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Maternal and Foetal Outcome among Pregnant Women Infected with COVID-19 in Three Referral Hospitals in Cameroon

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Abstract

Introduction: Pregnancy is generally known to be an immune compromised state, thus placing pregnant women at risk of SARS-COV-2 infection. We therefore carried out this study to assess the maternal and foetal outcomes among pregnant women infected with COVID-19 in three referral hospitals in Cameroon. **Methodology:** This was a hospital-based retrospective case control study covering a two-year period. Data collection was done over a duration of four months at the Yaoundé Central Hospital, Douala Gynaeco-Obstetric and Paediatric Hospital and the Bamenda Regional Hospital. Cases were pregnant women who gave birth after a confirmed COVID-19 infection, matched 1:2 by age (±1 year) and parity (±1) to pregnant women not infected by COVID-19, who gave birth at the three hospitals within the same period. **Results:** The rate of caesarean section delivery among our cases was 52.4% as compared to 44.3% among controls (OR, 1.38, 95% CI, 0.74 - 2.60, P = 0.296). Maternal mortality rate in our cases was at 8.2% as compared to 6.6% in controls (OR, 1.60, 95% CI, 0.50 - 5.12, P = 0.422). The rate of preterm delivery in our cases was 24.6% as compared to 11.5% in the control group (OR, 2.39, 95% CI, 1.05 - 5.42, P = 0.025). Perinatal death rate in our study was recorded at 8.2% as compared to 3.4% in the controls (OR, 2.63, 95% CI, 0.68 - 10.18, PS = 0.162) **Conclusion:** Pregnant women infected with COVID-19 were found to have higher risks of preterm delivery and acute foetal distress as compared to pregnant women who were not infected. Caesarean section deliveries, maternal and foetal mortality were higher in COVID-19 infected pregnant women as compared to those not though these findings were not statistically significant.

Keywords

COVID-19, Pregnancy, Maternal, Foetal, Outcome

1. Introduction

1.1. Background

Coronavirus disease 2019 (COVID-19) is a novel acute respiratory disease caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) [1]. The case of this disease was reported in Wuhan China in December 2019. This rapidly triggered a global health emergency alert, with the disease spreading to many countries resulting in its declaration as a pandemic by the World Health Organisation (WHO) on the 12th of March 2020 [2]. Genomic sequencing of SARS-CoV-2 found that this virus is related to two other viruses: Severe acute respiratory syndrome coronavirus 1 (SARSCoV-1) and Middle East respiratory syndrome coronavirus (MERS-CoV) [3]. As of June 23, 2022 a total of 539,893,858 confirmed cases of COVID-19 including 6,324,112 deaths (occurring mostly in industrialised countries), 533,569,746 recoveries and a total of 11.9 billion vaccine doses administered worldwide have been recorded [1]. In Africa, 12,267,000 cases of COVID-19 have been confirmed, with about 255,000 reported deaths as of June 2022 [4]. In Cameroon, from January 3, 2020 to 23 June 2022, there had been 120,002 confirmed cases of COVID-19 with 1930 deaths reported and a total of 1.8 million doses of vaccine were administered [4].

Earlier on, many questions had been raised regarding the effects of COVID-19 on pregnant women, including whether pregnancy increased susceptibility to SARSCoV-2 infections, or whether pregnant women were more likely to have severe infections or increased adverse pregnancy and neonatal outcomes. Described prevalence of COVID-19 among the obstetric population varies by region, testing period during the pandemic, and testing methodology. Early reports by the Centres for Disease Control and Prevention (CDC) stated that COVID-19 positivity in pregnancy ranged from <1% to 19.9% [5]. In a study carried out in 2020 in Douala, Cameroon, the prevalence of COVID-19 among pregnant women was 6%, representing 2.3% of all COVID-19 cases [6].

A high-quality systematic review and meta-analysis in 2021 found increased risk of preeclampsia, preterm delivery, gestational diabetes, low birth weight and still birth amongst pregnant women infected with COVID-19 than in pregnant women who were not infected [7] [8] [9] [10] [11]. Increased caesarean section rates, hypertensive disorders of pregnancy, premature rupture of membranes, maternal mortality, prematurity, foetal distress, neonatal asphyxia, neonatal deaths, are also commonly reported adverse pregnancy outcomes [12].

A retrospective study carried out in South Africa in 2021 on the clinical features and outcome of COVID-19 infection among pregnant women reported that; 53% of the women presented with COVID-19 related symptoms, with pre-

term labour, increased caesarean sections and maternal exhaustion as most common maternal outcome, while adverse foetal outcomes though less frequent, were represented mainly by fatal distress, prematurity, neonatal asphyxia, macerated still births, and neonatal deaths [13].

In Cameroon, a study carried out in Douala titled: *Materno-Foetal Outcomes of COVID-19 Infected Pregnant Women Managed at the Douala Gynaeco-Obstetric and Paediatric Hospital—Cameroon* reported preterm labour, maternal respiratory distress, caesarean section deliveries as the most common adverse maternal outcome while prematurity and neonatal asphyxia were the most encountered adverse foetal outcome [6]. A similar study carried out in 2020 in Yaoundé for three months titled: *Maternal and foetal outcomes of COVID-19 pregnant women followed up at a tertiary health unit* found no significant association between the occurrence of severe COVID-19 pneumonia and unfavourable prognosis in pregnancy [14].

Outcome of pregnancy among women infected with COVID-19 remain an area of ongoing research due in part to the imprecise nature of results published. Thus, more probing for knowledge in this vast area of research will improve anticipation and awareness of adverse pregnancy outcome and hence better preparedness to improve prognosis.

1.2. Problem Statement

The ongoing COVID-19 pandemic has been declared to have a poorer prognosis among people with underlying comorbidities such as hypertension, diabetes, obesity and now immune depressed states such as pregnancy [14]. Knowledge lapses existing in our setting hinder the formulation of standard follow up procedures and protocols that may prevent adverse pregnancy outcomes related to COVID-19 infection.

1.3. Justification

To the best of our knowledge, a limited number of studies on COVID-19 have been published in Cameroon evaluating maternal and foetal outcome among COVID-19 infected pregnant women. The first study was a descriptive study carried out over a period of three months, with 56 % of the study population having an ongoing pregnancy and at the end of the study [14]. The second study was a descriptive-cross sectional study carried out over a period of 4 months with 27.7% of the study population having an ongoing pregnancy at the end of the study [6].

The limited sample sizes and short duration of study in the above-mentioned studies creates a restrain on the generalizability of their conclusions. Moreover, lack of comparison groups in the existing studies makes it difficult to directly incriminate adverse pregnancy outcomes to COVID-19 infection. With the aim of overcoming some of this informative draw backs, this study titled—Maternal and foetal outcome among pregnant women infected with COVID-19 in three

Referral Hospitals in Cameroon, was done with a two-year period using a control group.

1.4. Research Questions

1) What is the impact of COVID-19 infection on maternal health?

2) What is the impact of maternal COVID-19 infection on the foetus?

3) How does the outcome of pregnancy vary between COVID-19 infected pregnant women and the non-COVID-19 infected pregnant women?

2. Materials and Methods

2.1. Study Design

This was a two-year hospital-based retrospective case control study.

2.2. Study Setting

The study was carried out at the Obstetrics and Gynaecology departments and departments for care of COVID-19 patients of some referral hospitals in Cameroon including; Yaoundé Central hospital, Bamenda Regional Hospital and the Douala Gynaecologic Obstetric and Paediatric Hospital.

Located in the Center Region in the Cite Vert' Health district, the Messa Health Area, the Yaoundé Central Hospital serves as one of the referral and teaching hospitals in Cameroon. The Obstetrics and Gynaecology unit of this referral hospital is composed; two common delivery rooms, room for residents, common and individual in-patient wards with an average capacity of 95 beds, four outpatient consultation boxes for obstetricians, emergency and intensive care, a family planning unit, archive, a conference room, three theatres, and neonatology. The services offered here run 24/7 by a highly qualified staff composed of: A Professor of Obstetrics and Gynaecology, seven specialist obstetricians and gynaecologists, a multitude of interns and residents, two general practitioners nurses, medical students and other paramedical staff. The department for care of COVID-19 infected patients in the YCH was instituted in August 2020. It consists of 8 hospitalisation units each with a capacity of about 2 beds, an office for the ward charges and an office for the doctors' consultation. Running of the service is under the supervision of the ward charge and two general practitioners but however being visited by several specialists in the hospital as need be.

Bamenda Regional Hospital. It is the biggest hospital in the Mezam Division of the Northwest Region of Cameroon. It is in the Azire Health Area of the Bamenda Health District. The study was carried out in the BRH maternity and the COVID-19 treatment centre of the hospital (solidarity ward), which is so far the only COVID-19 treatment centre in this Health district. The Solidarity Ward is composed of a single bloc with 23 hospitalization rooms and 25 beds used as follows: 21 isolation/hospitalization rooms containing a bed each and 2 rooms

allocated for the ICU each containing 2 beds. The others (asymptomatic and mild cases) are on home quarantine or ambulatory treatment. Pure oxygen, oxygen concentrators and pulse oximeters among other essential resources are available within the centre, the staff in this unit are comprised of a general practitioner, nurses and cleaner, who are supervised by a specialist.

The Douala Gynaeco-Obstetric and Paediatric Hospital. It is one of the referral hospitals in Littoral region located at Yassa with a very high patient turnover, dispenses high quality medical care, serves as educational support and promotes research. This hospital has four hospitalisation units: obstetrics and gynaecology, medicine, surgery and paediatrics, well equipped laboratory and radiology units and specialist clinicians. Added to that, it has a highly technical platform with specialised units like neonatology and intensive care.

The Obstetrics and Gynaecology department comprises of a hospitalisation ward that contains eight rooms containing 3 to 6 beds each and four private rooms containing 1 to 3 beds repartitioned for patients with; normal delivery, gynaecological pathologies, obstetrical pathologies, operated patients, an outpatient ward with 6 consultation boxes, a theatre and a room for celioscopy, six gynaecologists, nurses and midwives.

We chose the above hospitals because they are the main hospitals that receive and manage COVID-19 cases in pregnancy and sample size will easily be attained.

2.3. Study Population

Files of women who delivered in the above hospitals during the study period.

2.3.1. Inclusion Criteria

Files of pregnant women who gave birth after confirmed COVID-19 infection during the study period at the respective study sites to serve as cases. These are the groups that were confirmed positive after a COVID-19 test administered on them.

Files of non-COVID-19 infected pregnant women who gave who gave birth in the three hospitals in 2020 and 2021, as controls. Two controls were matched for each case by age (±1 year) and parity (±1). This group was the one that was administered COVID-19 test and after declared negative received their vaccination almost immediately.

2.3.2. Exclusion Criteria

Files of women that were referred to the three hospitals for obstetric and gynaecological emergencies.

2.4. Sampling of Participants

2.4.1. Sampling Method

Files were selected using exhaustive non-probability consecutive sampling method.

2.4.2. Sample Size Calculation

Sample size was calculated using the Schlesselman's formula for case-control studies.

$$n = \left(\frac{1+r}{r}\right)\left(\frac{\left((\bar{p})(1-\bar{p})(Z\beta + Z\alpha/2)\right)2}{(p1-p2)2}\right)$$

n = sample size

r = case control ratio (cases equal controls) = 1

$\bar{p} = (p1+p2)/2$ = median of proportions

$p1 - p2$ = difference in proportions

$Z\alpha/2$ = Standardized level of significance = 1.96

$Z\beta$ = Statistical power = 0.84

In a cross-sectional study done in Douala in 2020 [6], the rate of caesarean section in women infected with COVID-19 was 0.6 as compared to the controls with a rate of 0.3. Therefore, $\bar{p}$ = 0.45.

The ratio of cases controls was 1:2. The minimum sample size required was 43 cases for the those with COVID-19 before birth and 86 controls for those without and vaccinated.

2.5. Study Procedure

2.5.1. Ethical and Administrative Considerations

Before the onset of this study, ethical clearance was obtained from the Institutional Review Board of the Faculty of Health Sciences of the University of Bamenda and administrative authorization was obtained from the Dean of the Faculty of Health Sciences UBa. Administrative authorization to carry out the research in the North West region was obtained from the North West Regional Delegation of Public Health. An administrative authorization to carry out the research at the Obstetrics and Gynaecology Unit and the COVID-19 Treatment Centres were obtained from the Directors of BRH, YCH and DGOPH. Before obtaining information from the files, consent was sought from the ward charges of the various units.

2.5.2. Accessing Files and Participants

In the obstetrics and gynaecology departments we worked with the delivery registers. Registers were sorted according to years, after which files which corresponded to our study were identified. Sociodemographic, obstetrical and delivery information was recorded into the questionnaires. Patients with incomplete data were contacted for completion of the questionnaire.

In the COVID-19 treatment centres, files, home confinement registers or general registers were sorted according to year depending on the hospital, after which files that fit into our study were identified. Sociodemographic information was recorded into the questionnaires. Obstetrical history and delivery information was mostly gotten from phone calls.

All the files of COVID-19 infected pregnant women who had given birth

served as cases and the files of matched non COVID-19 infected pregnant women who had given birth during the study period were selected to serve as controls in a ratio 1:2. Information from each file was extracted into a questionnaire designed for this purpose and verified for completion. Patients whose files were incomplete were contacted through phone calls for completion of the questionnaire. Variables involved were mostly obstetric and delivery history. Prior to the foregone, verbal informed consent was obtained and confidentiality assured.

2.5.3. Study Variables

For each file, the following information was recorded:

Sociodemographic characteristics such as: age, region of origin, level of education, profession, marital status, and religion.

Medical characteristics such as: asthma, tuberculosis, hypertension, cardiac disease, diabetes mellitus, kidney disease, HIV, and cancer.

Obstetric characteristics such as: gravid formula, parity, number of antenatal consultations, intermittent preventive treatment for malaria (tetanus Vaccine status, oral iron, and calcium), history of any adverse pregnancy outcome (preterm labour, prolonged labour, premature rupture of membranes, antepartum haemorrhage) and gestational age at delivery.

Parity was defined as the number of pregnancies that evolved above 28 weeks.

Clinical characteristics. Fever, headache, asthenia, lower abdominal pains, difficulty breathing, anosmia, aguesia, chest pain, and cough.

Aguesia was defined as loss of ability to taste, and anosmia loss of ability to smell.

Maternal outcomes. Spontaneous abortion, preterm labour, mode of delivery (normal vaginal delivery, assisted vaginal delivery, caesarean section), indication for the mode of delivery (acute fetal distress, cephalopelvic disproportion, obstructed labour, previous scar, cervical dystocia, preeclampsia).

Foetal outcomes. Gender of neonate, birth weight, acute respiratory distress, intrauterine fetal demise, APGAR score at birth, hospitalization in neonatology unit (perinatal asphyxia, low birth weight, neonatal infection), COVID-19 test done on newborn and the result, live birth, stillbirth, neonatal demise.

2.6. Data Management and Analysis

Data collected were initially entered into questionnaires by the principal investigator, and then into a Microsoft excel version 2016 data base created for this purpose. It was analysed using statistical package for social sciences (SPSS) for windows version 27. Frequency tables were used to summarize descriptive and categorical variables, while mean, median, standard deviation, and inter-quartile range were used to represent continuous variables and results reported as per objective. Chi squared test was used to calculate p-values, with statistical significance set at <0.05.

3. Results

3.1. General Characteristics of the Study Population

We recruited a total number of 204 files at the beginning of our study: 68 cases and 136 controls. 7 cases (10.29%) were excluded alongside their corresponding 14 controls due to either incomplete files (didn't meet the inclusion criteria), ongoing pregnancy or inability to reach participant by phone call. We therefore retained 183 participants, 61 cases and 122 controls for analysis. All our cases were singleton pregnancies (**Figure 1**).

3.2. Sociodemographic Characteristics

Maternal age in our study ranged from 19 - 42 years. Majority of cases were in the age range of 25 - 34 years (59%). Mean age of study participants was 30.02 ± 5.9 (19 - 41) for cases and 30.2 ± 6.1 (19 - 42). Most of our cases (59.0%) and controls (60.6%) were married. A proportion of our cases were government employed (29.5%) while majority of controls were self-employed (35.2%). A majority of our cases (41.0%) and controls (23.0%) had university degree (**Table 1**).

We got most of our cases from the Bamenda Regional Hospital (37.7%), followed by DGOPH (32.8%) and the least number of cases from the YCH (29.5%) (**Figure 2**).

3.3. Obstetrical Profile of the Study Population

Majority of our cases were multiparous (80.3%). Mean gestational age at presentation was 37.05 ± 5.3 (10 - 43). A majority of our cases, >70% presented in the third trimester of gestation.

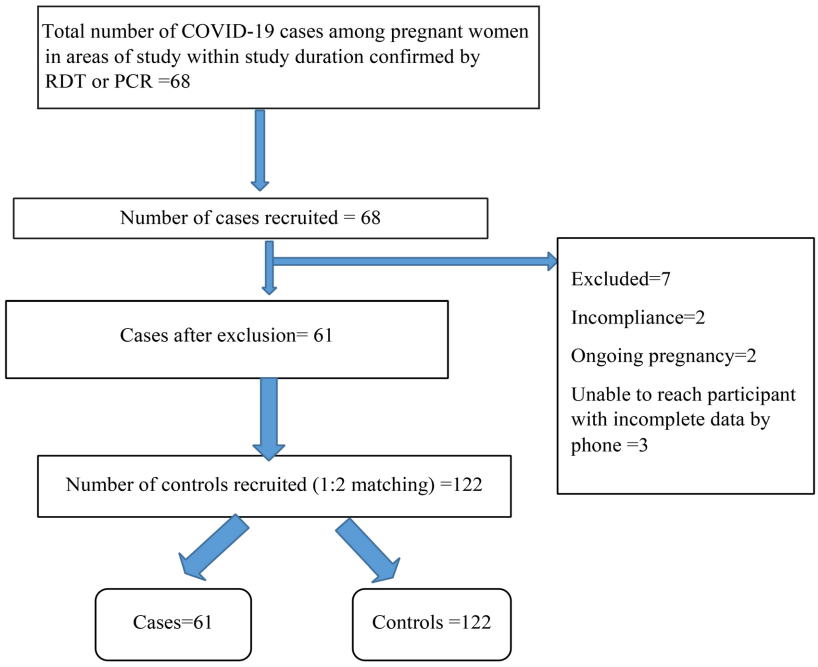

Figure 1. Flowchart of study participants.

Table 1. Sociodemographic characteristics of the study population.

C	Category	Cases		Controls	
		Absolute number	Percentage	Absolute number	Percentage
	15 - 24	13	21.3	25	20.5
	25 - 34	36	59.0	67	54.9
	35 - 45	12	19.7	30	24.6
Marital status	Single	18	29.5	34	27.9
	Married	36	59.1	74	60.7
	Divorced	1	1.6	2	1.6
	Cohabitation	6	9.8	12	9.8
Profession	Student	15	24.6	18	14.8
	Housewife	10	16.4	41	33.6
	Unemployed	1	1.6	1	0.8
	Government employed	18	29.5	19	15.6
	Nongovernment employed	17	27.9	43	35.2
Level of education	No formal schooling	11	18.0	30	24.6
	Primary	8	13.1	27	22.1
	Secondary	17	27.9	37	30.3
	University	25	41.0	28	23.0

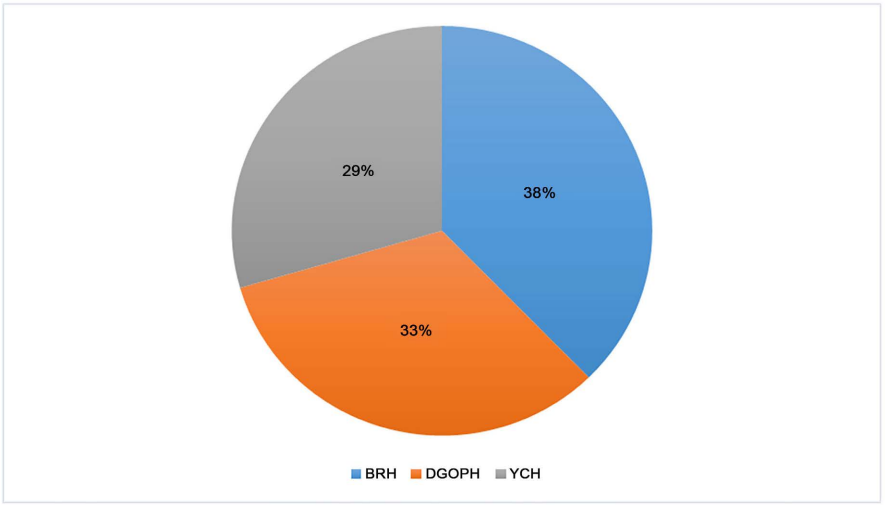

Figure 2. Distribution according to site of study.

68.9% of our cases and 73.8% of controls did not appropriately follow up their antenatal consultations according to the WHO recommendation. The number of antenatal clinics (ANCs) done is also shown on Table 2.

Table 2. Obstetrical characteristics of the study population.

Variable	Category	Cases		Controls	
		Absolute number	Percentage	Absolute number	Percentage
Parity	Primiparous	12	19.7	24	19.7
	Multiparous	49	80.3	98	80.3
Pregnancy (weeks) at diagnosis	<14 weeks	3	4.9	0	0
	15 - 28 weeks	7	11.5	2	1.6
	28 - 36 weeks	24	39.3	16	13.2
	≥37 weeks	27	44.3	104	85.2
Number of ANCS done	<8	42	68.9	90	73.8
	>8	19	31..3	32	26.2

3.4. Comorbidities in the Study Population

Hypertension had a highest odds ratio with a 95% confident interval 2.13 (0.51 - 8.84), followed by HIV, 1.50 (0.54 - 4.16) and diabetes mellitus 1.38 (0.22 - 8.50). However, there was no statistical significance (Table 3).

3.5. Presenting Symptoms among Cases Population

A majority of cases presented with fever (22.0%), cough (19.2%) and asthenia (14.1%). 4.9% of the cases were asymptomatic (Table 4).

3.6. Maternal Outcome

Preterm delivery was statistically significant with a P value less than 0.05 with an OR 2.51 (1.12 - 5.63). Maternal mortality among cases was at 8.2% as compared to 6.6% in the controls with OR 1.60 (0.50 - 5.12), which was not statistically significant (Table 5).

Rate of caesarean section deliveries among our cases was 52.5% as compared to 44.3% in the controls with OR 1.38 (0.74 - 2.60), with P value no statistically significant at 0.296 (Table 6).

The most common indication for caesarean section in our cases was acute foetal distress 26.2% whereas the most common indication in the controls was previous scar 18.3%. There was a statistical significance with previous scar (P value < 0.05) while the rest of the caesarean section indications were not statistically significant (Table 7).

3.7. Foetal/Early Neonatal Outcome

Perinatal death rate among cases was recorded at 8.2% as compared to 3.4% in the controls (OR, 2.63, 95% CI, 0.68 - 10.18) which was not statistically significant, P = 0.16 (Figure 3).

Majority of newborns in both cases and controls had a birth weight ranging from 2500 - 3900 g. There was no statistical significance recorded in birth weights (Table 8).

Table 3. Distribution according to comorbidities in the study population.

Variable	Cases		Controls		OR (95% CI)	P value
	Yes n (%)	No n (%)	Yes n (%)	No n (%)		
Hypertension	4 (6.6)	57 (93.4)	4 (3.4)	118 (96.7)	2.13 (0.51 - 8.84)	0.315
Diabetes mellitus	2 (3.4)	59 (96.7)	3 (2.5)	199 (97.5)	1.38 (0.22 - 8.50)	1.38
HIV	7 (11.5)	54 (88.7)	10 (8.2)	112 (91.8)	1.50 (0.54 - 4.16)	0.429
Tuberculosis	00	61 (100)	3 (2.5)	119 (97.5)	0	0.552
Cardiac disease	1 (1.7)	60 (98.4)	3 (2.5)	119 (97.5)	0.68 (0.07 - 6.67)	0.601
Kidney disease	00	61 (100)	2 (1.7)	120 (98.4)	0	0.451
Asthma	1 (1.7)	60 (98.4)	5 (4.2)	117 (95.9)	0.40 (0.05 - 3.51)	0.665
Cancer	00	61 (100)	2 (1.7)	120 (98.4)	0	0.451
Others	1 (1.6)	60 (98.4)	00	122 (100)		

OR = Odds ratio, P = P value, CI = Confident interval, Statistical test for significance = Chi-square test.

Table 4. Presenting symptoms of study participants with COVID-19.

Symptom	Absolute number	Percentage
Fever	39	22.0
Cough	34	19.2
Asthenia	25	14.1
Headache	20	11.5
Difficulty in breathing	17	9.6
Asymptomatic	3	4.9
Lower abdominal pain	8	4.5
Aguesia	2	1.1
Anosmia	7	4.0

Table 5. Distribution according to pregnancy outcome.

Variable	Cases		Controls		OR (95% CI)	P value
	Yes n (%)	No n (%)	Yes n (%)	No n (%)		
Abortion	2 (3.3)	59 (96.7)	00	122 (100)	10.29 (0.49 - 2.17)	0.13
Preterm delivery	15 (24.6)	46 (75.4)	14 (11.5)	108 (88.5)	2.51 (1.12 - 5.63)	0.025
PROM	3 (4.9)	58 (95.0)	12 (9.8)	110 (90.2)	0.47 (0.12 - 1.71)	0.25
Prolonged labour	3 (4.9)	58 (95.0)	10 (8.2)	112 (91.8)	0.60 (0.16 - 2.25)	0.330
Maternal death	5 (8.2)	56 (91.8)	8 (6.6)	114 (93.4)	1.60 (0.50 - 5.12)	0.422

Table 6. Distribution according to mode of delivery.

Variable	Cases		Controls		OR (95% CI)	P value
	Yes n (%)	No n (%)	Yes n (%)	No n (%)		
Vaginal Delivery	27 (44.3)	34 (55.7)	63 (51.6)	59 (48.4)	0.70 (0.37 - 1.31)	0.191
Caesarean section	32 (52.5)	29 (47.5)	54 (44.3)	68 (55.7)	1.38 (0.74 - 2.60)	0.296
Assisted Vaginal Delivery	2 (3.3)	59 (96.7)	1 (0.8)	122 (99.1)	2.02 (0.13 - 33.70)	0.622

Table 7. Indications for caesarean sections in cases and controls.

Variable	Cases		Controls		OR (95% CI)	P value
	Yes n (%)	No n (%)	Yes n (%)	No n (%)		
Acute foetal distress	16 (26.2)	45 (73.8)	19 (15.5)	103 (84.4)	2.01 (0.94 - 4.27)	0.044
CPD	6 (9.8)	55 (90.2)	4 (3.3)	118 (96.7)	3.32 (0.90 - 12.26)	0.065
Obstructed labour	2 (3.2)	59 (96.2)	2 (1.6)	120 (98.4)	2.09 (0.29 - 15.22)	0.397
Previous scar	4 (6.5)	57 (93.4)	22 (18.3)	100 (82.0)	0.33 (0.11 - 0.99)	0.030
Cervical dystocia	3 (4.9)	58 (95.1)	4 (3.4)	118 (96.7)	1.57 (0.34 - 7.25)	0.416

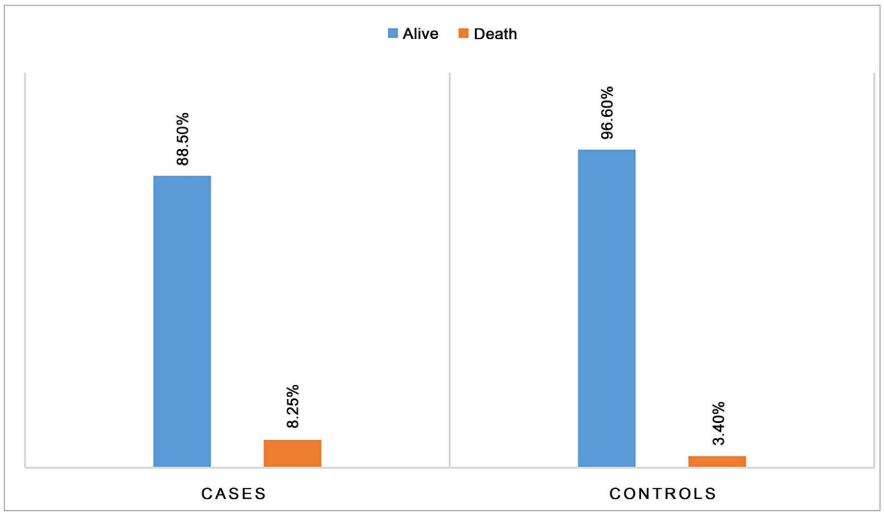

Figure 3. Distribution according to state at delivery.

Majority of neonates both in cases and controls had an APGAR score 0.56 (0.16 - 1.93). There was no statistical significance in APGAR scores (Table 9).

21 neonates were admitted into the neonatology unit giving an admission rate of 36.2%. The most common indication for neonatal admission was perinatal

Table 8. Distribution according to birth weight.

Birth weight (grams)	Cases		Controls		OR (95% CI)	P value
	Yes n (%)	No n (%)	Yes n (%)	No n (%)		
1000 - 2400	11 (18.0)	50 (82.0)	9 (7.4)	133 (92.6)	0.49 (0.22 - 1.09)	0.061
2500 - 3900	45 (73.8)	7 (26.7)	102 (83.6)	20 (16.4)	0.49 (0.22 - 1.09)	0.061
≥4000	3 (4.9)	58 (95.1)	11 (9.0)	111 (91.0)	0.54 (0.14 - 2.00)	0.266

Table 9. Distribution according to APGAR score in 5th minute.

Category	Cases		Controls		OR (95% CI)	P value
	Yes n (%)	No n (%)	Yes n (%)	No n (%)		
0 - 3	3 (5.2)	55 (94.8)	4 (3.4)	118 (96.7)	1.57 (0.34 - 7.25)	0.416
4 - 6	2(3.4)	56(96.6)	2(1.7)	120(98.4)	2.09 (0.29 - 15.22)	0.397
≥7	53(91.4)	5(8.6)	113(95)	9(7.4)	0.56 (0.16 - 1.93)	0.270

asphyxia covering 19.7% 10.7% of all admissions in the cases and controls respectively (Table 10).

4. Discussions

The main objective of our study was to assess maternal and foetal outcome among pregnant women infected with COVID-19 in three referral hospitals in Cameroon, in a two-year retrospective study. We were able to attain this from information from the files and from phone calls.

4.1. Socio Obstetrical Characteristics

Maternal ages in our study population ranged from 19 - 42 years, with mean age of cases 30.02 ± 5.9 (19 - 41) years and mean age of controls 30.2 ± 6.1 with a greater majority within the range of 25 - 34 years (59%). Our results were similar to the study done by Dingom *et al.* in Yaounde (64%) [10].

Mean gestational age at presentation in our study was 37.05 ± 5.3 with gestational age ranging from 10 - 43 weeks. Over 80% of cases presented in the third trimester, similar to Ngalame *et al.* [6] and Sutton D *et al.* *[11]* where majority of cases presented in the third trimester of gestation.

4.2. Distribution of Comorbidities in the Population

The highest comorbidity recorded in our study was HIV, 11.5% and 8.2% in cases and controls respectively. But hypertension had a higher odds ratio in a 95% confident interval 2.13 (0.51 - 8.84), followed by HIV, 1.50 (0.54 - 4.16) and diabetes mellitus 1.38 (0.22 - 8.50, implying that hypertension was the

Table 10. Reason for admission of neonates into the neonatology unit.

Variable	Cases		Controls		OR (95% CI)	P value
	Yes n (%)	No n (%)	Yes n (%)	No n (%)		
Perinatal asphyxia	12 (19.7)	46 (79.3)	13 (10.7)	109 (89.3)	2.05 (87 - 4.82)	0.099
Low birth weight	3 (4.9)	55 (95.1)	4 (13.3)	118 (96.7)	1.52 (0.19 - 5.03)	0.650
Neonatal infection	4 (6.6)	54 (93.4)	8 (6.7)	114 (93.4)	1.00 (0.288 - 3.466)	1.000
Others	2 (3.3)	56 (96.7)	5 (4.1)	117 (96.0)	1.23 (0.23 - 6.53)	0.584

comorbidity associated with the highest risk of disease severity in our study. In a case control study by Khalil *et al.* on impact of COVID-19 infection on pregnancy and neonates. A low rate of associated comorbidities could be explained by good access to health care services and small sample size [12].

4.3. Clinical Presentation in COVID-19 Infected Pregnant Women

In our study, most cases presented with the following symptoms of COVID-19 at diagnosis: fever (22.0%), cough (19.2%) and asthenia (14.1%). This is similar to a study done in Douala by Ngalame *et al.* which also recorded fever (27.4%) and cough (21.5%) as the most common presenting symptoms. In several other studies, fever was the major presenting symptom [6].

4.4. Maternal Outcome among Cases and Controls

The rate of caesarean section among our cases was 52.4% as compared to 44.3% among the control group with an odds ratio of 1.38 (0.74 - 2.60) indicating a causal effect between COVID-19 in pregnancy and caesarean section deliveries. A similar rate of C/S deliveries (61.5%) was noted by Ngalame *et al.* in a prospective study in Douala [6]. However higher rates of caesarean section were noted in COVID-19 infected pregnant women out of our context as the 83.5% obtained by studies carried out in [6] Thompson *et al.* (70% - 84.7%) [8], Wei *et al.* (94%) [7]. The higher rates of caesarean sections in these studies is explained by the fact that non obstetrical indications were considered due to considerations that maternal respiratory distress would be improved by expeditious delivery.

Caesarean sections were mostly indicated for foetal distress 27.6% with odds ratio of 2.01 (0.94 - 4.27) and P value statistically significant at 0.044. This is similar to the results obtained by Sutton *et al.* where caesarean section in COVID-19 infected women was mostly indicated for foetal distress [11].

We recorded higher rates of vaginal delivery (44.8%) as compared to other studies, 6% as obtained in [7], and 18.8% as obtained in [8]. The rates of vaginal delivery where however higher in the control groups (53.8) with OR of 0.70 (0.37 - 1.31).

There was a 3.3% increase in spontaneous abortion in the cases as compared to the controls, with OR of 10.29 (0.49 - 2.17) indicating a 10 times increase risk of spontaneous abortion from COVID-19 infection in early pregnancy, which was however not statistically significant, P value = 0.106. Higher rates were recorded by Dingom *et al.* 12.5% [10]. Lower rates in our study can be explained by the fact that a higher proportion of our study population presented in the third trimester.

Maternal mortality rates in our cases were at 8.2% which was not statistically significant with a P value of 0.42. Maternal mortality rates were however lower in the control group (6.6%) with an OR 1.60 (0.50 - 5.12) indicating a more than 1.5 times increased risk of maternal mortality from COVID-19 infection in pregnancy. Lower rates were recorded in a meta-analysis by Ngalame *et al.*, 1.4% and in the study carried out in which recorded 1.7%.

4.5. Foetal Outcome among Cases and Controls

The rate of preterm delivery in our study was 24.6%. This was statistically significant with a P value 0.025 our results were closely similar to a study done by Thompson *et al.* with preterm delivery rates at 15.2% - 20.1% [8]. Ngalame *et al.* 29.7% [6], Dingom *et al.* 21.2% [10] and Wei *et al.* 17% [7] . The rates where however lower (11.5%) in the control group with an OR 2.39 (1.05 - 5.42) signifying that pregnant women infected with COVID-19 had a double risk of preterm deliveries as compared to pregnant women not infected with COVID-19, similar to what was found in a case control study on maternal and neonatal outcome of pregnancy in women with COVID-19 by Taubenberger *et al.*, with preterm delivery, significantly higher in cases than in the control group [15].

Perinatal asphyxia was the highest reason for admission of neonates born to COVID-19 infected women into the neonatology unit (19.7%), followed by neonatal infection (6.6%), low birth weight (4.9%). With similar trends noted in the control groups. All admission indications were not statistically significant, all P values greater than 0.05. Perinatal asphyxia among the case and control groups produced a P value of 1.66 (0.43 - 6.38) indicating a causal effect between COVID-19 infection in pregnancy and perinatal asphyxia.

Perinatal death rates in our study were recorded at 8.2% as compared to 3.4% in the controls with OR 2.63 (0.68 - 10.18) indicating a double risk of perinatal mortality in COVID-19 infection, which was however not statistically significant, P value = 0.16.

5. Conclusions

Pregnancies infected with COVID-19 were found to have higher risks of preterm delivery and acute foetal distress as compared to those not infected among the pregnant women that were sampled.

Caesarean section deliveries, maternal and foetal mortality were higher in COVID-19 infected pregnant women as compared to pregnant women not in-

fected by the virus though these findings were not statistically significant.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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