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# Maternal sociodemographic factors associated with low Apgar scores: A hospital based cross-sectional study

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**Abstract:** *Background:* Neonatal mortality has been a major concern, especially in low-and-middle income-countries (LMIC). Globally, 2.3 million babies died in the first month of life in 2022 putting the neonatal mortality rate at 17 deaths per 1000 live births. The Apgar score remains a valuable tool for assessing whether or not the baby has tolerated the transition from intrauterine to extra uterine life. This study aimed to determine the maternal sociodemographic factors associated with low Apgar scores define as score of ≤ 6 at the 5th minute of life and the outcome of these babies.
*Methodology:* This is a prospective hospital-based cross-sectional study. Consecutive term babies delivered at the labour ward, with Apgar scores ≤ 6 at the 5th minute of life, who met the inclusion criteria, were recruited into the study. Each baby was monitored and followed up, and the outcome of admission was documented. Logistic regression was used to determine the factors associated with a low Apgar score.
*Result:* Five hundred and sixty term babies were delivered during the 10-month study period. Ninety -nine (17.7%) term babies had an Apgar score of ≤ 6 at the 5th minute of life. Seven term babies were excluded. Ninety-two (16.4%) term babies with Apgar score of ≤ 6 at 5th minutes of life were recruited into the study. Low Apgar score was significantly associated with low socio-economic class (aOR 8.408 95%CI 3.789-18.264, p<0.001); Unbooked (aOR 17.480, 95%CI 9.761-31.303, p<0.001); Antenatal care at maternity centres (aOR 28.111, 95%CI 14.432-54.575, p<0.001); Antenatal care in mission homes (aOR 18.208, 95%CI8.323-39.832, p <0.001). Sixty-five per cent of the babies had HIE, 72(78.3) were discharged home, 4 discharged against medical advice and 16 (17.4%) of the babies died.
*Conclusion:* Maternal factors associated with low Apgar scores include primiparity, low socio-economic class, and receiving antenatal care at maternity centres or mission homes.

**Key word:** Newborn, Apgar score, Neonatal Mortality.

**Résumé:** *Contexte:* La mortalité néonatale reste un problème majeur, en particulier dans les pays à revenu faible et intermédiaire (PRFI). En 2022, 2,3 millions de nouveau-nés sont décédés dans le premier mois de vie à l'échelle mondiale, soit un taux de mortalité néonatale de 17 décès pour 1 000 naissances vivantes. Le score d'Apgar demeure un outil précieux pour évaluer l'adaptation du nouveau-né à la vie extra-utérine. Cette étude visait à identifier les facteurs sociodémographiques maternels associés à un faible score d'Apgar, défini comme un score ≤ 6 à la cinquième minute de vie, ainsi que les issues cliniques de ces nouveau-nés.
*Méthodologie:* Il s'agit d'une étude transversale prospective menée en milieu hospitalier. Les nouveau -nés à terme, nés consécutivement en salle d'accouchement avec un score d'Apgar ≤ 6 à la cinquième minute de vie et remplissant les critères d'inclusion, ont été recrutés. Chaque nouveau-né a été suivi et l'issue de l'hospitalisation a été documentée. Une régression logis

logistique a été utilisée pour identifier les facteurs associés à un faible score d'Apgar.
*Résultats:* Cinq cent soixante (560) nouveau-nés à terme ont été enregistrés durant les 10 mois de l'étude. Quatre-vingt-dix-neuf (17,7 %) d'entre eux présentaient un score d'Apgar ≤ 6 à la cinquième minute de vie. Sept cas ont été exclus. Quatre-vingt-douze (16,4 %) nouveau-nés à terme ont finalement été inclus. Un faible score d'Apga rétait-significativementassociéà :

- une classe socio-économique basse (aOR 8,408 ; IC 95 % : 3,789–18,264 ; p < 0,001),
- l'absence de suivi prénatal (« non-booked ») (aOR 17,480 ; IC 95 % :9,761–31,303;p < 0,001),
- le suivi prénatal dans des centres de maternité (aOR 28,111 ; IC 95 % : 14,432–54,575 ; p < 0,001),
- le suivi dans des structures missionnaires (aOR 18,208 ; IC 95 % : 8,323–39,832 ; p < 0,001).

Soixante-cinq pour cent des nourrissons présentaient une encéphalopathie hypoxo-ischémique (EHI). Soixante-douze (78,3 %) ont été renvoyés à domicile, quatre sont sortis contre avis médical, et seize (17,4 %) sont décédés.
*Conclusion:* Les facteurs maternels associés à un faible score d'Apgar comprennent la primiparité, une classe socio-économique basse, et un suivi prénatal effectué dans des centres de maternité ou des structures missionnaires.

**Mots-clés:** Nouveau-né, score d'Apgar, mortalité néonatale.

## Introduction

The Apgar score has been used to assess newborns at birth. It conveys information about the newborn's transition from intrauterine to extrauterine life, the overall status at birth and response to resuscitation.[1] The Apgar score was devised in 1952 by Virginia Apgar and is universally accepted.[2] It was developed as an objective clinical tool that assessed five parameters of physiological adaptation to extrauterine life. These are colour, heart rate, muscle tone, reflex irritability, and respiratory effort.[3] Each parameter is assessed using values ranging from 0 to 2, and a maximum of 10 and a minimum of 0. The score is reported at the 1st and 5th minutes of life for all infants and then at 5-minute intervals until 20 minutes for infants with a score less than seven.[4] A low Apgar score may be due to adverse intrapartum events but may also be affected by trauma, gestational age, maternal sedation and anaesthesia, and interobserver variability.[5] Newborns with low Apgar scores often have poor neonatal outcomes, especially with issues related to gas exchange and if left unattended to promptly, this can lead to hypercapnia, hypoxemia, and severe metabolic acidosis.[6] A low Apgar score can result in hypoxic-ischaemic injury, which may cause multiple organ insults. Studies have shown that a 5th minute Apgar score of 0-3 correlates with mortality.[7, 8] In a study done among preterm babies, 81% of babies with low Apgar score at the 5th minute of life had poor outcome.[9] A low Apgar score at the 5th minute of life is a major determinant of a newborn's ability to develop well, so it is a better predictor of survival than the 1-minute low Apgar score.[10]

Birth asphyxia is defined as the failure to initiate and sustain breathing at birth.[11] The assessment at birth is often by the use of Apgar score. Ideally, diagnosis of birth asphyxia should be based on the Umbilical cord arterial pH less than 7; Apgar score of less than 3 for longer than 5 minutes; Neonatal neurological manifestations (e.g., seizures, coma, or hypotonia); and Multisystem organ dysfunction (MOD), involving cardiovascular, gastrointestinal, haematological, pulmonary, and renal systems but blood gas analysis is not available in many centres where birth asphyxia is a major problem.[12]

Birth asphyxia contributes significantly to neonatal mortality worldwide, accounting for 24% of all neonatal deaths and 11% of under-5 mortality.[13-16] Nearly all deaths related to asphyxia (98%) occur within the first week of life.[17] Approximately 75% of these deaths take place on the first day, and less than 2% occur after 72 hours of life.[17]
Although a low Apgar score is not a diagnosis but a clinical finding. Many centres use the Apgar score as part of the diagnostic criteria for birth asphyxia, while some centres make diagnoses of birth asphyxia based on the Apgar score only because the facility for blood gases is not available.[5,7] This study aimed to determine the maternal socio-demographic factors associated with low Apgar scores (A score of ≤ 6 at 5th minute of life) at a tertiary hospital in southwest Nigeria and the outcomes of these babies with low Apgar scores admitted to the newborn unit of the same hospital.

## Material and Methods

*Study design*

This prospective hospital-based cross-sectional study was conducted for ten months at the labour ward and the special care baby unit of a tertiary hospital in Southwest Nigeria. Admission records revealed an average of seventy admissions per month, with about 40 per cent of the admissions resulting from birth asphyxia. Prematurity, neonatal sepsis and jaundice are the other common reasons for admission into the unit.

*Recruitment of subject*

Consecutive term babies delivered at the labour ward during the study period and met the inclusion criteria were recruited into the study by the investigator. A low Apgar score was defined as ≤ 6 at the 5th minute of life. The investigator determined the Apgar scores at 1 and 5 minutes of life after birth and every five minutes for 20 minutes if the score is less than 7. When the investigator was unavoidably absent, a resident doctor trained in the study's methodology did the assessment and the Apgar scoring.

Babies with low Apgar scores were admitted into the newborn unit. Detailed clinical and neurological evaluations were conducted within fifteen minutes of resuscitation, and the babies were monitored for signs of hypoxic -ischaemic encephalopathy by the investigator and resident doctors in the newborn unit. The grading of hypoxic-ischaemic encephalopathy (HIE) was based on the level of consciousness, muscle tone, the occurrence of a seizure, sucking and respiration pattern according to Levene's classification of HIE.[18] The weight, length, occipitofrontal circumference, respiratory rate, heart rate, and systemic examinations were recorded. The primitive reflexes were also assessed during the neurologic examination on admission and regularly as part of follow-up evaluation.

Each baby was monitored and followed up, and the outcome of admission was documented as discharge, discharge against medical advice (DAMA), or death.
Maternal data collected included age, parity, marital status, history of antenatal care, labour and delivery, and any relevant drug history. The socio-economic status of the parents of each baby was assessed using the method described by Oyedeji.[19]

In this study, socio-economic class 1 was described as high-class, socio-economic class 2 as upper middle class, socio-economic class 3 as lower middle class, and socio-economic class 4 as low class.
Data were entered into a proforma designed explicitly for the study and then transferred to an electronic database.

*Data Analysis*

The data were analyzed using the Statistical Package for Social Sciences (SPSS) for Windows version 22.0. [20] Proportions and percentages were determined for discreet variables such as sex, Apgar score, and outcome of admission. Bi-variable associations were assessed using Pearson's Chi-square ($\chi 2$) and Fisher's exact test as appropriate. Binary Logistic regression was used to identify factors associated with low Apgar scores. A two -tailed test set a statistically significant level at a p-value $< 0.05$.

*Ethical consideration*

This study was approved by the Ethics and Research Committee of the hospital. Informed consent was also obtained from the parents/caregivers of the babies.

## Result

During the study period, a total of 560 term babies were delivered. Among them, 304 were males, resulting in an M: F ratio of 1.2:1. Of these, 99 babies (17.7%) had an Apgar score of ≤ 6 at 5 minutes of life. Seven term babies were excluded from the study because they were born to mothers who had pre-eclampsia or eclampsia and had received magnesium sulphate prior to delivery. Consequently, 92 term babies (16.4%) were included in the study. The birth weights of the included babies ranged from 2.95 kg to 3.95 kg, with a median weight of 3.3kg. Among the babies with low Apgar scores, 72 (78.3%) were males, leading to a male-to-female ratio of 3.6:1. Additionally, more than two-thirds (69.6%) of the babies with low Apgar scores were born to parents from the low socio-economic class. In comparison, only eight babies (8.7%) were born to parents from upper socio-economic class. Even though most mothers of babies with low Apgar scores live in Ilesa, only a few (4.2%) registered for antenatal care at the teaching hospital. Most sought antenatal care at maternity centres (47.8%) and mission homes (21.7%), where they planned to deliver their babies.
Maternal ages ranged from 22 to 39 years for babies born with low Apgar scores. Significant portions (82.6%) of the mothers were first-timers (primiparous women) Table 1.
Most of the babies with low Apgar scores (94.4%) were delivered via spontaneous vaginal delivery. In addition, 12 babies (13.0%) were delivered through assisted breach delivery, and the other babies (13.0%) were via emergency Caesarean section. Table 1 illustrates the socio-demographic characteristics of the mothers of babies with low Apgar scores.

*Factors associated with risk of low Apgar score*

On bivariable analysis, the factors that were found to be associated with a low Apgar score include the distance from residence ($\chi 2=42.99$, $p< 0.001$), socio-economic class ($\chi 2=112.430$, $p< 0.001$), booking status ($\chi 2=133.803$, $p< 0.001$), place of antenatal care ($\chi 2=154.833$, $p< 0.001$), mode of delivery($\chi 2=48.839$, $p< 0.001$), age of the mother($\chi 2=65.33$, $p< 0.001$) and parity($\chi 2=83.275$, $p<0.001$). These results show a significant association between these factors and low Apgar scores, Table 1.

On multivariable analysis, several factors were found to increase the risk of having a baby with a low Apgar score at 5th minute of life. Mothers who do not live near the teaching hospital had a significantly higher risk (adjusted odds ratio [aOR]: 7.847; 95% confidence interval [CI]: 3.846-15.848). Similarly, mothers from low socio-economic class (aOR: 8.408; 95% CI: 3.789-18.264), those who were unbooked (aOR: 17.480; 95% CI: 9.761-31.303), and those who received antenatal care at maternity centres (aOR: 28.111; 95% CI 14.432-54.575) and mission homes (aOR: 18.208; 95% CI: 8.323-39.832) had increased risk. Additionally, assisted breech deliveries were associated with heightened risk (aOR: 3.321; 95% CI: 0.968-11.394). Other factors include lower maternal age and being a first-time mother, as shown in Table 2

Fig 1 illustrates the proportion of babies with low Apgar scores among mothers who booked at this facility com

pared to unbooked ones. Fig 2 depicts the places where unbooked mothers received antenatal care (ANC)

The outcome of babies with Low Apgar score;

Occurrence of hypoxic ischaemic Encephalopathy (HIE)

Table 3 shows the proportion of babies with hypoxic-ischaemic encephalopathy as relate to Apgar score at 5th minute of life. The most common clinical feature observed was seizures.

Among the 92 babies with low Apgar scores, over sixty-five per cent (60 babies) had HIE. All babies who had Apgar scores of 2, 3 or 4 at 5th minute of life were diagnosed with HIE. Additionally, 71.4 per cent of babies with an Apgar score of 5 at 5th minute had HIE, while only 20 per cent of babies with an Apgar score of 6 at 5th minute of life had HIE. A statistically significant relationship existed between low Apgar score and HIE ($\chi 2 = 407.1$, df-8, $P<0.001$).

Outcome of Admission of babies with low Apgar score at 5th minute of life. The majority (72 /92) of the babies were discharged home. Four of the babies were discharged against medical advice, and sixteen (17.4%) of the babies died, as shown in Fig 3. Table 4 depicts the outcome based on the Apgar scores. Notably, all babies with an Apgar score of 2 at 5th minutes of life died, while all those with an Apgar score of 6 at 5th minute survived.

**Table 1:** Socio-demographicand general information of the babies in the study and their mothers

| Variables | Low Apgar Score, n = 92(%) | Normal Apgar Score, n = 468(%) | Total, n = | χ2 | *P-value* |
|---|---|---|---|---|---|
| *Gender* | | | | 25.499 | <0.001 |
| Male | 72(78.3) | 232(49.6) | 304(54.3) | | |
| Female | 20(21.8) | 236(50.4) | 256(45.7) | | |
| *Parent Resident* | | | | 42.99 | <0.001 |
| Within Ilesa | 72(78.3) | 452(96.6) | 524(93.6) | | |
| Outside Ilesa | 20(21.8) | 16(3.4) | 36(6.4) | | |
| *Social Economic Status* | | | | 112.420 | <0.001 |
| Social Class 1 | 8(8.7) | 84(17.9) | 92(16.4) | 4.795 | |
| Social Class 2 | 4(4.3) | 120(25.6) | 124(22.1) | 20.221 | |
| Social Class 3 | 16(17.4) | 184(39.3) | 200(35.7) | 16.098 | |
| Social Class 4 | 64(69.6) | 80(17.1) | 144(25.7) | 110.817 | |
| *Booking* status | | | | 133.803 | <0.001 |
| Booked in the Facility | 16(17.4) | 368(78.6) | 384(68.6) | | |
| Unbooked | 76(82.6) | 100(21.4) | 176(31.4) | | |
| *Place of ANC* | | | | 154.833 | <0.001 |
| WGH | 16(17.4) | 368(78.6) | 384(68.6) | | |
| Private Hospital | 4(4.3) | 0(0.0) | 4(0.7) | | |
| Maternity centre | 44(47.8) | 36(7.7) | 80(14.3) | | |
| Mission homes(Church) | 20(21.7) | 24(5.1) | 44(7.9) | | |
| Other Govt. Hospital | 8(8.7) | 36(7.7) | 44(7.9) | | |
| No ANC | 0 (0.0 ) | 4(0.9) | 4(0.7) | | |
| *Mode of Delivery* | | | | 48.839 | <0.001 |
| SVD | 68(73.9) | 360(76.9) | 428(76.4) | | |
| Emergency C/S | 12(13.0) | 104(22.4) | 116(20.7) | | |
| Elective C/S | 0(0.0) | 4(0.9) | 4(0.7) | | |
| Assisted Breech delivery | 12(13.0) | 0(0.0) | 12(2.1) | | |
| *Age of Mother* | | | | 65.33 | <0.001 |
| 20-29 | 76(82.6) | 180(38.5) | | | |
| 30-39 | 16(17.4) | 272(58.5) | | | |
| 40-49 | 0(0.0) | 16(3.4) | | | |
| *Parity* | | | | 83.275 | <0.001 |
| Primipara | 76(82.6) | 148(31.6) | 224(40.0) | | |
| Multipara | 16(17.4) | 320(68.4) | 336(60.0) | | |

**Fig 1:** Proportion of babies with low Apgar score among women that are booked and unbooked

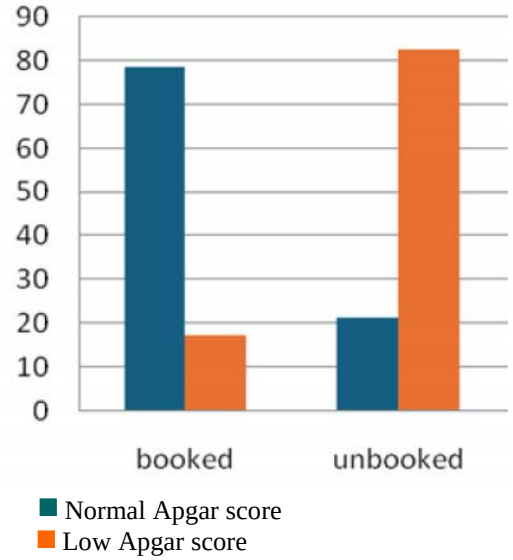



**Fig 2:** Place of antenatal care for unbooked mothers

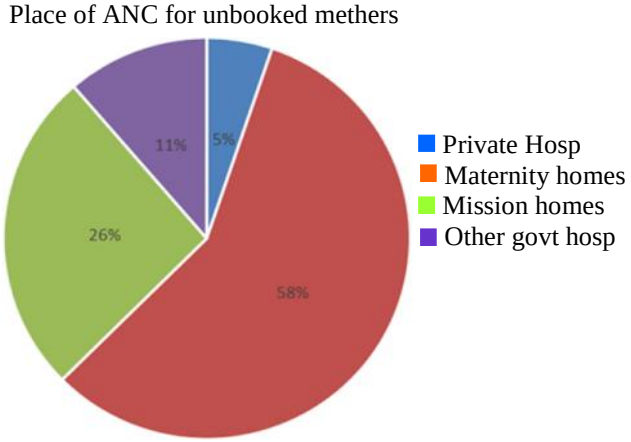



**Table 2:** Bivariate analysis of socio-demographic factors and other risk factors associated with low 5th minute Apgar score

| Variables | B | OR | P-value | 95%CI for EXP(B) |
|---|---|---|---|---|
| *Sex* | | | | |
| Male | | 1 | | |
| Female | -1.298 | 0.273 | 0.000* | 0.161-0.463 |
| *Parental Resident* | | | | |
| Within Ilesa | | 1 | | |
| Outside | 2.060 | 7.847 | 0.000 | 3.846-15.848 |
| *Social Economic status* | | | | |
| Social Class 1 | | 1 | 0.000 | |
| Social Class 2 | -1.050 | 0.350 | 0.095 | 0.102-1.20 |
| Social Class 3 | -0.091 | 0.913 | 0.841 | 0.376-2.217 |
| Social Class 4 | 2.128 | 8.408 | 0.000* | 3.789-18.264 |
| *Booking status* | | | | |
| Booked | | 1 | | |
| Unbooked | 2.861 | 17.480 | 0.000* | 9.761-31.303 |
| *Place of ANC* | | | | |
| WGH | | 1 | 0.000 | |
| Private hospital | 24.338 | 0.000 | 0.999 | 0.0000 |
| Maternity centre | 3.336 | 28.111 | 0.000* | 14.432-54.575 |
| Church | 2.953 | 18.208 | 0.000* | 8.323-39.832 |
| No ANC | -18.067 | 0.000 | 0.999 | 0.000 |
| Other government Hospital | 1.631 | 5.111 | 0.000* | 2.047-12.763 |
| *Mode of Delivery* | | | | |
| SVD | | 1 | 0.531 | |
| Emergency CS | -0.493 | 0.611 | 0.138 | 0.318-1.172 |
| Elective CS | -19.536 | 0.000 | 0.999 | 0.000 |
| Assisted Breach delivery | 22.869 | 3.321 | 0.998 | 0.968-11.394) |
| *Maternal Age* | | | | |
| 20-29 | | 1 | 0.000 | |
| 30-39 | -1.971 | 0.108 | 0.000* | 0.061-0.192 |
| 40-49 | -20.341 | 0.000 | 0.998 | 0.000 |
| *Parity* | | | | |
| Primipara | | 1 | 0.000 | |
| Multipara | -2.224 | 0.139 | 0.000* | 0.079-0.247 |
| Grand Multipara | -20.536 | 0.000. | 0.998 | 0.000 |

* Statistically significant relationship

**Table 3:** Low Apgar score at 5-minute as relate to Hypoxic Ischaemic Encephalopathy

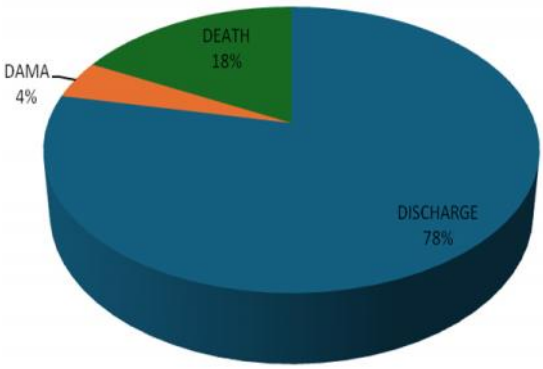
| APGAR Score | HIE Yes | HIE No | Percentage |
|---|---|---|---|
| 2 | 4 | 0 | 4(100.0) |
| 3 | 8 | 0 | 8(100.0) |
| 4 | 4 | 0 | 4(100.0) |
| 5 | 40 | 16 | 56(71.4) |
| 6 | 4 | 16 | 20(20.0) |

Pearson's Chi-square ($\chi^2$) 407.1, df-8, *P*= 0.000

**Table 4:** Outcome of admission as relate to Low

| Apgar score | No | Discharge (%) | DAMA (%) | Death (%) |
|---|---|---|---|---|
| 2 | 4 | 0(0) | 0(0) | 4(100) |
| 3 | 8 | 4(50) | 0(0) | 4(50) |
| 4 | 4 | 4(100) | 0(0) | 0(0) |
| 5 | 56 | 44(78.6) | 4(7.1) | 8(14.3) |
| 6 | 20 | 20(100) | 0(0) | 0(0) |

**Fig 3:** Outcome of Admission



## Discussion

This study has shown the maternal socio-demographic factors associated with low Apgar score of ≤ 6 at the 5th minute of life of babies delivered at a tertiary hospital in southwest Nigeria and the outcomes of these babies with low Apgar scores admitted to the newborn unit of the same hospital. It also highlighted the prevalence of low Apgar scores at the 5th minute of life among term babies delivered in our facility.

In this study, the prevalence of babies with low Apgar scores at the 5th minute of life was 16.4%. This result was similar to what Makinde et al. reported from Bayelsa state in south-south Nigeria, where he reported a prevalence of 16.6%. Still, the rate is higher than the 3.3% and 4% reported in Warri and Ibadan, Nigeria, by Ugwu et al. and Omokodion et al., respectively.[12,21,22] However, it is lower than the 23.1% reported by Idris et al. in Birnin Kudu, northern Nigeria and an institution-based study in Southwest Ethiopia (35.7%).[23,24] Other studies conducted among immigrants in Italy from West and sub-Saharan and North African regions and a study in Uganda found that the proportions of babies with low Apgar scores at the 5th minute of life were 3.9%, 1.8%, and 8.4%, respectively. [25,26] These observations may reflect the varying quality, availability, and utilization of antenatal and neonatal care and different patient mixes.

The findings of this study show that more males had low Apgar scores, which is consistent with a survey conducted in Warri but different from the study at Gusau, also in Nigeria.[27,28] The higher number of males in this study may be due to the higher birth rate of males during the study period, and also, studies show that boys tend to have a higher birth weight than girls, which may contribute to an increased risk of delivery complications and birth injuries.[29,30] Understanding these differences can help healthcare providers anticipate challenges and improve care during childbirth.

This study shows that for mothers who reside in other towns and are referred to the hospital, their babies are at higher risk of low Apgar scores. It shows that the farther away the residence is from the hospital, the more likely the baby will have a low Apgar score. The study also showed an association between low Apgar scores and socioeconomic class. Babies born to women from a low economic class, defined by their level of education and occupation, are at an 8 times higher risk of having a low Apgar score compared to those born to mothers from a high socioeconomic class. This finding was similar to what was reported from Sweden by Davis Odd et al.[31] This difference is likely due to the out-of-pocket healthcare financing system in many centres in Nigeria, particularly affecting the low socioeconomic group, who lack access to a national health insurance scheme.

In this study, low Apgar scores were more common in babies born to mothers who did not receive antenatal care (ANC) at the hospital. Mothers who received ANC at the maternity centre were 28 times and in the mission homes 18 times at risk of having babies with low Apgar scores at the 5th minute of life. This finding is similar to that of Ogunniyi et al. in Ile-Ife,Nigeria.[32] Most of these mothers sought ANC at maternity centres and mission homes, only going to the hospital when complications arose. In these maternity centres, referral decisions often occur late due to the lack of skilled birth attendants who can initiate referrals when necessary. As a result, infants are usually delivered vaginally and in a distressing condition, leading to low Apgar scores. This is why babies born vaginally to unbooked women were significantly more likely to have low Apgar scores, as observed in this study, which is consistent with what was reported in Warri and India.[33,34] The parity of mothers was found to have a significant relationship with the low Apgar score at the 5th minute of life. Multiparity has a protective effect, similar to what Onyiriuka reported in Benin but different from a report from Gusau.[28,35]Our study highlighted primiparity to be a risk factor for low Apgar score; they constituted the majority of the mothers, similar to what was reported by Dalal et al, Onyearugha et al and Kinoti.[33,34,36] It has been shown that primiparous women are often ignorant of the demands of pregnancy, neglecting early booking and regular attendance to antenatal care. This may result in complications of prolonged labour, which may lead to the delivery of babies with low Apgar scores.

The study found that babies with low Apgar scores at the 5th minute of life were more likely to have hypoxic-ischaemic encephalopathy (HIE) and a higher risk of dying. The Apgar score at the 5th minute of life assesses a baby's condition at birth. In this study, the incidence of HIE was found to be 65%, which is higher than previous studies that estimated the incidence of HIE to be 1 to 8 per 1,000 live births.[37] This difference is because the present study focused only on babies with low Apgar scores, which are significantly associated with HIE compared to live births generally. While many of these babies were discharged home, they may have late complications such as microcephaly, delayed developmental milestones, seizure disorders, and learning difficulties. Some of them may even develop blindness or deafness. The study also found that the case fatality rate among babies with low Apgar scores was 17.4%, which is higher than the neonatal mortality rate in Nigeria and the neonatal death rate in Abuja but similar to a previous study by Ogunlesi and Ilah.[28,38,39] The difference may be due to the criteria for selecting subjects. In this study, the babies with low Apgar scores were all in-borns whose conditions were assessed at birth by an expert, which puts them at a higher risk of dying as compared to the Gusau study, where out borns were included. The expert did not assess their condition at birth. Therefore, babies whose Apgar scores are unknown or whose Apgar scores were low for other reasons may have been included.

## Conclusion

The findings of this study have shown some maternal socio-demographic factors associated with low Apgar scores at the 5th minute of life in southwest Nigeria and the outcome of these babies with low Apgar scores. The maternal factors associated with low Apgar score include low socio-economic status, lack of proper ANC in the hospital and attending ANC in maternity centres or mission homes that lack appropriate expertise. There is a significant relationship between a low Apgar score at the 5th minute of life and hypoxic-ischaemic encephalopathy, and the fatality rate among these babies is very high (17.4%). There is a major concern about the low proportion of women who receive appropriate ANC in southwest Nigeria. Subsidising or providing free ANC to encourage more pregnant women to register for ANC in hospitals is essential so deliveries are monitored and handled by skilled birth attendants.

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