

Marked variability in institutional deliveries and neonatal outcomes during the COVID-19 lockdown in Nigeria

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Background: The coronavirus disease 2019 (COVID-19) pandemic and the interventions to mitigate its spread impacted access to healthcare, including hospital births and newborn care. This study evaluated the impact of COVID-19 lockdown measures on newborn service utilization in Nigeria.

Methods: The records of women who delivered in hospitals and babies admitted to neonatal wards were retrospectively reviewed before (March 2019–February 2020) and during (March 2020–February 2021) the COVID-19 pandemic lockdown in selected facilities in Nigeria.

Results: There was a nationwide reduction in institutional deliveries during the COVID-19 lockdown period in Nigeria, with 14 444 before and 11 723 during the lockdown—a decrease of 18.8%. The number of preterm admissions decreased during the lockdown period (30.6% during lockdown vs 32.6% pre-lockdown), but the percentage of outborn preterm admissions remained unchanged. Newborn admissions varied between zones with no consistent pattern. Although neonatal jaundice and prematurity remained the most common reasons for admission, severe perinatal asphyxia increased by nearly 50%. Neonatal mortality was significantly higher during the COVID-19 lockdown compared with pre-lockdown (110.6/1000 [11.1%] vs 91.4/1000 [9.1%], respectively; $p=0.01$). The odds of a newborn dying were about four times higher if delivered outside the facility during the lockdown ($p<0.001$).

Conclusions The COVID-19 lockdown had markedly deleterious effects on healthcare seeking for deliveries and neonatal care that varied between zones with no consistent pattern.

Keywords: COVID-19, healthcare utilization, health lockdown, newborns, Nigeria, pandemics

Introduction

Severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) was identified in humans in Wuhan, China, in late December

2019.^{1,2} A global pandemic was declared by the World Health Organization in March 2020. Widely used preventive measures included social distancing, the use of face masks, hand washing and alcohol-based hand sanitizers.³ Also, restrictive partial or

total lockdowns were instituted in many countries to break the transmission cycle.³ Although effective in curtailing transmission, lockdowns adversely affected economies⁴ and the outcomes of non-COVID-19-related illnesses.^{5,6} Lockdowns may have significantly reduced preterm births in some high-income countries.⁷⁻⁹ In contrast, adverse effects on institutional delivery and neonatal outcomes have been reported in low- and middle-income countries (LMICs).^{10,11}

Nigeria had a very high fertility rate, at 37/1000 births in 2019, but the effect of COVID-19 lockdown on the fertility rate has not been established.¹² The COVID-19 lockdown and curfews in Nigeria were imposed in March 2020 and were gradually eased in phases from May 2020 until February 2021.^{13,14} During lockdown, there were restrictions on movements, economic activities and social gatherings. Schools, offices, markets, religious houses and businesses were shut down.^{12,13} Individuals who tested positive for COVID-19 were quarantined in designated hospitals and hospitals that unknowingly admitted COVID-19-positive cases were shut down and decontaminated. People became afraid of visiting hospitals for fear of contracting the infection.¹⁵ Many health facilities had to rearrange their workflow and how COVID-19 and non-COVID-19 patients, including newborn infants, were attended to.^{16,17}

We reported previously that the lockdown markedly reduced institutional delivery at the Lagos University Teaching Hospital, but with no significant reduction in preterm birth.¹⁷ Here we report changes in institutional deliveries, stillbirths, neonatal admissions, newborn illnesses and outcomes in eight tertiary hospitals in Nigeria's six geopolitical zones.

Methods

Study design

This was a retrospective review of case records for deliveries and admissions to inborn and outborn neonatal wards.

Setting

The study was conducted in eight tertiary hospitals purposively selected to represent the six geopolitical zones in Nigeria: South West (Lagos University Teaching Hospital, Lagos, and University College Hospital, Ibadan); North West (Ahmadu Bello University Teaching Hospital, Zaria), North East (University of Maiduguri, Maiduguri), South East (University of Nigeria Teaching Hospital, Enugu; Alex Ekwueme Federal University Teaching Hospital Abakaliki, Abakaliki), North Central (Maitama District Hospital, Abuja) and South South (Federal Medical Centre, Asaba). All the hospitals provide specialist neonatal care and admit sick newborns from their delivery wards to inborn neonatal wards. The hospitals also serve as referral centres for general hospitals, maternity homes and private hospitals and admit these infants into outborn neonatal wards, which may or may not be separate from the inborn unit.

Study populations

The study populations were mothers who delivered in the facilities and babies who were admitted to the neonatal wards before

(March 2019–February 2020) and during (March 2020–February 2021) the COVID-19 pandemic lockdown. There were no exclusion criteria.

Outcomes

The frequency of institutional deliveries and stillbirths, gestation at delivery, age at admission, diagnoses and outcomes in newborns were compared before and during the lockdown according to geopolitical zone. Stillbirth in this study is defined as a dead foetus ≥ 1000 g or a baby born with no signs of life at or after 28-weeks gestation.^{18,19}

Data collection and analysis

Demographic, clinical and outcome data were collected from the admission registers from labour wards, emergency rooms and inborn and outborn neonatal wards. Each participating hospital contributed fully anonymized data (Excel or Access, Microsoft, Redmond, WA, USA) to the central Excel database hosted by the principal investigator and the statistician. Each neonatal unit (NNU) had access to its own data and could access data from other NNUs with appropriate approval. Data were analysed using Stata version 16 (StataCorp, College Station, TX, USA). Frequencies and percentages were generated for categorical data and differences between pre-lockdown and lockdown periods were assessed using the χ^2 test. For continuous data, means and standard deviations (SDs) were calculated for normally distributed variables and median and interquartile range (IQR) for skewed data and compared pre- and during lockdown by Student's t-test and the Mann–Whitney U test, respectively. Kaplan–Meier survival analysis was used to estimate the difference in survival times between the two periods and p-values < 0.05 were considered statistically significant.

Results

Institutional deliveries pre-lockdown were 14 444 but decreased to 11 723 during lockdown (a decrease of 18.8%; Figure 1). A decrease in the number of deliveries occurred in all six zones but varied markedly, from 9.7% in the North Central zone to 28.4% in the South West (Figure 2 and Table 1). The mean maternal age was similar pre-lockdown (26.9 ± 12.5 y) and during lockdown (25.5 ± 9.4 years; $p = 0.40$). Thirty-five mothers died during the study period, with a maternal mortality rate of 173/100 000 live births pre-lockdown and 85/100 000 live births during lockdown, but the difference was not statistically significant ($p = 0.078$).

Overall, the number of stillbirths decreased from 926 to 798 (a decrease of 13.8%; Figure 1) but ranged from a 33% decrease in the North West to a 14.8% increase in the South South zone (Figure 2 and Table 1). The stillbirth rate was similar pre- and during lockdown (64.1 and 68.1/1000 births, respectively; $p = 0.21$). Neonatal admissions showed a marked overall decrease from 4988 to 2875 (a 42.4% decrease; Figure 1) but with marked variability between zones, ranging from a decrease of 89.3% in the South South to an increase of 20.7% in the North East (Figure 2 and Table 1).

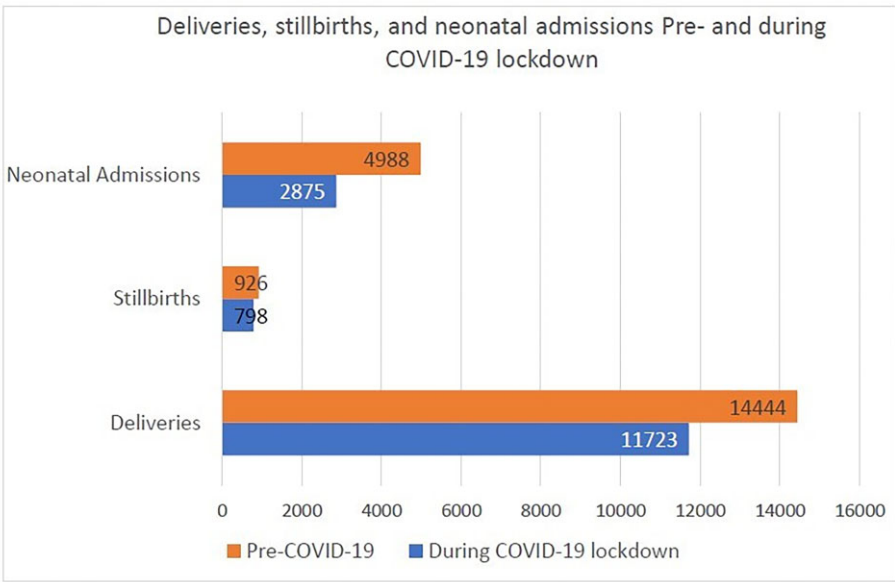


Figure 1. Deliveries, stillbirths and neonatal admissions before and during the COVID-19 lockdown in Nigeria, 2020–2021.

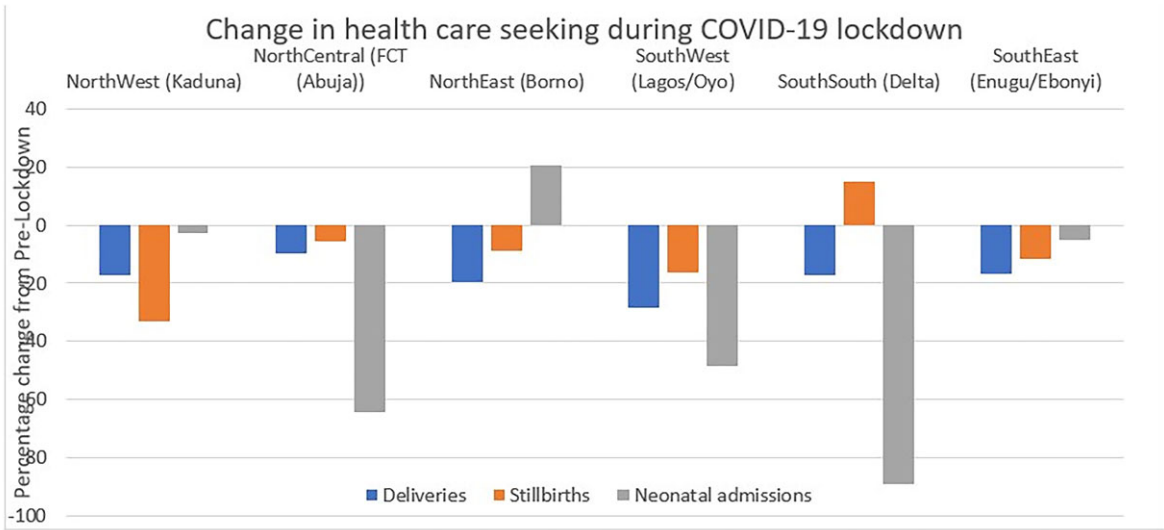


Figure 2. Changes in healthcare seeking according to region before and during COVID-19 lockdown in Nigeria, 2020–2021.

There was a marked decrease in admissions during lockdown for both inborn (−35.6%) and outborn (−41.0%) babies, with a greater decrease in the number of outborn vs inborn admissions ($p<0.00001$). However, the change in the number of inborn vs outborn admissions varied markedly between zones, with no consistent pattern (Table 2). Both inborn and outborn admissions decreased in three zones (North Central, South South and South West), both increased in one zone (North-East) and inborn admissions increased but outborn decreased in two zones (North West and South East; Table 2).

Neonatal admission characteristics and outcomes

The mean gestational age at admission was slightly higher during lockdown than pre-lockdown ($p=0.03$; Table 3). This difference occurred in both inborns and outborns but was of borderline statistical significance. When classified according to prematurity (gestation <37 weeks), there was a greater proportion of preterm infants among inborns during than pre-lockdown, but this was not statistically significant ($p>0.05$). Consistent with increased gestational age, there was a marked increase in birthweight for both in- and outborn infants during

Table 1. Deliveries, stillbirths and neonatal admissions according to zones before and during COVID-19 lockdown in Nigeria, 2020–2021

Zone	State	Deliveries			Stillbirths			Neonatal admissions		
		Pre-lockdown	Lockdown	Difference (%)	Pre-lockdown	Lockdown	Difference (%)	Pre-lockdown	Lockdown	Difference (%)
North West	Kaduna	1800	1486	−17.4	197	132	−33.0	744	725	−2.6
North Central	FCT (Abuja)	1887	1704	−9.7	55	52	−5.5	236	84	−64.4
North East	Borno	3282	2643	−19.5	199	181	−9.0	353	426	20.7
South West	Lagos/Oyo	2732	1957	−28.4	180	151	−16.1	1760	906	−48.5
South South	Delta	1901	1570	−17.4	81	93	14.8	1266	136	−89.3
South East	Enugu/Ebonyi	2842	2363	−16.9	214	189	−11.7	629	598	−4.9
Total		14 444	11 723	−18.8	926	798	−13.8	4988	2875	−42.4

FCT: Federal Capital Territory.

Table 2. Inborn and outborn neonatal admissions according to zones before and during COVID-19 lockdown in Nigeria, 2020–2021

Zone ^a	Inborn			Outborn		
	Pre-lockdown	Lockdown	Difference (%)	Pre-lockdown	Lockdown	Difference (%)
North West	279	336	20.4	446	377	−15.5
North Central	167	65	−61.1	57	17	−70.2
North East	172	187	8.7	174	223	28.2
South West	633	365	−42.3	1122	510	−54.6
South South	500	45	−91	299	26	−91.3
South East	254	293	15.4	363	298	−17.9
Total	2 005	1 291	−35.6	2 451	1 425	−41.0

^aPlace of delivery was unknown for 31 deliveries in the North West (19 pre-/12 during lockdown), 14 (12/2) in the North Central, 23 (7/16) in the North East, 36 (5/31) in the South West, 532 (467/65) in the South South and 19 (12/7) in the South East.

compared with pre-lockdown ($p < 0.01$). Age at admission was lower in inborns than outborns and was similar pre- and during the lockdown.

The frequency of common diagnoses changed significantly pre- and during lockdown (Table 4). Compared with pre-lockdown, neonatal jaundice was less common ($p = 0.02$), but sepsis ($p < 0.01$) and severe perinatal asphyxia ($p < 0.01$) were more common during lockdown.

A greater proportion of outborn babies required respiratory support during lockdown ($p = 0.01$). The mean duration of hospital stay for surviving inborn and outborn babies was similar before and during lockdown. However, case fatality was significantly higher during lockdown compared with pre-lockdown (110.6/1000 admissions vs 91.4/1000, respectively; $p = 0.004$). This was due to increased mortality among outborn infants, which increased from 5.6% pre-lockdown to 8.5% during lockdown ($p < 0.0001$). Mortality was four times higher among the outborn babies compared with the inborns during the COVID-19 lockdown ($p < 0.001$; Table 4).

Kaplan–Meier survival curves for the length of hospital stay in babies who were discharged were similar pre- and during lock-

down for both inborn and outborn babies (Figure 3). However, in-hospital survival was lower in both inborn and outborn babies during vs pre-lockdown (logrank test; $p = 0.01$; Figure 3).

Discussion

Our findings reveal a marked decline in institutional deliveries and newborn admissions as well as increased morbidity and mortality among newborns during compared with pre-lockdown. Another striking feature was the marked variability between zones in the changes in the numbers of deliveries, stillbirths and neonatal admissions.

Overall, stillbirths declined by 13.8% during lockdown, with marked variation such that the number of stillbirths increased in the South South zone (14.8%) while in the North West they decreased by 33.0%. Our findings are consistent with a study in Iran that recorded a decline or no change in stillbirths during lockdown²⁰ but contrast with a study from Nigeria²¹ and a meta-analysis that found a significantly increased risk of stillbirth during lockdown (relative risk 1.33 [95% confidence interval 1.04 to

Table 3. Newborn characteristics on admission before and during lockdown for COVID-19 in Nigeria, 2020–2021

Parameter	Pre-lockdown (n=4988)	Lockdown (n=2875)	p-Value
Gestational age (weeks), mean (SD), n			
All	36.1 (4.0), 4005	36.4 (3.4), 2472	0.03
Inborn	35.5 (4.1), 1884	35.8 (3.6), 1226	0.02
Outborn	37.0 (3.5), 1811	37.1 (3.3), 1161	NS
Preterm birth (<37 weeks), n (%)			
All	1491 (30.0)	854 (29.7)	NS
Inborn	911 (18.3)	571 (19.9)	NS
Outborn	453 (9.1)	251 (8.7)	NS
Birthweight (g), median (IQR), n			
All	2100 (1500–3000), 3043	2590 (1750–3200), 1953	<0.01 ^a
Inborn	1900 (1400–3000), 1912	2400 (1600–3200), 1229	<0.01 ^a
Outborn	2500 (2100–3200), 1131	2700 (2175–3250), 724	<0.01 ^a
Age at admission (hours), median (IQR), n			
All	4 (1–48), 4429	3 (1–27), 2731	NS ^a
Inborn	1 (1–3), 1997	1 (1–3), 1287	NS ^a
Outborn	24 (3–96), 2432	23 (3–96), 1444	NS ^a

NS: not significant; IQR: interquartile range.

^aMann–Whitney test.**Table 4.** Admission diagnoses, administration of respiratory support and outcomes before and during lockdown for COVID-19 in Nigeria, 2020–2021

Parameter	Pre-lockdown (n=4988)	Lockdown (n=2875)	p-Value
Common diagnoses, n (%) ^a			
Neonatal jaundice	2143 (43.0)	1157 (40.2)	0.01
Inborn	785 (15.7)	475 (16.5)	NS
Outborn	1194 (23.9)	654 (22.7)	NS
Prematurity			
Inborn	911 (18.3)	571 (19.9)	NS
Outborn	453 (9.1)	251 (8.7)	NS
Sepsis	361 (7.2)	402 (14.0)	<0.001
Inborn	137 (2.7)	211 (7.3)	<0.001
Outborn	105 (2.1)	179 (6.2)	<0.001
Severe perinatal asphyxia	187 (3.8)	183 (6.4)	<0.001
Inborn	87 (1.7)	85 (3.0)	0.001
Outborn	97 (1.9)	95 (3.3)	<0.001
CPAP administered, n (%)			
Inborn	602 (12.1)	320 (11.1)	NS
Outborn	297 (5.9)	240 (8.3)	<0.001
Length of hospital stay (days), median (IQR), n			
All	6 (3–10), 3570	6 (3–10), 2642	NS ^b
Inborn	5 (3–10), 1730	5 (3–10), 1289	NS ^b
Outborn	6 (4–10), 1840	6 (4–10), 1353	NS ^b
Mortality, n (%)			
All	456 (9.1)	318 (11.1)	0.004
Inborn	116 (2.3)	61 (2.1)	NS
Outborn	281 (5.6)	246 (8.5)	<0.001

CPAP: continuous positive airway pressure; NS: not significant.

^aSome babies had more than one diagnosis.^bMann–Whitney test.

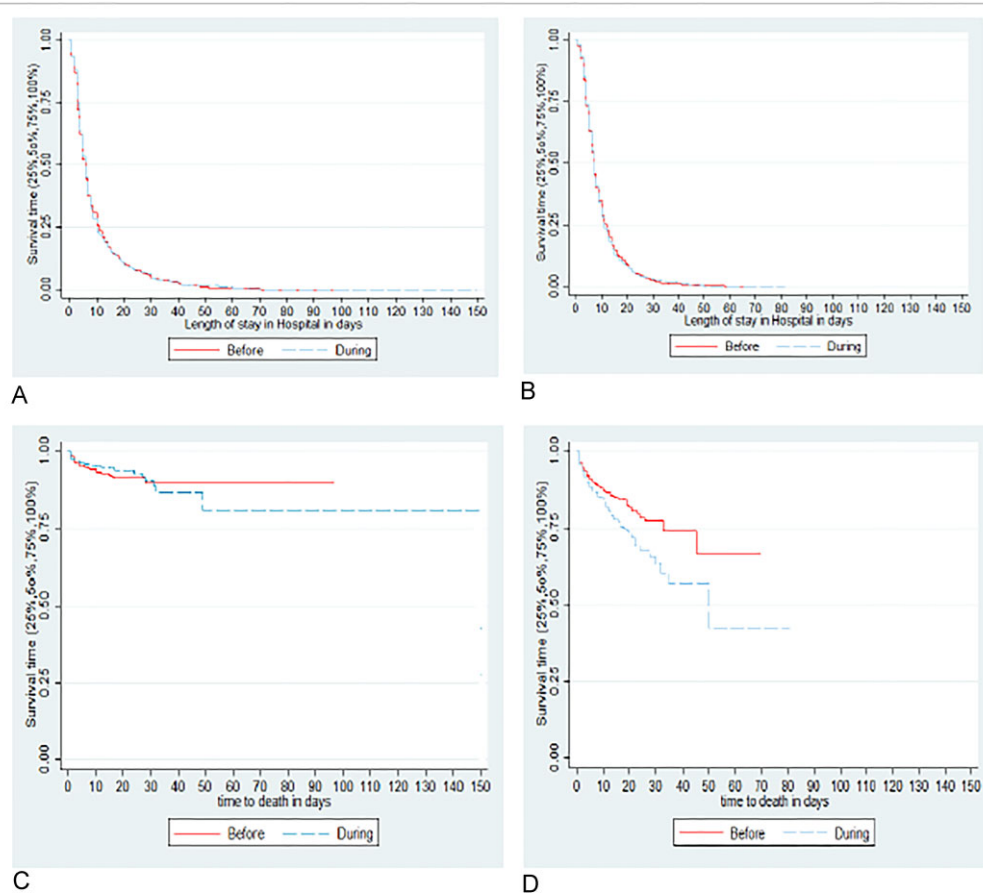


Figure 3. Kaplan–Meier in-hospital survival curves for the length of hospital stay in survivors and time to death before and during lockdown in Nigeria, 2020–2021. (A) Length of hospital stay in inborns ($\chi^2=0.04$; $p=0.84$). (B) Length of hospital stay in outborns ($\chi^2=0.05$; $p=0.82$). (C) Time to death in inborns ($\chi^2=0.56$; $p=0.45$). (D) Time to death in outborns ($\chi^2=11.76$; $p<0.01$).

1.69]).²² Stillbirth, a sequela of complicated pregnancy or labour, is associated with delayed presentations and poor-quality care.²³ Stringent lockdown measures applied in most zones in Nigeria may therefore have prevented pregnant women from accessing healthcare facilities due to restrictions on vehicular movement.²⁴ Where available, transport fares were exorbitant, coupled with markedly reduced incomes for families.⁵ Therefore, our overall finding likely reflects reduced attendance at facilities rather than a reduced stillbirth rate in the population.

We found a marked decrease of 18.8% in institutional deliveries during lockdown. Nigeria has one of the highest proportions of unsupervised deliveries globally, with 61% occurring outside a health facility and without a qualified, skilled birth attendant in 2018.^{25,26} As with stillbirths, lack of affordable transport may have increased deliveries at home or at birthing homes with unskilled birth attendants, putting both mother and baby at risk of poorer outcomes.^{27,28} The marked variation between zones in the decrease in the number of deliveries suggests that the implementation of lockdown measures and/or alternative options for delivery varied between zones. Marked variability of the effects of lockdown even within countries has been reported recently.²⁹

Newborn admissions decreased markedly during lockdown (42.4%) and were greatest in the South West and North Central zones, which bore the brunt of the COVID-19 pandemic^{30,31} and had the strictest lockdown measures in Nigeria.^{13,14} Again reflecting the variability between zones, a surge in newborn admissions was noted in the North East zone, already ravaged by a humanitarian crisis, with 60% of health facilities not functioning, while the teaching hospital remained open to patients.³²

Our data also showed a modest increase in the gestational age of newborns admitted during lockdown. Although markedly fewer preterm deliveries during lockdown have been reported from some high-income countries,^{7–9} this has not been observed in LMICs,^{17,22} including in a previous study in Lagos, Nigeria,¹⁷ except for a single-centre observational study in Uganda that reported a decrease in outborn preterm admissions during lockdown.³³ The increase in gestational age on admission is worrying, as it may reflect reduced healthcare seeking following preterm delivery during lockdown. However, it is well recognised that the accuracy of gestational age assessment in LMICs is problematic, as many women do not have access to early antenatal scans during pregnancy.³⁴ Therefore the increased gestational

age is likely to be linked to the observed increase in birthweight in both inborn and outborn infants during lockdown.

The frequency of neonatal morbidities among hospitalised infants differed during lockdown vs pre-lockdown. The striking increase in neonatal sepsis during lockdown may reflect women delivering outside of facilities despite having risk factors for infection and increased newborn exposure to infection in non-institutional deliveries. The similar numbers of admissions with severe perinatal asphyxia in the two periods suggest that deficiencies in access to quality maternal and newborn healthcare services preceded the lockdown,³⁵ thus predisposing infants to this adverse outcome that the lockdown restrictions are likely to have exacerbated, where many may not have been able to access neonatal care services. However, babies with illnesses that may have been perceived as less severe by parents/caregivers, such as jaundice and mild respiratory distress, may not have attended tertiary facilities for care.

Although the mean length of hospital stay among survivors was similar before and during lockdown, consistent with the increased severity of illness, case fatality among newborn admissions was significantly higher during lockdown due to increased mortality in outborn babies. The odds of a newborn dying during lockdown were about four times higher in outborn vs inborn babies ($p < 0.001$). Case fatality during lockdown was very high (9.8/100 newborn admissions) and increased despite the modest increase in gestational age and marked increase in birthweight. Okeke et al.²¹ noted that delayed care seeking might have increased mortality during the COVID-19 pandemic. Likewise, the high mean age at admission in our outborn babies likely indicates that delayed healthcare seeking contributed to the high mortality, considering that the four most typical morbidities (prematurity, sepsis, neonatal jaundice and severe perinatal asphyxia) require early and appropriate interventions.³⁶

Our findings highlight the need for mitigation measures to maintain appropriate care seeking for deliveries and sick newborns during lockdown. The effects of lockdown on the healthcare-seeking indices that we assessed varied markedly between zones, with no consistent pattern. In addition to how strict restrictions are applied, many other factors likely contribute to healthcare seeking during lockdown, making the effects of lockdown unpredictable for individual facilities and the populations they serve.

Strengths and limitations

The inclusion of centres from each of the geopolitical zones in Nigeria resulted in the inclusion of a large number of deliveries and neonatal admissions and revealed the marked differences in the effects of the COVID-19 lockdown restrictions in the different zones. However, our study was limited to tertiary facilities, therefore our findings may not be generalisable to healthcare seeking and outcomes at other health service levels. In addition, the retrospective nature of this study resulted in some missing information in case records, especially for the place of birth. We only report stillbirths, neonatal morbidities and mortality occurring in the tertiary centres engaged in the study, so we cannot comment on the effects of lockdown at the population level in the six zones. Finally, we did not test for COVID-19 infection, so we cannot determine its direct effects on newborns.

Conclusions

Overall, the COVID-19 lockdown had a markedly deleterious effect on healthcare seeking for deliveries and sick newborns in tertiary facilities in Nigeria. The higher case fatality was likely due to increased neonatal sepsis and more unwell babies being brought for care very late. The effects of lockdown on the healthcare-seeking indices that we assessed varied markedly between zones, with no consistent pattern. This highlights that, in addition to how strictly lockdown measures are applied, many other factors likely contributed to healthcare seeking, making the effects of lockdown unpredictable. This study contributes to the ongoing conversation concerning the toll the COVID-19 pandemic had and continues to have on populations in LMICs and the mitigation measures required to maintain appropriate healthcare seeking and services for mothers and their newborns during future pandemics with similar restrictions.

Authors' contributions: BNE and SA conceived the study. BNE, IBF, AI, VCE, SP, OE and SA designed the study protocol. BNE, IBF, SP, OE, KI, UD, TO, AI, OAA, OK, DN, OC, OE, DO, AA, NO, BJD, HL, AF, MA and UN extracted the data from medical records. AI, BNE and SA carried out data analysis and interpretation. BNE, IBF, HMN and SA drafted the manuscript. All authors read and approved the final manuscript. BNE and SA are guarantors of the paper.

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Competing interests: None declared.

Ethical approval: Ethical approvals were obtained from the Health Research and Ethics Committees of all the participating institutions and the National Health Research Ethics Committee of Nigeria (approval NHREC/01/01/2007-03/08/2021). Informed consent was not required for retrospective data collection.

Data availability: The authors confirm that the data supporting the findings of this study are available within the manuscript.

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