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A Case-Control Study of Risk Factors and Outcome of Low Birth Weight Neonates in the Bafoussam Regional Hospital, Cameroon

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Article

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Abstract

Background

Low birth weight (LBW) is associated with increased morbidity, mortality and multiple short and long-term complications, exerting impacts on the individual, the families, the community and the health care system. Fetal, maternal and environmental factors have been associated with LBW. This study set out to determine the associated risk factors and immediate outcome of low birth weight neonates at the Bafoussam Regional Hospital, Cameroon.

Methods

This was a hospital-based case- control study involving 260 neonates (130 cases and 130 controls) and their mothers from January 2020 – May 2020 using a consecutive sampling technique. Odds ratios (OR) were calculated using binary logistic regression to assess the association between determinants and LBW.

Results

Tertiary education was protective against LBW (AOR = 0.476, 95% CI 0.251–0.902, p = 0.023). Independent predictors of LBW ($p < 0.05$) were; women who were in the age group 30–40 years (AOR = 3.542, 95% CI = 0.866–14.495), unemployed (AOR = 2.691, 95% CI = 1.425–5.081), Not Educated (AOR = 5.513, 95% CI = 1.192–25.499), having a gynecological abnormality -Uterine fibroids, cervical incompetence (AOR = 4.373, 95% CI = 1.415–13.514), pregnancy induced hypertension (AOR = 5.944, 95% CI = 1.364–25.892) and multiple gestation (AOR = 4.421, 95% CI = 2.227–8.777). Prematurity and intrauterine growth restriction were major causes of LBW. Complications diagnosed were: jaundice infection, apneas, hypothermia, cerebral hemorrhage, gastrointestinal problems, hypocalcemia, hypoglycemia and umbilical hernia. We recorded 21.5% deaths due to: birth asphyxia (70%), respiratory distress (23.3%) and infection (6.7%).

Conclusion

This study has demonstrated that low socio-economic status, low literacy levels of mothers, lack of focused antenatal care were important indicators of LBW.

Trial Registration

Clinical trial number: not applicable

1-BACKGROUND

Low birth weight (LBW) defined as birth weight less than 2500g irrespective of the gestational age at delivery [1] remains a major global public health problem and it is associated with increased mortality as well as multiple short-term and long-term adverse health outcomes. Globally, it is estimated that 15% to 20% of all births are low birth weight and its prevalence in developing countries has been estimated at 16.5%, twice that in developed regions [2], contributing to about 60–80% of neonatal deaths in very limited resource settings [3]. While most regions of the world have made great strides in reducing neonatal mortality, very little progress has been made in sub-Saharan Africa [4].

Recent studies found maternal factors like maternal malnutrition [5], antepartum haemorrhage and anaemia [6, 7], pre-eclampsia/eclampsia [8], diabetes [9], low/high maternal age [10, 11], short inter-pregnancy interval [12], smoking [13], alcohol, [14], inadequate antenatal care [15], mother's level of education and socio-economic status [16] and foetal factors like multiple gestation [17], sex [18] as risk factors of LBW. However, most of the factors associated with LBW have been identified in the industrialized nations which account for less than 5% of all LBWs and it is uncertain if these factors or other factors account for the high prevalence of LBW in low- and middle-income settings. LBW babies often have complications like; birth asphyxia, hypothermia, infection, hyaline membrane disease, nervous system problems, such as intraventricular haemorrhage, digestive problems, such as necrotizing enterocolitis and long-term complications and disability such as cerebral palsy, blindness, deafness, developmental delay [19].

A recent study reported an increase in the incidence of LBW in Cameroon from 11% in 2014 to 13.7% in 2015 [20]. Reducing LBW among neonates will help in reducing neonatal mortality and long term morbidity when they become adults. Therefore, this study aims at determining the associated risk factors and immediate outcome of low birth weight neonates in a Regional Hospital in the West Region of Cameroon. While national trends and institutional data regarding low birth weight (LBW) determinants are progressively documented in major Cameroonian urban centers like Yaoundé and Douala, there remains a critical gap in localized clinical data from secondary administrative regions. The West Region of Cameroon possesses unique socio-demographic dynamics and healthcare access challenges that differ from the metropolitan capitals, meaning that centralized findings cannot be accurately extrapolated here. Consequently, a focused assessment within this specific sub-population is highly necessary.

2-MATERIALS AND METHODS

2.1 STUDY DESIGN, POPULATION AND SITE

This was a hospital-based analytic case-control study with prospective collection of data carried out between January and May 2020 at the Neonatal and Postnatal unit of the Bafoussam Regional Hospital

(BRH) involving all neonates aged 0 to 28 years using consecutive sampling during the study period. The neonatal unit of the BRH is specifically designed for the monitoring and appropriate management of LBW babies and other neonatal pathologies in the West Region of Cameroon. This study involved 260 neonates (130 cases and 130 controls). Cases included neonates with birth weight < 2500g including those with multiple gestation and extremely low birth weight neonates, while controls included neonates with birth weight ≥ 2500g whose parents gave written informed consent.

2.2 RECRUITMENT OF PARTICIPANTS AND DATA COLLECTION

Clients were invited to participate in the study and given an information sheet. Participants were given enough time to ask questions, express their worries and clarify their doubts before signing informed consent forms. Birth weight was measured using a standard beam balance to the nearest 10g. The babies were naked and were placed at the centre of the beam so that weight was evenly distributed. The weight was recorded when the baby lied still. The scale was zeroed daily to ensure accuracy of measurements. To determine the risk factors of LBW, a pre-tested questionnaire was used to interview the mothers; to determine outcome, the neonates were then closely examined from admission to discharge so as to early detect complications due to low birth weight and manage them appropriately. On physical examination, preterm babies have distinct physical features which help in their recognition; deep skin creases on the sole in the anterior one third, the external ear or the pinna is soft and devoid of cartilage. Hence, it does not recoil back promptly on being folded. In males, the scrotum does not have reggae and testes are not descended into the scrotum. In female's infants, the labia are widely separated, not covering the labia minora, resulting in the prominent appearance of the clitoris. The back of the preterm babies has abundant growth of fine hair called lanugo. Neonates with intrauterine growth restriction have an emaciated look with prominent features of malnutrition, loose skin fold because of lack of subcutaneous tissue, long finger nails, small abdomen and often look anxious and hyper alert.

2.3 VARIABLES MEASURED

The dependent variable in this study was low birth weight.

Independent variables were; Maternal socio-demographic factors (age; occupation- any activity that earns her money; marital status; highest level of education attained; monthly income and place of residence), Obstetric history (gravidity, parity, previous premature birth, previous abortion, previous stillbirth, history /presence of a morphological gynaecological abnormality), medical history of chronic disease (hypertension- clinically recorded by nurse or doctor during antenatal visit; diabetes- and HIV), social history (alcohol, tobacco), Index of current pregnancy (Inter-pregnancy interval, number of ANCs attended, when ANC started, who followed up the pregnancy, laboratory tests done, episodes of: anaemia, antepartum haemorrhage, urinary tract infection, malaria, lower genital tract infections, pregnancy induced hypertension, gestational diabetes during the pregnancy, amount paid and psychological state of the mother at discharge of the hospital. Infant factors were: gestational age at

delivery, gender, multiple pregnancy, type of low birth weight, complications diagnosed, state at discharged, length of stay in the hospital.

2.4 DATA MANAGEMENT AND ANALYSIS

Data for this study was analysed using Statistical Package for Social Science (SPSS) version 22. Frequency distribution tables were used to summarize the descriptive characteristics as well as categorical variables while mean and standard deviation or median and inter-quartile range were used to represent continuous variables. Chi square test was used to compare categorical variables. The frequencies of LBW by potential risk factors were estimated and this was followed by calculation of odds ratios (OR) using a univariate binary logistic regression analysis. Further, a multivariate binary logistic regression analysis (adjusting for confounders) was performed to determine the independent predictors of LBW using all the variables that were significant in the bivariate. A *p*-value of 0.05 was considered to be statistical significant.

2.5 ETHICAL ISSUES

Ethical clearance was obtained from the Institutional Review Board of the University of Bamenda. Authorization to carry out this work was obtained from the Regional Delegation of Health West Region and Director of the BRH. All methods were performed in accordance with the relevant guidelines and regulations.

In addition, the purpose, study procedure and expected outcomes of this study were explained to the participants and mothers of the children before data collection was done. The following ethical concerns were taken into account according to the Helsinki declaration:

Written informed consent was obtained from mothers. In addition, all the data collected from the patients was treated with confidentiality. As benefit; the mothers with low birth weight neonates were counselled based on their risk factors identified to prevent recurrence (for those that could be prevented) since its cost of management is high. Furthermore, there was an opt out facility to enable those who were no longer willing to participate in the study to withdraw.

3-RESULTS

3.1 RECRUITMENT OF PARTICIPANTS

Three hundred (300) mothers of neonates were approached during the study period, 260 met the inclusion criteria (130 Cases and 130 Controls) and gave consent to participate in the study and none withdrew later. Forty (40) were excluded due to the absence of the mother for evaluation of risk factors.

3.2 SOCIO-DEMOGRAPHIC CHARACTERISTICS OF THE STUDY POPULATION

The mean maternal age of cases was 27.5 ± 4.7 years, (ranging from 17–39 years), while the mean maternal age of controls was 25.8 ± 7 years (ranging from 17–34 years). More than 50% of the participants (both cases and controls) were single. Also, 51.9% were self-employed and more than 85% were Christians. In addition, more than 70% were living in urban settings and more than half had attained tertiary education. The mean monthly household income of the study population was 17850 ± 8200 FCFA for cases and 22400 ± 11500 FCFA for controls.

For neonates, the mean birth weight for cases was 1600 ± 500g with 62.3%, 20.8% and 16.9% having LBW, VLBW and ELBW respectively. We also found that 52.3% of the children were females. On the contrary, for the neonates in the control group the mean birth weight was 2800 ± 300g with 56.9% being females. Table 1 illustrates the descriptive characteristic of the study population.

Table 1
Descriptive characteristic of the study population

Variable	Total N (%)	Cases n (%)	Controls n (%)
Age range (years)			
<20	15(5.8%)	7(5.4%)	8(6.2%)
20–30	183(70.4%)	81(62.3%)	102(78.5%)
30–40	62(23.8%)	42(32.3%)	20(15.4%)
Marital status			
Single	143 (55.0%)	71(54.6%)	72(55.4%)
Married	117 (45.0%)	59(45.4%)	58(44.6%)
Occupation			
Unemployed	125 (48.1%)	53(40.8%)	72(55.4%)
Employed	135 (51.9%)	77(59.2%)	58(44.6%)
Religion			
Christian	226 (86.9%)	108(83.1%)	118(90.80%)
Muslim	29 (11.2%)	18(13.8%)	11(8.5%)
Others	5 (1.9%)	4(3.1%)	1(0.8%)
Residence			
Rural	68 (26.2%)	37(28.5%)	31(23.8%)
Urban	192 (73.8%)	93(71.5%)	99(76.2%)
Level of education			
None	16 (3.2%)	13(10.0%)	3(2.3%)
Primary	28 (10.8%)	18(13.8%)	10(7.7%)
Secondary	73 (28.1%)	42(32.3%)	31(23.8%)
Tertiary	143 (55.0%)	57(43.8%)	86(66.2%)
Mean monthly household income (FCFA)		17850 ± 8200	22400 ± 11500
Gender			
Male	118(45.4%)	62(47.7%)	56(43.1%)
Female	142(54.6%)	68(52.3%)	74(56.9%)
Mean birth weight (grams)		1600 ± 500	2800 ± 300

3.3 FACTORS ASSOCIATED WITH LOW BIRTH WEIGHT

BIVARIATE AND MULTIVARIATE LOGISTIC REGRESSION ANALYSIS

Bivariate analysis for potential risk factors associated with LBW can be found on Table 2. Our study found that age group 20–30 years, tertiary education IPI > 24 months were protective factors against LBW. Age group 30–40 years, unemployed, no education, being diagnosed of a gynecological abnormality (uterine fibroids, cervical incompetence), history of diabetes, unwanted pregnancy. IPI 6–12 months, alcohol consumption, pregnancy induced hypertension, multiple gestation, episodes of malaria, anemia and lower genital tract infection in pregnancy were potential risk factors of low birth weight.

On multivariate analyses, tertiary education was protective against low birth weight (AOR = 0.476, 95% CI 0.251–0.902, p = 0.023). Also, independent predictors of low birthweight ($p < 0.05$) were; women who were in the age group 30–40 years (AOR = 3.542, 95% CI = 0.866–14.495), unemployed (AOR = 2.691, 95% CI = 1.425–5.081), Not Educated (AOR = 5.513, 95% CI = 1.192–25.499), having a gynecological abnormality -Uterine fibroids, cervical incompetence (AOR = 4.373, 95% CI = 1.415–13.514), pregnancy induced hypertension (AOR = 5.944, 95% CI = 1.364–25.892) and multiple gestation (AOR = 4.421, 95% CI = 2.227–8.777) as shown in Table 2

Table 2
Potential risk factors for LBW neonates at the BRH, 2020

Variables	Crude OR (95% CI) (Univariable Analysis)	*p*-value	Adjusted OR (95% CI) (Multivariable analysis)	*p*-value
Age range (years)				
20–30	0.4 (0.262 -0 .785)	0.006	0.5 (0.148–2.030)	0.368
30–40	2.6 (1.438–4.791)	0.002	3.5 (0.866–14.495)	**0.079**
Unemployed	1.8 (1.103–2.949)	0.025	2.7 (1.425–5.081)	**0.002**
Level of Education				
No education	4.7 (1.307–16.922)	0.018	5.5 (1.192–25.499)	**0.029**
Tertiary education	0.4 (0.242 -0 .660)	0.000	0.5 (0.251–0.902)	**0.023**
Diagnosed of a gynecological abnormality	3.1 (1.185–8.161)	0.027	4.3 (1.415–13.5140	**0.010**
History of diabetes	2.0 (1.818–2.346)	0.007	0.0 (0.000–0 .000)	0.999
Unwanted pregnancy	5.3 (1.145–24.840)	0.034	4.9 (0.735–32.787)	0.100
IPI (in months)				
6–12	5.3 (1.145–24.840)	0.034	3.4 (0.513–23.403)	0.202
≥ 24	0.6 (0.340–0.926)	0.032	1.6 (0.836–2.983)	0.160
Alcohol consumption	6.0 (1.285–27.244)	0.019	3.8 (0.708–20.891)	0.119
Episodes of anemia	3.5 (1.110 -11.038)	0.042	2.4 (0.581–9.542)	0.230
Episodes of malaria	2.7 (1.274–5.740))	0.012	2.2 (0.856–5.536)	0.102
Episodes of lower genital tract infection	2.6 (1.099 -6.200)	0.040	2.3 (0.802–6.917)	0.119
Pregnancy induced hypertension	4.1(1.325–12.739)	0.015	6.0 (1.364–25.892)	**0.018**
Multiple gestation	3.7 (2.090–6.602)	0.000	4.4 (2.227–8.777)	**< 0.001**

IPI: Inter-pregnancy interval

3.4 NEONATAL OUTCOME OF LOW BIRTH WEIGHT

Follow up of these 130 low birth weight neonates from admission till discharge revealed that most LBW neonates were late preterm births (46.9%) with the minority being extremely preterm births 5.4%. prompted immediate resuscitation following admission or delivery at the maternity or theater ranging

from 5–15 minutes. More than half were weighing between 1500–2499g with 16.9% weighing < 1000g. The major cause of low birth weight was due to prematurity (90.8%) with 9.2% due to intrauterine growth restriction. Complications diagnosed were: jaundice (34.9%), infection (20.6%), apneas (17.5%), hypothermia (11.1%), cerebral hemorrhage (4.8%), gastrointestinal problems (3.2%), hypocalcemia (3.2%), hypoglycemia (1.6%) and umbilical hernia (1.5%). We recorded 21.5% deaths due to: birth asphyxia (70%), respiratory distress (23.3%), infection (6.7%). The mean length of stay at the hospital was 18.19 ± 9.34 ranging from 1–40 days. The mean amount paid at discharge was 61800 ± 35000 FCFA. At discharge the majority of these mothers were worried, sad and stressed up. Follow up visits were programmed depending on the evolution of the neonate during their stay in the hospital, every 2 weeks if their evolution were bad and 4 weeks if their evolution were good as shown in Table 3.

Table 3
Outcome of low birth weight neonates

Variables	Class	Cases
Gestational age at delivery (weeks. days)	> 37(Term)	12(9.2%)
	34–36.6(Late PTB)	61(46.9%)
	32–33.6(Moderate PTB)	12(12.3%)
	28–31.6 (Very PTB)	34(26.2%)
	< 28 (Extremely PTB)	7(5.4%)
Multiple gestation		
	Yes	56(43.1%)
	No	74(56.9%)
Gender		
	Male	62(47.7%)
	Female	68(52.3%)
Apgar score at 1st min	0–3	23(17.7%)
	4–6	69(53.1%)
	7–10	38(29.0%)
Apgar score at 5th min	0–3	/
	4–6	28(21.5%)
	7–10	102(78.5%)
Birth weight in grams	1500–2499 (LBW)	81(62.3%)
	1000–1499 (VLBW)	27(20.8%)
	< 1000 (ELBW)	22(16.9%)
Type of low birth weight	Prematurity	118(90.8%)
	IUGR at term	12(9.2%)
Complications diagnosed	Infection	13(20.6%)
	Hypothermia	7(11.1%)
	Hypoglycemia	1(1.6%)
	Jaundice	22(34.9%)
	Hypocalcemia	2(3.2%)

Variables	Class	Cases
	Apneas	11(17.5%)
	Gastrointestinal problems	2(3.2%)
	Cerebral hemorrhage	3(4.8%)
	Umbilical hernia	2(3.2%)
State at discharge	Alive	102(78.5%)
	Dead	28(21.5%)
If dead, what was the cause?	Neonatal infection	1(6.7%)
	Birth asphyxia	20(70%)
	Respiratory distress	7(23.3%)

4-DISCUSSION

4.1 Socio-demographic Risk Factors

Mothers with no formal education had increased odds of having LBW newborns. These findings are in line with those in studies conducted by Iltaf *et al*, 2017 Pakistan [21] which showed that women with tertiary education were less likely to have low birth weight neonates. This can be explained by the fact that formal education enables women to improve their capacity to generate income and to promote optimal dietary practices during pregnancy. Further it may also enhance their awareness about other risk factors of LBW. Education enables women to make independent decisions and to have better access to household resources that are important for better nutrition. Siza et al, 2008, Northern Tanzania [22]. However, this finding is inconsistent with a study by Njim *et al*, 2015, Cameroon, which revealed no association between maternal level of education and low birth weight [13].

Mothers who were unemployed were three times more likely to have LBW neonates. This is in line with a study carried out by De Maio *et al*, 2018 in five North America cities (Baltimore, Boston, Chicago, Philadelphia, and Toronto) [23]. The results obtained in this study might be due to the fact that women who are unemployed usually have a low income to meet the financial demand of a pregnancy. This finding is contrary to a study carried out by Endalamaw *et al*, 2018 Ethiopia [19] that revealed no association of LBW and unemployment status. Maternal age of 30–40 years had a higher risk of having LBW neonates compared to the other age groups. Similar findings were found in studies conducted by Watson- Jones *et al*, 2007, Northern Tanzania [24]. This can be due to decreased maternal nutrient reserves necessary to maintain a pregnancy to term.

4.2 Obstetric Risk Factors

Mothers being diagnosed of a gynecological abnormality especially uterine fibroids and cervical incompetence had an increased odd of having LBW neonates. This result is similar to reports of studies done by Ouyang *et al*, 2006, North America [25] and Noor *et al*, 2009, Pakistan [26]. Although most pregnancies are unaffected by the presence of uterine fibroids, large submucosal and retro-placental fibroids seem to impart a greater risk for complications, including pain (degeneration), vaginal bleeding, placental abruption, IUGR, preterm labor and birth.

Mothers with pregnancy induced hypertension had a six times risk of low birth weight. This is similar to reports of studies conducted by Zhang *et al*,2012, [27] and Deressa *et al*, Ethiopia [28]. This may be related to reduced placental blood flow, which would affect the exchange of nutrients and oxygen between the mother and fetus. This would result in decreased fetal growth and increase the risk of abnormal pregnancy outcomes, such as intrauterine growth restriction, low birth weight, and preterm birth. Lastly, multiple gestation had five times increased odds of having LBW neonates similar to studies conducted by Laelago et al, 2020 Malawi [29] and Abaraya *et al* ,2020, Southwest Ethiopia [30]. This may be due to overstretching of the uterus and deciding to complete pregnancy before term. Furthermore, it may be due to spontaneous labor or premature rupture of membranes.

4.3 Immediate Outcome of Low Birth Weight Neonates

Compared to normal weight infants, LBW is positively associated with neonatal complications and mortality and negatively associated with normative childhood cognitive and physical development [31]. In this study, most LBW neonates were late preterm births (46.9%) with the minority being extremely preterm births (5.4%). This is similar to studies done by Kitsantus *et al*, 2016, Saudi Arabia [32] but contrary to studies carried by Roy *et al*, 2006, India [33]. This is probably because of immediate consultation in the hospital once signs of preterm labor starts for immediate tocolysis hence increasing the chances of having late preterm and term births. that prompted immediate resuscitation following admission or delivery at the maternity or theater ranging from 5–15 minutes. More than half were LBW with 16.9% being ELBW and this group of neonates had the highest mortality rate and complications diagnosed which could be single or multiple. The major cause of low birth weight was due to prematurity (90.8%) with 9.2% due to intrauterine growth restriction occurring in mothers with pregnancy induced hypertension. Complications diagnosed were: jaundice, infection, apneas, hypothermia, cerebral hemorrhage, gastrointestinal problems, hypocalcemia, hypoglycemia and umbilical hernia. We recorded 28 deaths exclusively in VLBW and ELBW neonates due to: birth asphyxia (70%), respiratory distress (23.3%), infection (6.7%). The likelihood of asphyxia and perinatal morbidity were significantly higher among the preterm babies. It is expected that the incidence of perinatal morbidities and mortality decreases with increasing gestational age at delivery. These findings are similar to the WHO report, 2020 [34], Das *et al*, 1993, India [35].

A major strength of this study lies in its focus on the Bafoussam Regional Hospital, which serves as a vital tertiary referral hub handling a complex mix of semi-urban and rural transition populations. Unlike specialized university clinics in capital cities, our institution manages a highly diverse cohort affected by

distinct local public health constraints, including regional variations in antenatal care (ANC) compliance and localized environmental or infectious risk factors. Therefore, these findings provide a highly realistic depiction of neonatal outcomes in a typical, resource-constrained regional referral network

5-CONCLUSION

Tertiary education was protective against LBW while being of the 30–40 age group, unemployed, not educated, having been diagnosed of a gynecological abnormality like uterine fibroids or cervical incompetency, pregnancy induced hypertension and multiple gestation were risk factors of low birth weight.

Extremely low birth weight neonates underwent immediate resuscitation following admission or delivery at the maternity or theater ranging from 5–15 minutes. This group had the highest mortality rate and complications diagnosed which were single or multiple.

Complications diagnosed were infection, hypothermia, hypoglycemia, jaundice, hypocalcemia, apneas, gastrointestinal problems, cerebral hemorrhage and umbilical hernia. Twenty-eight deaths were recorded due to: birth asphyxia, respiratory distress, infection. The mean length of stay at the hospital was 18.19 ± 9.34 ranging from 1–40 days.

Ultimately, these findings offer a crucial epidemiological baseline that is currently missing for the West Region of Cameroon. Rather than merely reflecting a single-center experience, this data identifies specific, actionable maternal and clinical risk factors that local healthcare authorities can utilize to design targeted, region-specific neonatal intervention strategies. This localized baseline is a vital stepping stone toward optimizing resource allocation and reducing neonate mortality rates across similar regional hospitals nationwide.

Declarations

Authors' Contributions

LNND was responsible for the conception and design of the study, data collection and organization, statistical analysis and drafted the manuscript. CKN contributed to the conception and design of the study as well as interpretation and analysis concepts of data. All authors contributed to the editing and writing of the final manuscript.

Competing interests

The authors declare no competing interests.

Ethics Approval

This study was approved by Institutional Review Board (IRB) of the University of Bamenda

Consent to Participate

Informed consent was obtained from all individual participants prior to their inclusion in the study as approved by the Institutional Review Board of the University of Bamenda.

Trial Registration

Clinical trial number: not applicable

Funding Declaration

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Consent to Publish Declaration

‘Not Applicable”

Written informed consent for publication was not required because the data are fully anonymized

Data Availability Statement

All data generated or analyzed during this study are included in this published article

Declaration of competing interests

The authors declare no competing interests

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