International Journal of Reproduction, Contraception, Obstetrics and Gynecology
Makinde OI et al. Int J Reprod Contracept Obstet Gynecol. 2023 Jul;12(7):1960-1968
www.ijrcog.org
pISSN 2320-1770 | eISSN 2320-1789

DOI: https://dx.doi.org/10.18203/2320-1770.ijrcog20231904

Original Research Article

Rate and determinants of low fifth minute Apgar score at the federal medical centre Yenagoa, Bayelsa State, Nigeria

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Received: 28 April 2023
Accepted: 02 June 2023

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ABSTRACT

Background: About a quarter of neonatal deaths and about 10% of deaths of children under 5 years are due to intrapartum related events reflected as low fifth minute Apgar score. This study is to assess the rate of low fifth minute Apgar score and its determinants at the Federal Medical Centre Yenagoa, Bayelsa State, Nigeria.
Methods: A cross-sectional study of births at the Federal Medical Centre Yenagoa between July 2020 and April 2021. Data was collected in real time from parturients' case notes at delivery. Low fifth minute Apgar score was defined as Apgar score < 7 at the 5th minute of birth. Data was analysed using IBM SPSS Statistics version 23. Multivariate logistic regression was used to identify determinants of low fifth minute Apgar score. P Value was 0.05.
Results: Rate of low fifth minute Apgar score was 16.6%. Unbooked status (OR - 2.29; CI-1.11 - 4.71; p value - 0.024), emergency caesarean section (OR - 10.44; CI - 1.10 - 99.26; p value - 0.041), urgent caesarean section (OR - 25.75; CI - 2.58 – 256.72; p value=0.006) and breech presentation (OR - 1.96; CI - 1.03 – 3.82; p value=0.049) significantly increased the odd of low fifth minute Apgar score.
Conclusions: Unbooked status, emergency and urgent caesarean section, and breech presentation were the determinants of low fifth minute Apgar score in the population studied. This highlights the patient group and clinical scenario requiring a focus of intervention for prevention of morbidity and mortality from low fifth minute Apgar score.

Keywords: Determinants, Low fifth minute Apgar score, Nigeria, Perinatal asphyxia

INTRODUCTION

The Apgar score was developed in 1952 for rapid evaluation of the newborn following delivery and has become a globally accepted standard for assessment of neonatal clinical status within minutes of birth.[1-4] Each of the five variables of the Apgar score is scored 0, 1, or 2 and a cumulative score of 10 is assigned. The score is determined at the first and fifth minute of life.[1-4] The need for initial resuscitation where necessary is not dependent on the Apgar score as it is often obvious before the first minute of life.[5] The assigned first minute Apgar score is the first indication of the neonate's health status at birth. The fifth minute Apgar score is a better predictor of neonatal outcome, indicates response to resuscitation; where needed, the capacity to recover and need for further resuscitation or ongoing management.[4,6,7] The fifth minute Apgar score of 7 to 10 is interpreted as normal or reassuring, 4-6 as low or moderately abnormal and 0-3 as very low in the term and late preterm neonate.[5] For a neonate requiring further resuscitation for Apgar score <7 at the fifth minute, scores are determined at 5 minutes intervals until 20 minutes.[2-4] It is appropriate to discontinue neonatal resuscitation if it is confirmed that no heart rate has been detectable for at least 10 minutes.[4,6]

Apgar score is used for diagnosis and determination of severity of perinatal asphyxia.[6,8,9] score <5 at 5 minutes and 10 minutes clearly confer an increased relative risk of neonatal mortality.[6] About 6,400 neonates die daily around

the world,[10] with about a quarter of neonatal deaths and about 10% of deaths of children under 5 years due to intrapartum related events.[11] Low fifth and tenth minute Apgar score confer an increased relative risk of cerebral palsy[6] and other long-term neurological problems like epilepsy, cognitive impairment, low academic performance etc.[12-14] Risk of cerebral palsy among surviving neonates increases with Apgar score 0-3 at the 10th, 15th and 20th minute.[6] Neonatal morbidity and mortality from low fifth minute Apgar score remains significant in many countries, especially in Africa. Establishing the magnitude and factors associated with low fifth minute Apgar score in various practice settings helps to determine actions to reduce resultant morbidity and mortality.

Rate of low fifth minute Apgar score or perinatal asphyxia varies globally. The incidence of fifth minute Apgar score <7 was 1.2% in USA, 0.46% in Brazil and 0.57% in Peru.[15-17] Within Africa, Ethiopian studies reported rates of low fifth minute Apgar score or perinatal asphyxia ranging from 6.7% to 32%.[9,18-24] A meta-analysis of 13 studies in east and central Africa reported a pooled prevalence of 15.9%.[25] A Ghanaian study reported a rate of very low fifth minute Apgar score of 1.9%.[26] Studies done in Nigeria showed rate of low fifth minute Apgar score or perinatal asphyxia of 3.3% in Warri, 4% in Ibadan and 23.1% in Birnin Kudu.[27-29] In developing countries, death of perinatally asphyxiated neonates largely ranged from 13.3% to 42.29%, but was as low as 0.95% in Brazil.[29-40] A study in USA recorded 0.06%, while in China 28.72% was recorded in 2016.[15,41]

Several studies have documented independent fetal/neonatal and maternal factors associated with low fifth minute Apgar score.[9,16-24,26-28,42-46] No previous study has been undertaken at the Federal Medical Centre Yenagoa, Bayelsa State, Nigeria, to assess the rate of low fifth minute Apgar score and its determinants, hence the need for this study to add to the data and knowledge from south-south Nigeria.

METHODS

This was a cross-sectional analytical study. There are 36 states distributed in six geopolitical zones which together with the Federal Capital Territory Abuja make up the country Nigeria. Bayelsa State is one of the states in the south-south geopolitical zone of Nigeria. Bayelsa State with a population of about 2,700,000 has its indigenous people collectively referred to as Ijaws and the state is also home to a sizable community of non-indigenous tribes including the Igbos, Ibibios, Efiks, Urhobos, Itsekiris, Isokos, Edos, Yorubas, Hausas etc.[47] Most people in Bayelsa State engage in trading, subsistence farming and small-scale commercial farming. Others work in the State and Federal civil service. Yenagoa is the capital city of Bayelsa State. Federal Medical Centre. Yenagoa is a tertiary level health facility. Patients present directly and by referrals from primary and secondary level state-owned health facilities, private hospitals in Yenagoa and its environs, and from traditional birth attendants in Yenagoa and its environs. The department of Obstetrics and Gynaecology conducts an average of 1800 deliveries annually, but the facility was just recovering from the impact of COVID-19 at the time of the study.

Study population

Women who deliver at the Federal Medical Centre Yenagoa, Bayelsa State Nigeria, and their babies.

Inclusion criteria

All births at the Federal Medical Centre Yenagoa between July 2020 and April 2021 were included.

Data collection

The protocol for this study was approved by the research ethics committee, Federal Medical Centre Yenagoa and study was performed in accordance with the 2013 Helsinki declaration. Real time data related to all births during the study period were collected from parturients' case notes using a pre-designed proforma. Variables of interest collected for the study included women's age, level of education, booking status, parity, previous caesarean section, number of previous caesarean section, number of fetuses, fetal lie, fetal presentation, fetal sex, birth weight categories and Apgar scores. Low fifth minute Apgar score was defined as Apgar score <7 at the 5th minute of birth.

Data analysis

Data from study proforma was entered into IBM SPSS Statistics version 23 which was used for data cleaning and analysis. Mean and standard deviation of continuous data was determined while categorical data were summarized using frequencies, percentages and charts. Chi Square was used to determine association between low fifth minute Apgar score and the fetal, neonatal and maternal characteristics of interest. A logistic regression analysis was done to identify determinants of low fifth minute Apgar score and multivariate logistic regression analysis to adjust for confounding variables. Level of significance was set at p value <0.05.

RESULTS

Rate of low fifth minute Apgar score

There were 583 total births during the study period out of which 97 had low fifth minute Apgar score giving an incidence of 16.6% (Figure 1). There were 98 (16.8%) Neonatal Intensive Care Unit (NICU) admissions (Figure 1). Figure 2 shows the indication for NICU admission. The commonest (n=57; 58.1%) indication was prematurity/low birth weight followed by perinatal asphyxia (n=19; 19.4%).

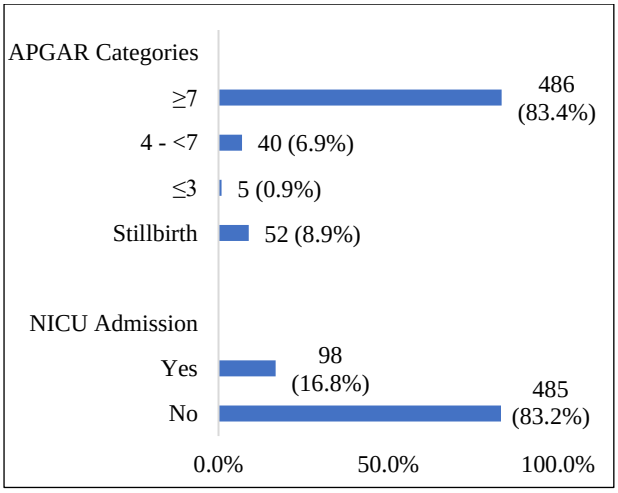

Figure 1: Neonatal outcomes at birth.

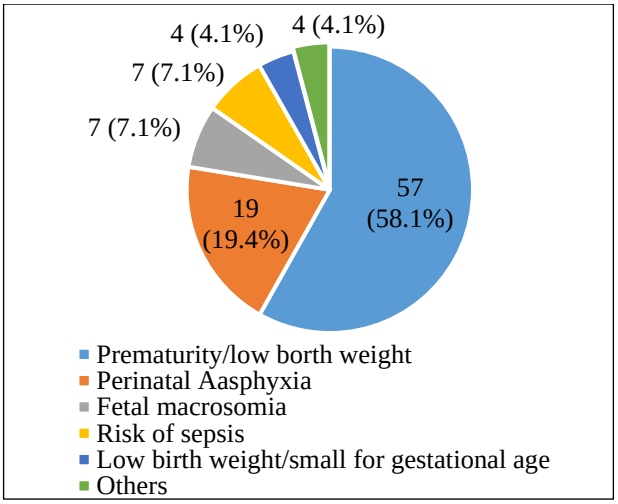

Figure 2: Indications for admission into neonatal intensive care unit.

Maternal and fetal/neonatal characteristics

Table 1 and Table 2 shows the distribution of the maternal and fetal/neonatal characteristics of interest in this study.

Table 1: Sociodemographic characteristics and previous obstetric history.

Characteristics	Frequency N = 556	Percent (%)
Age group		
<20 years	14	2.5
20 - 24 years	41	7.4
25 - 29 years	151	27.2
30 - 34 years	190	34.2
35 - 39 years	129	23.2
>40 years	31	5.6
Mean Age ±SD in years	31.1±5.4	
Level of education		
No formal education	41	7.4
Primary education	47	8.5
Secondary education	233	41.9
Tertiary education	235	42.3
Booking status		
Booked	351	63.1
Unbooked	205	36.9
Parity		
Nulliparous	127	22.8
Primiparous	128	23.0
Multiparous	255	45.9
Grand-multiparous	46	8.3
Parity-Median (range)	2 (0 – 6)	
Previous CS		
Yes	42	7.6
No	514	92.4
Number of previous CS	N = 42	
1	33	78.6
2	8	19.0
3	1	2.4

Table 2: Fetal/neonatal characteristics during labour and delivery.

Characteristics	Frequency N = 583	Percent (%)
Fetal sex		
Male	310	53.2
Female	273	46.8
Number of fetuses		
Singleton	529	95.1
Twin	25	4.5
Triplet	2	.4
Fetal lie		
Longitudinal	562	96.4
Transverse	13	2.2
Oblique	8	1.4
Fetal presentation		
Breech	59	10.1
Shoulder	18	3.1
Cephalic	506	86.8
Fetal maturity		
<37 weeks	109	18.7
37 weeks – 41^{+6} weeks	471	80.8
≥ 42 weeks	3	0.5
Birth weight categories		
1 kg - < 1.5 kg	27	4.7
1.5 kg - < 2.5 kg	83	14.2
2.5 kg - < 4 kg	408	70.0
≥ 4 kg	65	11.1

Association between low fifth minute Apgar score, maternal and fetal/neonatal characteristics (unadjusted model)

There was a significant association between low fifth minute Apgar score, age group of the women, level of education, booking status, mode of delivery, and urgency of caesarean section. The odd of low fifth minute Apgar

score was high below and above the age range of 30-34 years. The odd was significant at age ranges 20 -24 years (OR-2.79; CI - 1.23-6.33; p value - 0.014) and <20 years (OR - 3.28; CI - 1.05-10.2; p value - 0.040). Educational attainment below tertiary education was associated with higher odd of low fifth minute Apgar score. The odd was highest and only significant with primary level of education (OR - 2.26; CI - 1.09-4.69; p value - 0.029). Unbooked women have an almost 7 times higher likelihood of their babies having a low fifth minute Apgar score (OR - 6.77; CI - 4.13-11.1; p value - 0.001) relative to booked women. Delivery by caesarean section increases the odd of low fifth minute Apgar score by 77% relative to vaginal delivery (OR - 1.77; CI - 1.14-2.77; p value - 0.012). Urgent (OR - 15.4; CI - 2.1-115.0; p value - 0.008) and emergency (OR - 36.7; CI - 4.7-287.2; p value - 0.001) caesarean sections are associated with higher odds of low fifth minute Apgar score relative to elective caesarean section (Table 3).

Table 3: Association between low fifth minute APGAR score and maternal characteristics.

Characteristics	APGAR Score (fifth minute)		χ^2	OR (95%CI)	P value
	Low N = 97 (%)	Reassuring N = 486 (%)	(p value)		
Age group of participants					
<20 years	5 (29.40)	12 (70.6)	10.09 (0.007*)	3.28 (1.05-10.2)	0.040*
20 - 24 years	11 (26.2)	31 (73.8)		2.79 (1.23-6.33)	0.014*
25 - 29 years	27 (16.9)	133 (83.1)		1.60 (0.87-2.93)	0.131
30 - 34 years	22 (11.3)	173 (88.7)		1	
35 - 39 years	24 (17.8)	111 (82.2)		1.70 (0.91-3.18)	0.056
>40 years	8 (23.5)	26 (76.5)		2.42 (0.98-6.00)	0.096
Level of education					
No formal education	8 (19.5)	33 (80.5)	5.45 (0.042*)	1.60 (0.68-3.77)	0.284
Primary education	13 (25.5)	38 (74.5)		2.26 (1.09-4.69)	0.029*
Secondary education	44 (17.7)	204 (82.3)		1.42 (0.87-2.33)	0.163
Tertiary education	32 (13.2)	211 (86.8)		1	
Booking status					
Booked	25 (6.8)	341 (93.2)	68.19 (0.001*)	1	
Unbooked	72 (33.2)	145 (66.8)		6.77 (4.13-11.1)	0.001*
Parity					
Nulliparous	22 (16.4)	112 (83.6)	5.69 (0.127)	1	
Primiparous	19 (14.4)	113 (85.6)		0.86 (0.44-1.67)	0.648
Multiparous	42 (15.7)	226 (84.3)		0.95 (0.54-1.66)	0.847
Grand-multiparous	12 (28.6)	35 (71.4)		2.04 (0.94-4.40)	0.070
Onset of labour					
Spontaneous	80 (17.6)	375 (82.4)	4.52 (0.104)	1.67 (0.89-3.13)	0.107
Induction of labour	4 (30.8)	9 (69.2)		3.49 (0.9-12.95)	0.062
CS before labour	13 (11.3)	102 (88.7)		1	
Mode of delivery					
SVD	37 (12.7)	254 (87.3)	6.45 (0.011*)	1	
CS	60 (20.5)	232 (79.5)		1.77 (1.14-2.77)	0.012*
Urgency of CS					
Emergency	20 (39.2)	31 (60.8)	23.54 (0.001*)	36.7 (4.7-287.2)	0.001*
Urgent	39 (21.3)	144 (78.7)		15.4 (2.1-115.0)	0.008*
Elective	1 (1.7)	57 (98.3)		1	

Low APGAR Score <7; Reassuring APGAR score ≥7; OR – Odd ratio; *Statistically Significant; SVD-Spontaneous vaginal delivery, CS-Caesarean section

There was a significant association between low fifth minute Apgar score, fetal maturity, fetal lie, fetal presentation, and birth weight categories. The odd of low fifth minute Apgar score was high in preterm fetuses (OR -4.75; CI - 2.94-7.70; p value - 0.001). Transverse lie increased the likelihood of low fifth minute Apgar score by 3.29 to 1 relative to a longitudinal lie (OR - 3.29; CI - 1.1-10.25; p value - 0.041). Abnormal fetal presentations also increased the odd of low fifth minute Apgar score relative to a normal cephalic presentation. The odd was higher with shoulder presentation (OR-3.84; CI-1.44-10.1; p value 0.007) than breech presentation (OR-2.65; CI-1.44-4.85; p value 0.002). The odd of low fifth minute Apgar score was only slightly higher (0.5%) with fetal macrosomia (OR-1.05; CI-0.47-2.34; p value 0.001). Low birth weight (OR - 3.23; CI-1.85-5.64; p value 0.001) and very low birth weight (OR-10.91; CI-4.8-24.9; p value 0.001) were associated with much higher odds of low fifth minute Apgar score (Table 4).

Table 4: Association between low fifth minute APGAR score and fetal/neonatal characteristics.

Characteristics	APGAR Score (fifth minute)		χ^2	OR (95%CI)	P value
	Low N = 97 (%)	Reassuring N = 486 (%)	(p value)		
Fetal sex					
Male	54 (17.4)	256 (82.6)	0.29 (0.589)	1.13 (0.73 – 1.75)	0.589
Female	43 (15.8)	230 (84.2)		1	
Fetal maturity					
<37 weeks	41 (37.6)	68 (62.4)	59.46 (0.001*)	4.75 (2.94 – 7.70)	0.001*
37 weeks – 41^{+6} weeks	53 (11.3)	418 (88.7)		1	
≥ 42 weeks	3 (100.0)	0 (0.0)			
Birth weight categories					
1 kg - < 1.5 kg	16 (59.3)	11 (59.3)	54.11 (0.001*)	10.91 (4.8 – 24.9)	0.001*
1.5 kg - < 2.5 kg	25 (30.1)	58 (69.9)		3.23 (1.85 – 5.64)	0.001*
2.5 kg - < 4 kg	48 (11.8)	360 (88.2)		1	
≥ 4 kg	8 (12.3)	57 (87.7)		1.05 (0.47 – 2.34)	0.001*
Number of fetuses					
Singleton	91 (17.2)	438 (82.8)	1.91 (0.385)	1.45 (0.60 – 3.52)	0.407
Twin	6 (12.5)	42 (87.5)		1	
Triplet	0 (0.0)	6 (100.0)			
Fetal lie					
Longitudinal	90 (16.0)	472 (84.0)	5.03 (0.048*)	1	
Transverse	5 (38.5)	8 (61.5)		3.29 (1.1 – 10.25)	0.041*
Oblique	2 (25.0)	6 (75.0)		1.75 (0.35 – 8.80)	0.498
Fetal presentation					
Cephalic	72 (14.2)	434 (85.8)	16.72 (0.001*)	1	
Breech	18 (30.5)	41 (69.5)		2.65 (1.44 – 4.85)	0.002*
Shoulder	7 (38.9)	11 (61.1)		3.84 (1.44 – 10.1)	0.007*

Low APGAR Score < 7; Reassuring APGAR score ≥ 7; OR – Odd ratio; *Statistically Significant

Table 5: Predictors of low fifth minute APGAR score.

Characteristics	B-coefficient	Adjusted OR	95%CI for adjusted OR		P value
			Min	Max	
Age group of participants					
<20 years	0.26	1.30	0.28	5.97	0.736
20 - 24 years	-0.21	0.81	0.22	2.99	0.753
25 - 29 years	-0.18	0.84	0.34	2.04	0.691
30 - 34 years	0.12	1.13	0.26	4.87	0.874
35 - 39 years	-0.07	0.94	0.38	2.31	0.886
>40 years		1			
Level of education					
No formal education	0.14	1.15	0.25	5.28	0.854
Primary education	-0.25	0.78	0.24	2.57	0.681
Secondary education	0.39	1.48	0.70	3.15	0.305

Continued.

Tertiary education		1			
Booking status					
Booked	0.83	2.29	1.11	4.71	0.024*
Unbooked		1			
Mode of delivery					
SVD		1			
CS	0.44	1.55	0.95	2.53	0.082
Urgency of CS					
Emergency	2.35	10.44	1.10	99.26	0.041*
Urgent	3.25	25.75	2.58	256.72	0.006*
Elective		1			
Fetal maturity					
<37 weeks	0.33	1.39	0.50	3.88	0.531
37 weeks – 41^{+6} weeks		1			
Birth weight categories					
1 kg - < 1.5 kg	0.53	1.70	0.37	7.91	0.497
1.5 kg - < 2.5 kg	0.02	1.02	0.34	3.10	0.969
2.5 kg - < 4 kg		1			
≥ 4 kg	-0.28	0.76	0.25	2.35	0.632
Fetal presentation					
Cephalic		1			
Breech	0.67	1.96	1.03	3.82	0.049*
Shoulder	0.48	1.62	0.52	5.02	0.405
OR – Odd ratio; *Statistically Significant; SVD – Spontaneous vaginal delivery, CS – Caesarean section					

Association between low fifth minute Apgar score, maternal and fetal/neonatal characteristics (adjusted model)

After adjusting for confounding variables, only unbooked status (OR-2.29; CI-1.11-4.71; p value 0.024), emergency caesarean section (OR-10.44; CI-1.10-99.26; p value -0.041), urgent caesarean section (OR-25.75; CI-2.58-256.72; p value 0.006) and breech presentation (OR-1.96; CI-1.03-3.82; p value 0.049) significantly increased the odd of low fifth minute Apgar score, relative to a booked status, elective caesarean section and cephalic presentation (Table 5).

DISCUSSION

This study was conducted to assess the rate of low fifth minute Apgar score and its determinants at the Federal Medical Centre Yenagoa, Bayelsa State, Nigeria. The incidence rate of low fifth minute Apgar score at the Federal Medical Centre Yenagoa during the study was 16.6%. Compared with other studies in Nigeria, this rate is higher than the 3.3% and 4% reported in Warri and Ibadan, Nigeria by Ugwu et al and Omokodion et al respectively.[27,28] But it is lower than 23.1% reported by Idris et al in Birnin Kudu, northern Nigeria.[29] While this rate is higher than the 1.9% reported from a study in Ghana, and some studies in Ethiopia that reported rates ranging from 6.7% to 13.8%,it is lower than 17.8%, 18.1%, 27.1%, and 32% reported from other studies also done in Ethiopia.[26,9,18-24] Reported rates of low fifth minute Apgar score are much lower outside Africa. It was 0.46% in a study done in Brazil, 0.57% in a study in Peru and 1.2% in a study in the USA.[16,17,15] This variation in rates of low fifth minute Apgar score within and across countries may reflect the varying availability, quality and utilization of antenatal and neonatal services and manpower, and preferences for elective caesarean section over labour or vaginal delivery.

From this study, women who were unbooked were 2.29 times more likely to deliver a neonate with low fifth minute Apgar score than booked women. This is in line with what was reported by Wayessa et al, moreover, the odd of low fifth minute Apgar score was higher at 6.7 times in women who had no antenatal care in their study.[21] Similarly, inadequate antenatal care has also been documented to increase the odd of low fifth minute Apgar score. Wayessa et al found that incomplete antenatal care was associated with a 4.6 times higher likelihood of low fifth minute Apgar score.[21] Less than 6 antenatal visits[16] and lack of antenatal care follow-up increased the likelihood of low fifth minute Apgar score by 2.85 times and 3.5 times respectively in other studies.[43]

Emergency and urgent caesarean section largely increased the likelihood that the fifth minute Apgar score will be low in the newborn by about 10 times and 25 times respectively, over elective caesarean section in this study. Wayessa et al did also report that caesarean section was associated with 2.3 times higher odd of a low fifth minute Apgar score in the neonate, and similarly, the odd

associated with caesarean section as reported in a study in Australia by Lai et al was 2.6.[21,46] The large difference in the odd reported in other studies compared with this study is possibly a result of analysis by urgency of caesarean section in this study. The study by Ajibo et al conducted in Ethiopia to identify determinants of low fifth minute Apgar score among newborns delivered by caesarean section throws more light on the role of caesarean section.[45] They found that skin incision to delivery time and general anaesthesia increased the likelihood of a low Apgar score 5.27 and 3.37 times respectively.

Breech presentation was another factor found to increase the likelihood of low fifth minute Apgar score in this study, increasing the likelihood by 1.96 times. In southwest Nigeria, Omokhodion et al studied the social, obstetric and environmental determinants of low Apgar score among infants born in four selected hospitals in Ibadan, Nigeria, and reported breech presentation as one of the predictors of low Apgar score at five minutes.[28] A similar finding was reported by Dassah et al in Ghana, that breech presentation increased the likelihood of low fifth minute Apgar score by 3.05 times.[26] Lai et al in Australia similarly reported a 2.4 times increased likelihood.[46]

This study is limited by its single centre design which limits the generalizability of the results. Moreover, its cross-sectional design precludes a causal relationship between low fifth minute Apgar score and the associated fetal/neonatal and maternal factors identified in this study. However, the result highlights the patient group and the clinical scenario requiring a focus of intervention.

Multicentre studies that will seek to identify the obstetric and socioeconomic determinants of low fifth minute Apgar score in Bayelsa state is recommended to increase our understanding.

CONCLUSION

Rate of low fifth minute Apgar score was 16.6% in the population studied. An unbooked status, emergency caesarean section, urgent caesarean section and breech presentation were the determinants of low fifth minute Apgar score. This highlights the patient group and the clinical scenario requiring a focus of intervention for prevention of morbidity and mortality from low fifth minute Apgar score.

ACKNOWLEDGMENTS

Authors would like to thank Dr. Azibato B. Benson, a senior registrar in the department of Obstetrics and Gynaecology, Federal Medical Centre Yenagoa, for his contribution to data collection. Also, authors would like to thank Dr. Adedotun D. Adesina, an epidemiologist and biostatistician at the department of medical services, Nigerian Law School Yenagoa campus, for his major role in the analysis of data.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Research Ethics Committee, Federal Medical Centre Yenagoa, Nigeria

REFERENCES

1. Apgar V. A Proposal for a New Method of Evaluation of the Newborn Infant. Anesth Analg. 2015;120(5):1056-9.
2. Apgar V, Holiday DA, James LS, Weisbrot IM, Berrien C. Evaluation of the newborn infant; second report. J Am Med Assoc. 1958;168(15):1985-8.
3. Apgar V, James LS. Further observation on the newborn scoring system. Am J Dis Child. 1962;104(4):419-28.
4. American College of Obstetricians and Gynecologists, American Academy of Pediatrics. The Apgar score. Committee opinion No. 644. American College of Obstetricians and Gynecologists. Obstet Gynecol. 2015;126:e52-55.
5. American Academy of Pediatrics and American Heart Association. Textbook of Neonatal Resuscitation. 6th edition. Elk Grove Village, IL: American Academy of Pediatrics and American Heart Association; 2011.
6. American College of Obstetrics and Gynecology, Task Force on Neonatal Encephalopathy; American Academy of Pediatrics. Neonatal Encephalopathy and Neurologic Outcome, 2nd edition. Washington, DC: American College of Obstetricians and Gynecologists; 2014.
7. Jeganathan R, Karalasingam SD, Hussein J, Allotey P, Reidpath DD. Factors associated with recovery from 1 minute Apgar score <4 in live, singleton, term births: an analysis of Malaysian National Obstetrics Registry data 2010-2012. BMC Preg Childb. 2017;17:110.
8. Aliyu I, Lawal T O, Onankpa B. Hypoxic-Ischemic-Encephalopathy and the Apgar scoring system: The experience in a resource-limited setting. J Clin Sci. 2018;15(1):18-20.
9. Bayih WA, Tezera TG, Alemu AY, Belay DM, Hailemeskel HS, Ayalew MY. Prevalence and determinants of asphyxia neonatorum among live births at Debre Tabor General Hospital, North Central Ethiopia: a cross-sectional study. Afr Health Sci. 2021;21(1):385-96.
10. UNICEF. UNICEF DATA: Neonatal mortality, 2023. Available at: https://data.unicef.org/topic/child-survival/neonatal-mortality/. Accessed 22 April 2023.
11. UNICEF. UNICEF DATA: Newborn care, 2022. Available at: https://data.unicef.org/topic/maternal-health/newborn-care/. Accessed 22 April 2023.
12. Persson M, Razaz N, Tedroff K, Joseph KS, Cnattingius S. Five and Ten minutes Apgar scores and risks of cerebral palsy and epilepsy: a population based cohort study in Sweden. BMJ. 2018;360:k207.

13. Ehrenstein V. Association of Apgar scores with death and neurologic disability. Clin Epidemiol. 2009;1:45-53.
14. Stuart A, Otterblad Olausson P, Källen K. Apgar scores at 5 minutes after birth in relation to school performance at 16 years of age. Obstet Gynecol. 2011;118(2 Pt 1):201-8.
15. Gillette E, Boardman JP, Calvert C, John J, Stock SJ. Associations between low Apgar scores and mortality by race in the United States: A cohort study of 6,809,653 infants. PLoS Med. 2022;19(7):e1004040.
16. Junior LCM, Pinto CN, Gerencer CS, Pro ECG, de Carvalho HB. Association of maternal, fetal and labor variables with a low Apgar score in the fifth minute in term pregnancy: a case-control study. Arch Gynecol Obstet. 2022;1-11.
17. Chiclla MAC, Atencio, Castillo KEA, Arias JPS. Perinatal low fifth-minute Apgar predictors at a Peruvian hospital. Rev Fac Med Hum. 2021;21(1):40-9.
18. Getachew B, Etefa T, Asefa A, Terefe B, Dereje D. Determinants of Low Fifth Minute Apgar Score among Newborn Delivered in Jimma University Medical Center, Southwest Ethiopia. Int J Pediatr. 2020;2020:9896127.
19. Zewude SB, Ajebe TM, Gessesse SS, Wassie TH. Proportion and Predictive factors of low Apgar score at five minute among singleton term neonates delivered in Debre Tabor Specialized hospital, Northwest Ethiopia: A cross-sectional study. Int J Afr Nurs Sci. 2021;15:100322.
20. Mersha A, Shibiru S, Bante A. Meconium-stained liquor and low birth weight increases the odds of low fifth-minute apgar scores in public health facilities of arba minch town, southern Ethiopia: a cross-sectional study. J Pediatr Neonatal Care. 2020;10(3):86-90.
21. Wayessa Z, Belachew T, Joseph J. Birth asphyxia and associated factors among newborns delivered in jimma zone public hospitals, Southwest Ethiopia: a cross-sectional study. J Midwifery Reprod Health. 2018;6(2):1289-95.
22. Gudayu TW. Proportion and factors associated with low fifth minute Apgar score among singleton newborn babies in Gondar University referral hospital; North West Ethiopia. Afr Health Sci. 2017;17(1):1-6.
23. Admasu FT, Melese BD, Amare TJ, Zewude EA, Denku CY, Dejenie TA. The magnitude of neonatal asphyxia and its associated factors among newborns in public hospitals of North Gondar Zone, Northwest Ethiopia: A cross-sectional study. PLoS ONE. 2022;17(3):e0264816.
24. Jamie AH, Abdosh MZ. Prevalence and risk factors of perinatal asphyxia in a tertiary care level hospital, Harari Regional State, Ethiopia. J Nepal Paediatr Soc. 2019;39(2):103-8.
25. Workineh Y, Semachew A, Ayalew E, Animaw W, Tirfie M, Birhanu M. Prevalence of perinatal asphyxia in East and Central Africa: systematic review and meta-analysis. Heliyon. 2020;6(4):e03793.
26. Dassah ET, Odoi AT, Opoku BK. Stillbirths and very low Apgar scores among vaginal births in a tertiary hospital in Ghana: a retrospective cross-sectional analysis. BMC Pregnancy Childbirth. 2014;14:289.
27. Ugwu GI, Abedi HO, Ugwu EN. Incidence of birth asphyxia as seen in central hospital and GN children's clinic both in Warri Niger Delta of Nigeria: an eight year retrospective review. Glob J Health Sci. 2012;4(5):140-6.
28. Omokhodion FO, Roberts OA, Onadeko MO, Beach JR, Cherry N, Burstyn I. Social, obstetric and environmental determinants of low Apgar score among infants born in four selected hospitals in Ibadan, Nigeria. J Obstet Gynaecol. 2018;38(4):454-60.
29. Idris UA. Perinatal asphyxia in term neonates seen in Federal Medical Centre, Birnin Kudu, Nigeria. Int J Health Allied Sci. 2019;8:44-7.
30. Yelamali B, Panigatti P, Pol R, Talawar K, Naik S, Badakali A. Outcome of newborn with birth asphyxia in tertiary care hospital-a retrospective study. Medica Innovatica. 2014;3(2):59-64.
31. Trotman H, Garbutt A. Predictors of outcome of neonates with hypoxic ischaemic encephalopathy admitted to the neonatal unit of the University Hospital of the West Indies. J Trop Pediatr. 2010;57(1):40-44.
32. Yadav S, Shah GS, Poudel P, Mishra OP. Risk factors for adverse outcome in asphyxiated newborn in Eastern Nepal. Int J Comm Med Pub Heal. 2017;3(6):1419-23.
33. Agrawal J, Yadav S, Chaudhary S, Kafle S. Treatment and outcome of neonates with hypoxic ischaemic encephalopathy at BP Koirala Institute of Health Sciences. Sri Lanka J Child Heal. 2017;46(2).
34. Seyal T, Hanif A. Factors related to adverse outcome in asphyxiated babies. Ann King Edw Med Univ. 2009;15(4):180-0.
35. Adebami OJ. Maternal and fetal determinants of mortality in babies with birth asphyxia at Osogbo, Southwestern Nigeria. Glo Adv Res J Med Med Sci. 2015;4(6):270-6.
36. Padayachee N, Ballot DE. Outcomes of neonates with perinatal asphyxia at a tertiary academic hospital in Johannesburg, South Africa. SAJCH S Afr J Child Health. 2013;7(3):89-94.
37. Ekwochi U, Asinobi NI, Osuorah CD, Ndu IK, Ifediora C, Amadi OF, et al. Incidence and Predictors of Mortality Among Newborns with Perinatal Asphyxia: A 4-Year Prospective Study of Newborns Delivered in Health Care Facilities in Enugu, South-East Nigeria. Clin Med Insights Pediatr. 2017;11:1179556517746646.
38. Yitayew YA, Yalew ZM. Survival status and predictors of mortality among asphyxiated neonates admitted to the NICU of Dessie comprehensive specialized hospital, Amhara region, Northeast Ethiopia. PLoS ONE. 2022;17(12):e0279451.
39. Ketema DB, Aragaw FM, Wagnew F, Mekonnen M, Mengist A, Alamneh AA, et al. Birth asphyxia related

mortality in Northwest Ethiopia: A multi-centre cohort study. PLoS ONE. 2023;18(2):e0281656.
40. Kawakami MD, Sanudo A, Teixeira MLP, Andreoni S, de Castro JQX, Waldvogel B, et al. Neonatal mortality associated with perinatal asphyxia: a population-based study in a middle-income country. BMC Pregnancy Childbirth. 2021;21:169.
41. Mu Y, Li M, Zhu J, Wang Y, Xing A, Liu Z, et al. Apgar score and neonatal mortality in China: an observational study from a national surveillance system. BMC Pregnancy Childbirth. 2021;21:47.
42. Abukari AS, Awuni N, Yakubu I, Mohammed S, Yakubu A, Yakubu S. Factors associated with low fifth minute Apgar score in term and preterm singleton live births in a Ghanaian hospital. J Neonatal Nurs. 2021;27(6):476-82.
43. Yeshaneh A, Kassa A, Kassa ZY, Adane D, Fikadu Y, Wassie ST, et al. The determinants of 5th minute low Apgar score among newborns who delivered at public hospitals in Hawassa City, South Ethiopia. BMC Pediatr. 2021;21(1):266.
44. Tavares VB, E Souza JS, Affonso MVG, Da Rocha EM, Rodrigues LFG, da Costa Moraes LF, et al. Factors associated with 5-min APGAR score, death and survival in neonatal intensive care: a case-control study. BMC Pediatr. 2022;22(1):560.
45. Ajibo BD, Wolka E, Aseffa A, Nugusu MA, Adem AO, Mamo M, et al. Determinants of low fifth minute Apgar score among newborns delivered by cesarean section at Wolaita Sodo University Comprehensive Specialized Hospital, Southern Ethiopia: an unmatched case control study. BMC Pregnancy Childbirth. 2022;22(1):665.
46. Lai S, Flatley C, Kumar S. Perinatal risk factors for low and moderate five-minute Apgar scores at term. Eur J Obstet Gynecol Reprod Biol. 2017;210:251-6.
47. Bayelsa State. Website of the Bayelsa State government, 2022. Available at: https://bayelsastate.gov.ng/. Accessed on 28 April 2023.

Cite this article as: Makinde OI, Awotundun BO, Osegi N. Rate and determinants of low fifth minute Apgar score at the federal medical centre Yenagoa, Bayelsa State, Nigeria. Int J Reprod Contracept Obstet Gynecol 2023;12:1960-8.