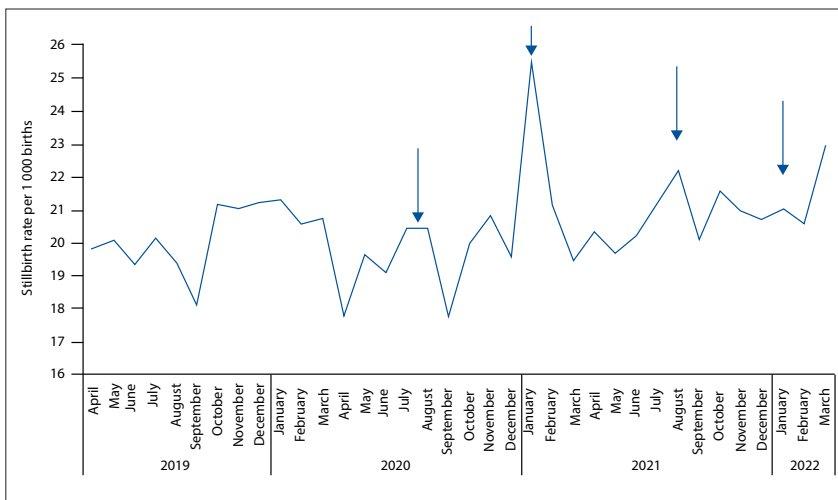


Fig. 4. Stillbirth rate per month, April 2019 - March 2022 (District Health Information System).

factors in 2020 and 2021, but not in patient/community-related or health provider-related factors (Tables 5 and 6).

There was a large increase in administrative avoidable factors in the 2020 - 2022 triennium compared with 2017 - 2019 with respect

to interfacility transport (12.9% v. 6.2%) and lack of blood products (12.0% v. 3.1%) (Table 6). The increase in avoidable factors for 2020 (61.2%) and 2021 (59.5%) was much greater than for 2022 (50.6%) and the previous triennium (48.1%), illustrating how

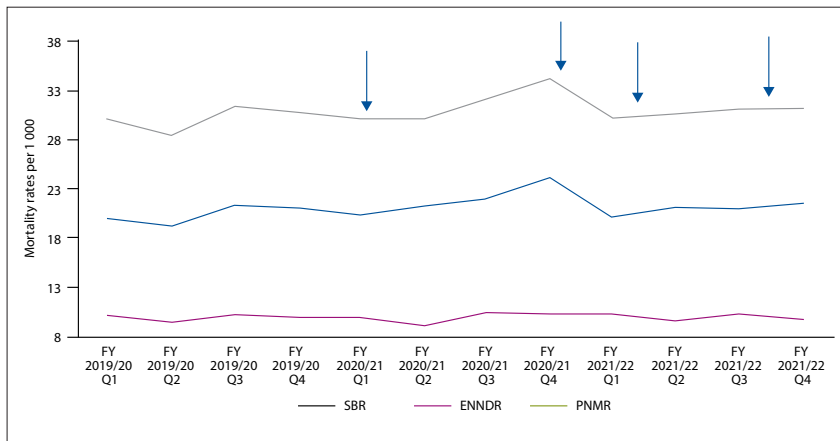


Fig. 5. Perinatal mortality rates per quarter (District Health Information System; DHIS). Perinatal Problem Identification Program data used for Mpumalanga due to suspected underreporting in DHIS data. (SBR = stillbirth rate; ENNDR = early neonatal death rate; PNMR = perinatal mortality rate.)

The decrease in reported neonatal deaths was across all weight categories. This shift from neonatal deaths to stillbirths can indicate a lack of access to services, with potentially complicated babies dying *in utero* before access to hospital services.

The primary cause of perinatal death indicated that there was an increase in the percentage of intrauterine deaths from 27% to 32.6% and a decrease in the number of babies reported to die from intrapartum asphyxia, from 17.3% to 14.7%. This is most likely the group of babies with undetected late-onset intrauterine growth restriction that presented with stillbirths instead of intrapartum deaths due to the restricted access to hospital services. Where the direct obstetric cause of death was infection, the

Table 6. Administrative-related avoidable factors (N=3 673)

Description	2020 - 2022, n	2020 - 2022, %	2017 - 2019, %
Lack of information	330	8.8	8.7
Assessable cases	3 404	91.2	91.3
No avoidable factor	1 702	50	n/r
Avoidable factors/assessable cases	1 702	50	n/r
Transport problem: home to institution	57	1.5	1.9
Transport problem: institution to institution (1 812 referred)	234	12.9	6.2
Lack of accessibility: barriers to entry	47	1.3	1.2
Lack of accessibility: other	50	1.3	0.7
Delay in attending to patient (overburdened service)	265	7.1	6.4
Delay in attending to patient (reason unknown)	185	5	n/r
Lack of healthcare facilities: intensive care units	328	8.8	8.3
Lack of healthcare facilities: blood/blood products (683 requiring blood)	82	12.0	3.1
Lack of healthcare facilities: other	119	3.2	2.9
Inadequate numbers of staff on duty	271	7.3	n/r
Appropriate skill not available onsite/on standby	363	9.7	n/r
Communication problems: technical	70	1.9	1.6
Communication problems: interpersonal	63	1.7	3
Other	359	9.6	9.1

n/r = not relevant as classification changed with respect to staffing categories.

Table 7. Changes in PPIP rates per weight categories between FY 2019/2020 and 2020/2021

Category	FY 2019 - 2020	FY 2020 - 2021	FY 2019 - 2020	FY 2020 - 2021	Decrease	FY 2019 - 2020	FY 2020 - 2021	Increase
	PMR (/1 000)	PMR (/1 000)	NMR (/1 000)	NMR (/1 000)	% decrease in NMR	SBR (/1 000)	SBR (/1 000)	% increase in SBR
All deliveries	30.8	31.3	11.8	10.3	12.7	22.1	23.2	4.97
All	21.4	22.1	8.1	7.0	13.4	15.8	16.6	5
>1 000 g								
500 - 999 g	712.1	693.8	510.6	472.4	7.48	480.7	493.4	2.6
1 000 - 1 499 g	305.4	314.1	160.9	147.4	8.39	213.4	227.9	6.8
1 500 - 1 999 g	137.2	142.4	39.3	37.4	4.83	110.4	117.3	6.25
2 000 - 2 499 g	42.7	46.1	11.9	10.9	8.4	34.1	37.6	10.26
>2 500 g	8.6	8.6	4.1	3.1	24.4	6.0	6.0	0

PPIP = Perinatal Problem Identification Program; FY = financial year; PMR = perinatal mortality rate; NMR = neonatal mortality rate; SBR = stillbirth rate.

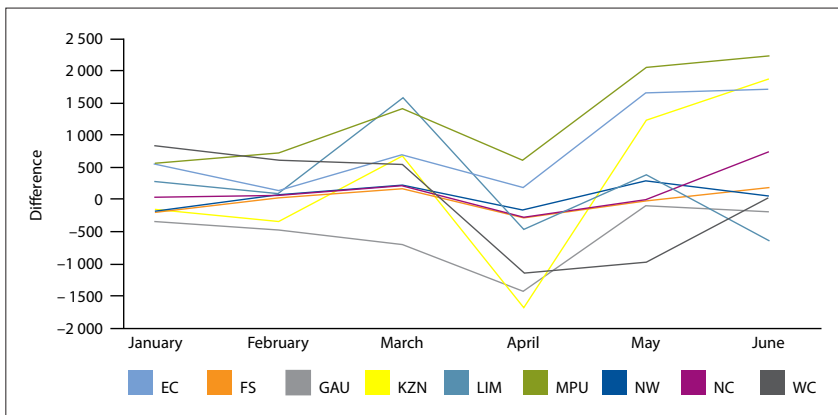


Fig. 6. Difference in all first antenatal attendance 2020 and 2019, by province; January - June. (EC = Eastern Cape; FS = Free State; GAU = Gauteng; KZN = KwaZulu-Natal; LIM = Limpopo; MPU = Mpumalanga; NW = North West; NC = Northern Cape; WC = Western Cape provinces.)

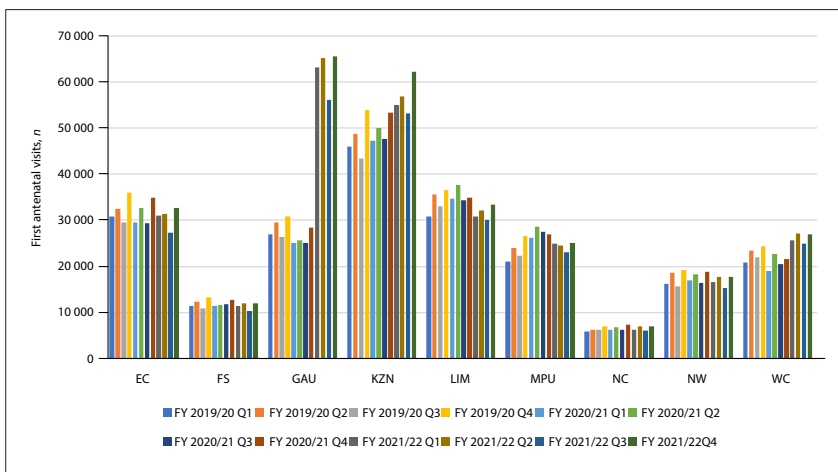


Fig. 7. First antenatal visits per province per quarter, April 2019 - March 2022. (EC = Eastern Cape; FS = Free State; GAU = Gauteng; KZN = KwaZulu-Natal; LIM = Limpopo; MPU = Mpumalanga; NC = Northern Cape; NW = North West; WC = Western Cape provinces; FY = financial year; Q = quarter.)

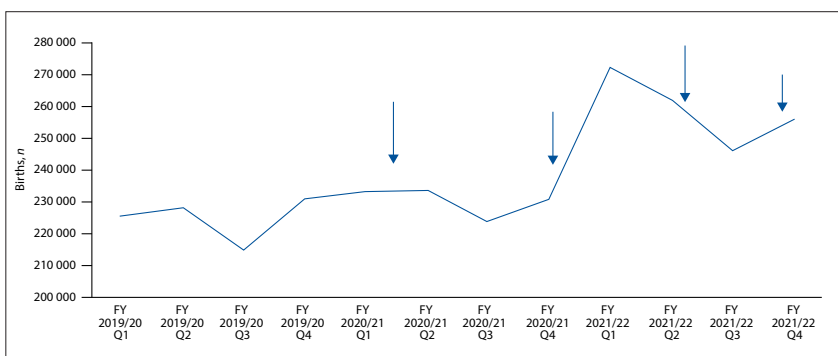


Fig. 8. Facility births per quarter, April 2019 - March 2022. (FY = financial year; Q = quarter.)

percentage of babies dying from syphilis also increased from 28% to 39%.

Maternity and reproductive health services utilisation (DHIS data)

Antenatal care first visits

There was a dip in antenatal attendances in all provinces during the first quarter of 2020/2021, which covered the beginning of

the pandemic and was during the restrictive lockdown (Fig. 6). After this, antenatal care visits showed an increase.

Fig. 7 shows the trend in first antenatal visits for the different provinces. Visits remained similar to the pre-COVID FY for Gauteng, KwaZulu-Natal and Western Cape provinces in the first year of the pandemic (FY 2020/2021), but increased in the second

year of the pandemic (FY 2021/2022). In the more rural provinces of Limpopo and Mpumalanga there was an increase in FY 2020/2021 corresponding to the first wave, which could have been due to urban to rural movement of the population related to the lockdown and economic hardships.

Births in facilities

There was a trend to more facility births from Q4 of 2020/2021, which continued into FY 2021/2022 (Fig. 8). These trends are difficult to interpret, but could reflect more conceptions during lockdown (Q1 2019/2020), with restricted access to contraceptive and TOP services, both of which resulted in births 9 months later. Statistics for home births are not part of the DHIS data set, but there were no observed reductions in facility births during the pandemic, suggesting that a trend to home births did not occur.

Fig. 9 shows facility births per province. A slight increase in Limpopo and Mpumalanga provinces in the first year of the pandemic is noted, similar to first antenatal care visits.

Fig. 10 illustrates the shift in provinces where women gave birth during COVID-19. The red lines indicate the percent change of births for SA, with the FY 2019/20 being the control period. The timing of the COVID-19 waves is illustrated by vertical arrows.

Initially in Gauteng Province (a mostly urban province) there was no real change in births until the second wave, when births decreased. There were also fewer births than the national average in subsequent waves. Limpopo Province showed a dramatic increase in births initially, with a doubling of the percent change of births compared with Gauteng Province, which subsequently reduced dramatically in FY 2021/22. A sustained increase of >10%, going up to 25% in births, was seen in Mpumalanga Province coinciding with the first three waves. Thereafter it declined. These changes indicate how the population of pregnant women moved from an urban province initially to more rural provinces during the epidemic.

Contraceptive prescriptions

Figs 11, 12, 13 and 14 show provision of Depo-Provera, subdermal implants, oral contraceptive pills and intrauterine contraceptive device (IUCD) insertion. With the exception of subdermal implants, all methods showed a decline in the first two quarters of FY 2020/2021 during the first COVID wave. This was particularly marked for IUCD insertion. Increases were observed from the fourth quarter of 2020/2021, with all methods getting back to pre-COVID levels by the second quarter of 2021/2022.

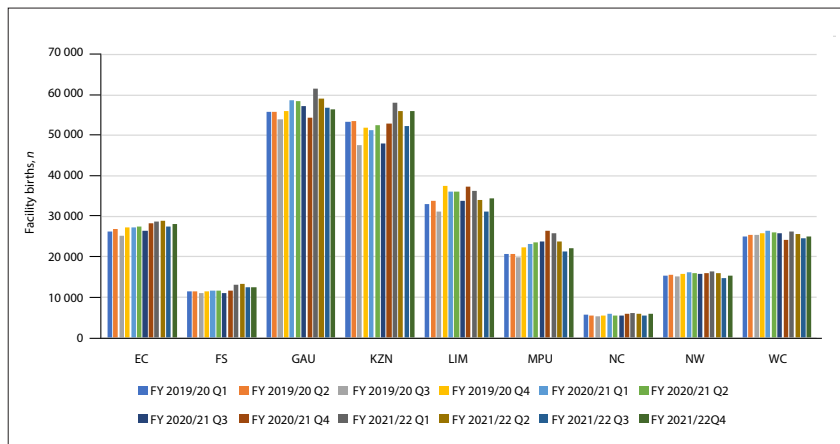


Fig. 9. Facility births per province per quarter, April 2019 - March 2022. (EC = Eastern Cape; FS = Free State; GAU = Gauteng; KZN = KwaZulu-Natal; LIM = Limpopo; MPU = Mpumalanga; NC = Northern Cape; NW = North West; WC = Western Cape provinces; FY = financial year; Q = quarter.)

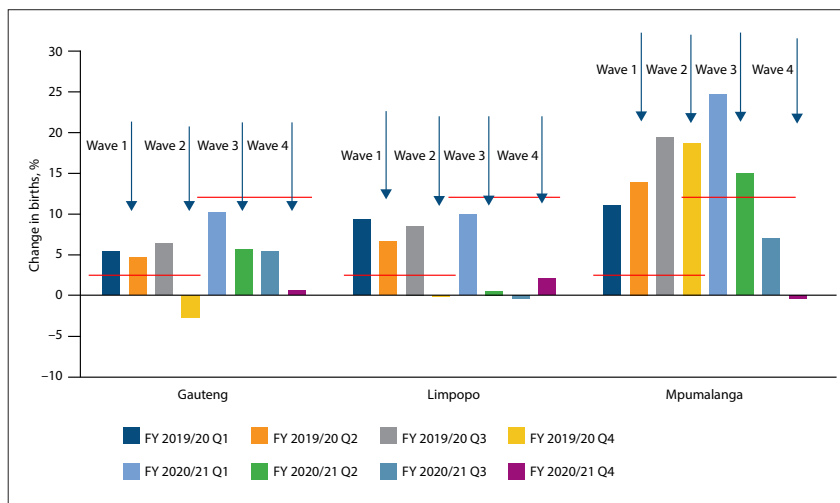


Fig. 10. Migration of pregnant women in the time of COVID-19, illustrated by an urban province (Gauteng) and two rural provinces (Limpopo and Mpumalanga). (FY = financial year; Q = quarter.)

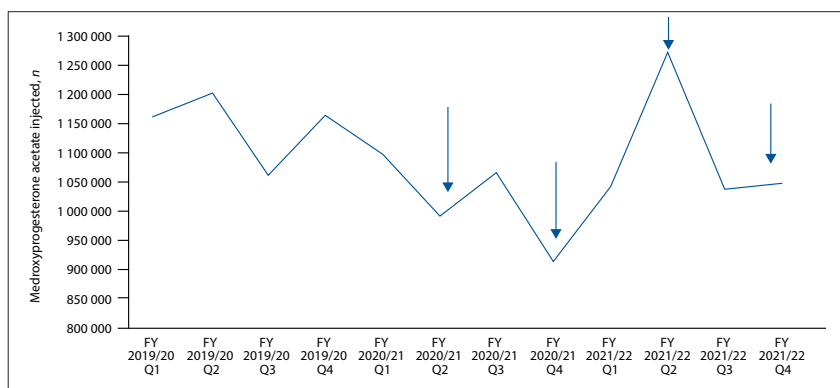


Fig. 11. Medroxyprogesterone acetate injected per quarter. (FY = financial year; Q = quarter.)

Termination of pregnancy

TOPs showed marked reduction during the restrictive lockdown and first COVID wave, and another dip in the second wave (Fig. 15). They started to increase from the first quarter of 2021/2022 after the second wave, and were higher than pre-COVID levels by the fourth quarter, during the fourth wave.

Discussion

Both the DHIS and NCCEMD report a marked increase in iMMR in the 2 worst years of the COVID pandemic (2020 and 2021), but it returned to pre-pandemic levels in 2022, due to vaccination, population immunity and lesser virulence of the Omicron variant. Although DHIS is a routine data collection

system that may under-report and lack the rigour of focused research, it nevertheless provided very useful information for assessing impact on maternal/perinatal outcomes and service utilisation in a timeous manner. The NCCEMD data sets were delayed during the pandemic due to human resource and reporting constraints. They confirm the trends in maternal mortality, but also provide information on clinical cause of the excess maternal mortality observed during the pandemic, and avoidability.

NPRIs were markedly increased in 2020 - 2022 compared with the previous triennium, accounting for 29.1% of all maternal deaths. COVID-19 pneumonia and complications constituted the majority of these NPRI deaths in 2020 and 2021, showing a direct effect of COVID-19 on maternal mortality. However, the marked increase in haemorrhage deaths in these 2 years suggests an indirect or collateral effect, as evidenced by the doubling of interfacility transport problems and four-fold increase in lack of availability of blood. These latter problems are reflected by the increase in administrative avoidable factors in the 2020 - 2022 triennium.

The lack of increase in patient/community and healthcare provider avoidable factors illustrates the resilience of these parts of the health system. Unfortunately, it was in areas of health system management such as transport and blood supplies that the system suffered. This is the area where special attention needs to be applied so that healthcare managers will have the capacity to manage such a healthcare crisis in the future.

The INTERCOVID surveillance system review^[8] and other COVID maternal and perinatal surveillance have shown increases in MMR ranging from 8.0 to 61.7% during the pandemic.^[9-13] These findings confirm the accuracy of the modelling estimates by Robertson *et al.*,^[1] which predicted 8 - 38% increases in MMR if maternal and reproductive health services were not maintained.

Perinatal mortality: SBRs increased during the FYs 2020/2021 and 2021/2022, but early neonatal deaths did not show change. The 10% increase in perinatal mortality rate in the 2 000 -2 499 g category shown in the PPIP data could possibly be explained by a larger number of babies with late-onset growth restriction during the COVID waves, or that there was an increase in the number of late preterm deliveries with less access to supportive healthcare than before. It remains speculative if these smaller/lower birthweight babies were delivered to women who survived COVID-19.

The *South African Health Review* article^[2] suggested reasons for the observed increases

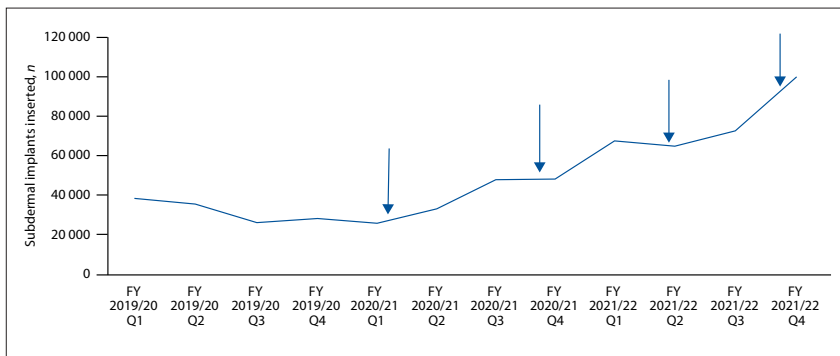


Fig. 12. Subdermal implants inserted per quarter. (FY = financial year; Q = quarter.)

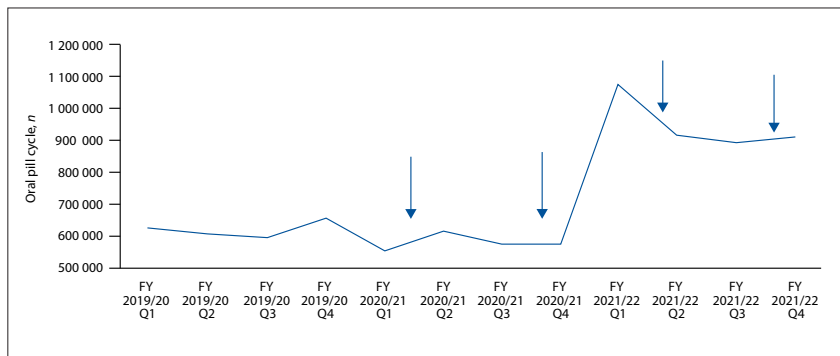


Fig. 13. Oral pill cycle per quarter. (FY = financial year; Q = quarter.)

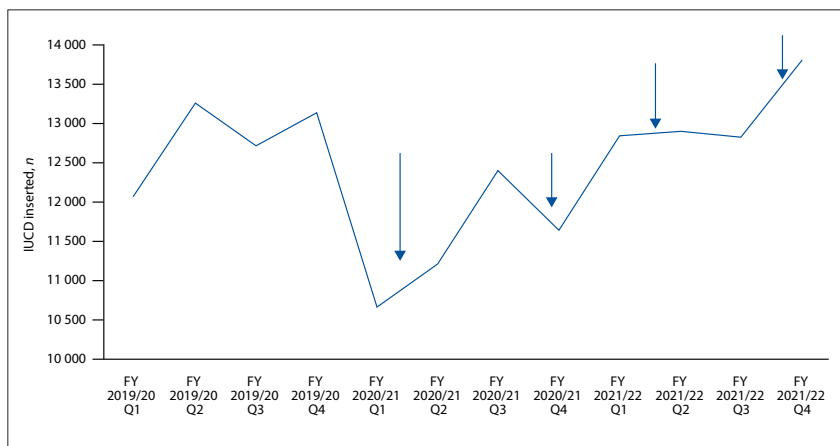


Fig. 14. Intrauterine contraceptive device (IUCD) inserted per quarter. (FY = financial year; Q = quarter.)

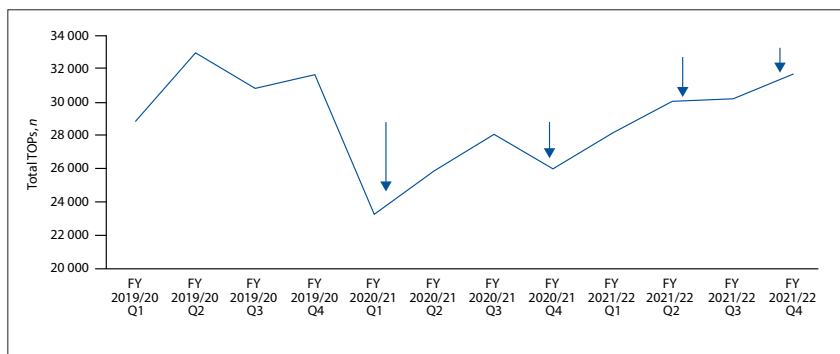


Fig. 15. Terminations of pregnancy (TOPs) per quarter. (FY = financial year; Q = quarter.)

in maternal and perinatal mortality for the FY 2020/2021, which were probably also factors in the first three quarters of FY

2021/2022. COVID-19 was a new condition, and services had to respond quickly to optimal management. In particular, doctors

and nurses working in maternity needed to upskill to manage severe respiratory illness in their wards and use high-flow nasal oxygen. Staffing levels and intensive care were severely limited owing to diversion of staff to COVID wards, staff sickness and quarantine. Dedicated maternity COVID areas or wards were seen to offer the best service model. It would be expected that clinical management had improved by the FY 2021/2022, but in Q2 the MMR was at its highest, related to the virulence of the Delta variant and possible burnout of staff. The subsequent decline was multifactorial, as described above.

Several publications have described the negative impact of the pandemic and associated restrictions on mental health of pregnant women and also healthcare providers, and on gender-based violence.^[14,15] Two publications from SA have also described similar findings for healthcare providers.^[16,17]

Apart from during lockdown, women continued to attend for antenatal care and facility delivery. The profound effect on contraception and TOP services during the pandemic needs to be mitigated against in future pandemics, with such services being classified as essential.

Conclusion

The COVID-19 pandemic had a marked direct and indirect effect on maternal and perinatal mortality. Maternal, perinatal and reproductive health services for pregnant women and newborns came under severe stress, and it is this aspect that must be addressed in future to mitigate the effects of future health crises. The return of outcome measures from 2022 to pre-pandemic levels is encouraging, and suggests some resilience of both the health system and pregnant women's health-seeking behaviour.

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