Factors associated with low fifth minute Apgar score in term and preterm singleton live births in a Ghanaian hospital

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Abstract

Background: Apgar score remains the most effective measure of newborn health outcomes in the first few minutes of delivery and it is useful in diagnosing perinatal asphyxia and metabolic acidosis.

Methods: This retrospective cross-sectional study was conducted at the Baptist Medical Centre in the North East Region of Ghana. For the period January 1 to December 31 2018, we extracted information on 3011 women who delivered at the facility from birth records. Binary logistic regression models were used to determine the factors associated with low fifth minute Apgar score, preterm low fifth minute Apgar score, and term low fifth minute Apgar score.

Results : Nearly half of the participants had experienced 2 to 5 pregnancies (47.1%) and had given birth to 2 to 5 children (47.7%). Most of the women delivered at 37 weeks gestation or more (87.6%), attended 1 to 4 antenatal care visits (53.2%), and received 1 to 3 doses of sulfadoxine-pyrimethamine (70.9%). The majority of the newborns weighed 2.5kg or more at birth (90.7%), were delivered through the vagina (79.8%), and a little over half of them (51.40%) were males. After adjusting for potential confounders, we found evidence that multigravid women were 0.67 (95% CI 0.49 - 0.90) times less likely to deliver a child with low fifth minute Apgar score while delivery at less than 37 weeks gestation, birth weight of less than 2.5kg, and caesarean delivery were associated with increased odds of low fifth minute Apgar score. For infants born at term, being born to a multigravid mother was protective against low fifth minute Apgar score while delivery through caesarean section increased the odds of low fifth minute Apgar score among this group of newborns. Among preterm infants, our study found strong evidence that those born with low birth weight (<2.5kg) had about 4 times the odds of suffering low fifth minute Apgar score compared to those with normal birth weight.

Conclusion: In designing interventions to improve the survival and the Apgar score of newborns, measures to properly diagnose and prevent preterm delivery and low birth weight should be of great concern.

Plain English Summary

The aim of the study was to examine the specific maternal, obstetrics and socio-demographic factors that influence low fifth minute Apgar score among term and preterm single live births in the North

East Region of Ghana. We extracted information on 3011 women who delivered at the facility from birth records and analysed the data to determine the factors associated with low fifth minute Apgar score, preterm low fifth minute Apgar score, and term low fifth minute Apgar score. We found that nearly half of the participants had experienced 2 to 5 pregnancies and had given birth to 2 to 5 children. Most of the women delivered at 37 weeks pregnancy or more, attended 1 to 4 antenatal care visits, and received 1 to 3 doses of sulfadoxine-pyrimethamine. The majority of the newborns weighed 2.5 kg or more at birth, were delivered normally through the vagina, and a little over half of them were males. Our study revealed that women who delivered severally were less likely to deliver a child with low fifth minute Apgar score while delivery at less than 37 weeks of pregnancy, birth weight of less than 2.5 kg, and caesarean delivery were associated with the likelihood of low fifth minute Apgar score. Delivery through caesarean section increased the likelihood of low fifth minute Apgar score among this group of newborns. Among preterm infants, those born with low birth weight (< 2.5 kg) had about 4 times likelihood of suffering low fifth minute Apgar score compared to those with normal birth weight. In designing interventions to improve the survival and the Apgar score of newborns, measures to properly diagnose and prevent preterm delivery and low birth weight should be of great concern.

Background

Apgar score is a standardized obstetric tool used globally to evaluate newborn health outcomes immediately after delivery and to diagnose birth asphyxia for immediate resuscitation in both preterm and full-term babies (1). The tool is used in the first and fifth minutes of a neonate’s life (2–4); the assessment is then continued every 5 minutes until 20 minutes after birth. The Apgar score assesses five clinical variables of the neonates: appearance (colour), pulse (heart rate), grimace (reflex irritability), activity (muscle tone), and respiration immediately after delivery. Each of the variables assessed has a score of 0 to 2 and a cumulative score of 10 with a normal score range of 7 to 10 (3,5–7). The Apgar score remains the most effective measure of newborn health outcomes in the first few minutes of delivery (1,8,9) and it is useful in diagnosing perinatal asphyxia, hypoxic-ischemic-encephalopathy, metabolic acidosis, and cerebral palsy (2,4,10). Estimates from the World Health

Organization show that about 23% of neonatal and infant deaths are associated with birth asphyxia (11).

Low Apgar score has proven to be a significant risk factor for infant morbidity, mortality in neonates, and poor neurological outcomes(4,12,13). For instance, in Denmark, Apgar scores less than 7 in the first minute has been found to be consistent with low cognitive function of a child later in life (14). In fact, a low fifth minute Apgar score has been found to cause neonatal deaths shortly after birth and may cause long term problems including epilepsy and cognitive impairment (7). In a prospective cohort study of live births from preterm deliveries in Brazil, a fifth-minute Apgar score of less than 7 was found to be associated with foetal death before the 24th hour (15). In West Africa, an estimated 8–38% of live babies have low Apgar scores (9), and the majority of them result in perinatal mortality (16–18).

Smoking, low socioeconomic status, maternal short stature, low educational status of the mother, poor prenatal visits, mode of delivery, grand multiparity, primiparity, and maternal obesity have all proven to increase the risk of low Apgar scores in live babies (19–24). For example, in Sweden, preterm birth, post-term birth, multiple pregnancies and previous caesarean section were found to be strongly associated with low fifth minute Apgar score (25). However, in a similar study in south-eastern Sweden, history of preeclampsia and multiple pregnancies were found to be the strongest predictors of low fifth minute Apgar score and no signification relationship was established between maternal age, history of maternal smoking and low fifth minute Apgar score at term (25). A study in the United State reported that the distribution of Apgar score was largely dependent on the gestational age, with the youngest gestational age having the highest proportion of low 5-min Apgar score (26). A Brazilian study identified prolonged second stage labour as responsible for low fifth-minute score below 7 (2).

Despite the strong association between low Apgar score and neonatal mortality, infant morbidity and neurological complications later in life, few studies have investigated the determinants of low Apgar score in Ghana. A literature search revealed that the few studies on this topic in Ghana are concentrated in the southern part of the country. The aim of the study, therefore, was to examine the

specific maternal, obstetrics and socio-demographic factors that influence low fifth minute Apgar score among term and preterm singleton live births in the North East Region of Ghana. Our study provides evidence that would guide clinicians in their plan towards at-risk birth and obstetric care in order to reduce neonatal mortality, infant morbidity, and the lifelong complications associated with low Apgar score.

Methods

This retrospective cross-sectional study was conducted at the Baptist Medical Centre in the North East Region of Ghana. The Baptist Medical Centre (BMC) was established in 1958 through the joint efforts of the Ghana Baptist Convention and the International Mission Board. The hospital is currently managed and maintain by the Ghana Baptist Convention and under the Christian Health Association of Ghana (CHAG). It serves patients from the Northern, Upper East, Upper West, and North East Regions of Ghana as well as patients from neighbouring Togo and Burkina Faso. The facility also contributes to the practical training of medical and allied health professionals from the Medical School of the University for Development Studies and from several Nursing and Midwifery Training Colleges in Ghana. In 2018, the hospital provided health care services to about 77,592 outpatient, admitted 15, 400 patients, conducted 3011 deliveries and delivered 3126 babies within the year. All deliveries conducted in the maternity unit of the hospital are recorded in a birth register by registered nurses and midwives. For this current study, we extracted data on all deliveries conducted from January 1 to December 31 2018 from the birth register. Upon approval from the hospital management, two registered nurses were recruited and trained on how to extract and record information from the birth register. A data extraction sheet was then designed using Microsoft Excel spreadsheet and pretested on the birth records of May 2019. For the period January 1 to December 31 2018, we extracted information on 3011 women who delivered at the facility, from the register. However, data on 2742 deliveries were analysed after excluding data on multiple pregnancies, abortions, and entries with missing information on Apgar score, and gestational age.

Outcome variable

Apgar score at 5 minutes after birth was the main outcome variable in this study. Infants with 5

minutes Apgar score of less than 7 were considered to have a low score, whiles a score of 7-10 was considered normal. For further analysis, Apgar score was further categorised, using gestational age at delivery, into term (gestational age ≥37 weeks) 5 minutes Apgar score and preterm (gestational age <37 weeks) 5 minutes Apgar score.

Explanatory variables

The explanatory variables that were extracted from the delivery records are maternal age, occupation, number of pregnancies, number of children, gestational age, number of antenatal care visits, doses of sulfadoxine-pyrimethamine received, mode of delivery, birth weight of newborns, and the sex of infants. The number of pregnancies a woman ever had was categorised as primigravida, gravida 2-5, and gravida 6 or more while the number of children ever had was categorised as primipara, para 2-5, and para 6 or more. Gestational age at delivery was grouped into deliveries before 37 weeks gestation (preterm birth) and deliveries at 37 weeks gestation or more (term birth). The number of antenatal visits made was categorised into <4 visits and ≥4 visits while the doses of sulfadoxine-pyrimethamine received by each woman were grouped into none, 1-3 doses, and >3 doses. Caesarean section and vaginal delivery were the two categories of the mode of delivery analysed in this study. Birth weights recoded at birth were categorised into <2.5kg (low birth weight) and ≥2.5kg (normal birth weight).

Data analysis

All statistical analyses were performed using Stata version 14 after the extracted data were entered into Microsoft Excel spreadsheet and imported into the statistical software. The explanatory variables were described in tables using frequencies and percentages. Binary logistic regression models were used to determine the factors associated with low fifth Apgar score, preterm low fifth minute Apgar score, and term low fifth minute Apgar score. For all the logistic regression models, bivariate analyses were first performed and explanatory variables that were significant at $p < .05$ were moved into a multivariable model. At multivariable level, the significant covariates were adjusted for confounding to identify the independent predictors of low fifth Apgar score, preterm low fifth minute Apgar score, and term low fifth minute Apgar score. Explanatory factors were only retained in the final

multivariable model if they were significant at $p < .05$. The explanatory factors were all examined for multicollinearity using the variance inflation factor (VIF) test. Based on the VIF test, parity was excluded from the logistic regression models due to high collinearity.

Results

Sociodemographic characteristics of participants

Table 1 presents the sociodemographic and obstetric characteristics of the participants in this study. More than half (n=1719, 59.2%) of the mothers were between the age range of 20 to 30 years. Only 57(1.9%) of them were older than 40 years. The majority of the women were housewives (n=2045, 70.8%) with only 93(3.2%) of them being public or private sector employees. Nearly half of the participants had experienced 2-5 pregnancies (n=1369, 47.1%) and had given birth to 2-5 children (n=1387, 47.7%). Most of the women delivered at 37 weeks gestation or more (n=2479, 87.6%), attended 1 to 4 antenatal care visits (n=1547, 53.2%), and received 1 to 3 doses of sulfadoxine-pyrimethamine (n=2061, 70.9%). The results show that most of the infants weighed 2.5kg or more at birth (n=2626, 90.7%), were delivered through the vagina (n=2259, 79.8%), and a little over half of them (n=1489, 51.40%) were males.

Factors associated with Low fifth minute Apgar score

Table 2 presents the factors associated with low fifth minute Apgar score among the newborn infants in this study. On bivariate analysis, we found that infants born to multigravida (2-5 pregnancies) and grand multigravida (6 or more pregnancies) women had 0.59 (95% CI 0.45 - 0.78) and 0.67 (95% CI 0.48 - 0.94) decreased odds of suffering low fifth minute Apgar score compared to women who were pregnant for the first time, respectively. Infants born at less than 37 weeks gestation had 2 times the odds (OR 2.62, 95% CI 1.92 - 3.57) of low fifth minute Apgar score compared to those who were delivered at term. Furthermore, babies born with a birth weight of less than 2.5kg and those delivered through caesarean section were 2.3 (95% CI 1.66 - 3.31) times and 2.9 (95% CI 2.28 - 3.87) times more likely to experience low fifth minute Apgar score. After adjusting for potential confounders, we found evidence that multigravidity (OR 0.67, 95% CI 0.49 - 0.90), delivery at less than 37 weeks gestation (OR 2.39, 95% CI 1.70 - 3.35), birth weight of less than 2.5kg (OR 1.67 95% CI 1.13 - 2.48),

and caesarean delivery (OR 2.88, 95% CI 2.19 - 3.79) were independently associated with low fifth minute Apgar score.

Factors associated with low fifth minute Apgar score among infants born at term

The factors associated with low fifth minute Apgar score among term singleton live births are shown in Table 3. The likelihood of suffering a low Apgar score at 5 minutes after birth was 0.6 (95% CI 0.45 - 0.85) times less likely among infants born at term to mothers who had had 2-5 pregnancies compared to those who were pregnant for the first time. However, babies who were delivered at term through caesarean section and babies who were males were 3.4 (2.49 - 4.56) times and 1.3 (1.00 - 1.76) times more likely to experience a low fifth minute Apgar score after birth compared to those delivered per vagina and female babies, respectively. Being born to a mother who had experienced 2-5 pregnancies (OR 0.66, 95% CI 0.47 - 0.92) and delivery through caesarean section (OR 3.40, 95% CI 2.51 - 4.61) were the only significant predictors of low fifth minute Apgar score among infants born at term in the final multivariable analysis.

Factors associated with low fifth minute Apgar score among preterm infants

Table 4 reports the factors associated with low fifth minute Apgar score among preterm singleton live births in the year under consideration. When compared with infants born to mothers who had not received sulfadoxine-pyrimethamine during pregnancy, the results show that preterm infants whose mothers received more than three doses of sulfadoxine-pyrimethamine were 0.2 (95% CI 0.04 - 0.76) times less likely to experience low Apgar score 5 minutes after birth. However, preterm infants born with a birth weight of less than 2.5kg had 4.2 (95% CI 2.35 - 7.65) times the odds of experiencing low fifth minute Apgar score compared to those who had a birth weight of 2.5kg or more. In the final multivariable model, being born with a birth weight of less than 2.5kg (OR 3.99, 95% CI 2.19 - 7.24) was the only significant predictor of low fifth minute Apgar score among the preterm infants.

Discussions

This study assessed the determinants of low fifth minute Apgar score in term and preterm singleton live births in a Ghanaian hospital. There was evidence that women who had experienced two or more pregnancies were less likely to deliver a child with low fifth minute Apgar score while delivery at less

than 37 weeks gestation, birth weight of less than 2.5 kg, and caesarean delivery were associated with increased odds of low fifth minute Apgar score in newborns. For infants born at term, being born to a mother who had experienced 2 to 5 pregnancies was protective against low fifth minute Apgar score while delivery through a caesarean section was associated with increased odds of low fifth minute Apgar score among the infants born at term. Among preterm infants, the odds of suffering a low fifth minute Apgar score was about 4 times higher among those born with a birth weight of less than 2.5 kg compared to those who were born with normal birth weight (≥ 2.5 kg).

As in our study, other studies, have found that the risk of low Apgar score and birth asphyxia is reduced for infants born to parous women(27,28). Therefore, women who never gave birth are at risk of given birth to children with a low Apgar score. This indeed has been observed by Svenvik, who stated that nulliparity increases the risk of a low Apgar score (27). Furthermore, in determining the effect of grand multiparity on the possible risk of adverse maternal and neonatal outcomes, Al-Shaikh et al., intimated that multiparity does not pose any higher risk of a neonatal outcome as compared to other parity groups (29). Therefore, in considering determinants for low 5-minute Apgar score, multiparity should be of less concern.

Globally, it has been established that there is an increased risk for low birth weight in children born before 37 weeks gestation(30,31), and as observed in this study, studies in Iran and Sweden show that low birth weight and preterm births are associated with low fifth minute Apgar score(25,32). Evidence suggests that the Apgar scores in premature newborns may reflect neurodevelopmental immaturity and severe neurologic morbidity(4,33). The lifelong consequences of preterm birth among survivors include learning disabilities, visual impairment, and hearing problems (30). In designing interventions to improve the survival and Apgar score of newborns, prevention of preterm delivery and low birth weight should be of great concern.

Caesarean section is either planned or conducted under emergency circumstances (34). Irrespective of the circumstance, caesarean delivery is observed to be associated with low fifth minute Apgar score and significantly increases the risks of several clinically related adverse neonatal outcomes including seizures, asphyxia, hypoglycaemia, and admission to Neonatal Intensive Care Unit (NICU).

Most emergency caesarean section births are conducted because of poor progress of labour or intrapartum maternal and foetal compromise (35). Similar to our finding, a study in Pakistan also observed that vaginal deliveries were related to higher fifth minutes Apgar scores than those delivered by caesarean Sect. (36). This is probably because, during a spontaneous vaginal delivery, the rib cage of the baby is squeezed as it passes through the birth canal and this is said to enhance the clearance of the airway of newborns thereby reducing the risk of neonatal asphyxia and low 5 minutes Apgar score. This physiological phenomenon does not occur during caesarean section delivery (37). Regular assessment of maternal and foetal condition during pregnancy could help reduce the incidence of emergency caesarean section and its related complications. It is important to note however that, when a caesarean section is indicated for therapeutic reasons, the risk of low five-minute Apgar score may reduce. For instance, a cohort study conducted to assess the association between 5th minute Apgar scores and planned mode of delivery in diabetic pregnancies, found that there was a significantly decreased risk of low 5 minutes Apgar score among the group who underwent an elective caesarean section at 38 weeks compared with those who continued pregnancy to term (38). Similarly, in breech presentation, a caesarean section has been reported to increase the Apgar score of both term and preterm babies (39). Contrary to our finding, in Sweden, Svenvik et al, found that there was no significant difference between spontaneous vaginal birth and elective caesarean section, except for those newborns delivered by immediate emergency caesarean section, where there was a significantly higher frequency of low fifth minute Apgar score (27).

Limitations

Our study has several limitations that must be considered when interpreting the findings. Firstly, the data source had limited information on the potential confounders of the outcome of interest and this may have affected the accuracy of the effects observed. Furthermore, the purpose of recording the data was to measure care delivered to women and not for research purposes and since several people were involved, mistakes may have occurred during the documentation of the records. However, the authors were assured that the staffs were all professionally trained with several years of experience and the risk of errors was minimal. Lastly, our study is based on data from a single hospital and the

results may not be generalizable to deliveries in other healthcare facilities.

Conclusion

Our study provides evidence that, preterm birth, low birth weight, and caesarean delivery are the predictors of low fifth minute Apgar score in the studies population. These factors should be of greater concern in designing interventions to improve the survival and Apgar score of newborns. Concerted efforts must be directed towards promoting early ANC attendance, improving maternal haemoglobin, quality of ANC services, management of maternal illness during pregnancy, and the socioeconomic status of women, as these factors have an influence on birth weight and the gestational age at delivery.

Declarations

Ethics approval and consent to participate

The relevant authorities of the Baptist Medical Centre in the North East Region of Ghana granted approval and permission for the authors to use the healthcare records of the maternity unit of the hospital for this study. We did not capture identifying information from the records and the confidentiality of the information extracted from the records was ensured in accordance with the data protection act.

Consent for publication

Not applicable

Availability of data and material

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests

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No funding was received for this study.

Authors' contributions

ASA and SM conceived and designed the study, wrote the protocol, and performed the statistical

analysis. NA and SY designed the data capture sheet and retrieved the data from the facility records. IB and AY managed the literature search and the discussion of the findings. NA and IY drafted the manuscript. All authors read and approved the final manuscript.

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Abbreviations

ANC: Antenatal Care

IPTO-SP: Intermittent Preventive Treatment in pregnancy with sulfadoxine-pyrimethamine

LBW: Low Birth Weight

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Tables

Table 1 Sociodemographic characteristics of participants

Variables	Number	Percent
Age (years)		
<20	507	17.46
20-30	1719	59.19
31-40	621	21.38
>40	57	1.96
Occupation		
Housewife	2045	70.76
Self-employed	311	10.76
Farmer	308	10.66
Formal sector employee	93	3.22

Student	133	4.60
Number of pregnancy		
Primigravida	889	30.58
Gravida 2-5	1369	47.09
Gravida 6 or more	649	22.33
Number of children		
Primipara	893	30.72
Para 2-5	1387	47.71
Para 6 or more	627	21.57
Gestational age (weeks)		
≥37 weeks	2479	87.60
<37 weeks	351	12.40
ANC visits		
None	149	5.13
1-4 visits	1547	53.22
>4 visits	1211	41.66
IPTp-SP doses		
None	566	19.48
1-3 doses	2061	70.92
>3 doses	279	9.60
Birth Weight (Kg)		
≥2.5kg	2626	90.68
<2.5kg	270	9.32
Mode of delivery		
Vaginal Delivery	2259	79.77
caesarean delivery	573	20.23
Sex of child		
Female	1408	48.60
Male	1489	51.40

Table 2 Factors associated with low fifth minute Apgar score among infants delivered at the Baptist Medical Centre between January 2018 and December 2018

Variables			**Bivariate analysis**		
	Infants with Apgar score ≥7	**Infants with Apgar score <7**	**OR (95% CI)**	**P value**	

	at 5 minutes	at 5 minutes		
Age (years)				
<20	420(17.16)	60(20.62)	Ref.	
20-30	1455(59.46)	171(58.76)	0.82 (0.60 - 1.13)	0.222
31-40	525(21.45)	55(18.90)	0.73 (0.49 - 1.08)	0.117
>40	47(1.92)	5(1.72)	0.74 (0.28 - 1.95)	0.548
Occupation				
Housewife	1723(70.70)	208(72.22)	Ref.	
Self-employed	268(11.00)	32(11.11)	0.98 (0.67 - 1.47)	0.956
Farmer	252(10.34)	24(8.33)	0.79 (0.51 - 1.22)	0.294
Formal sector employee	78(3.20)	13(4.51)	1.38 (0.75 - 2.53)	0.296
Student	116(4.76)	11(3.82)	0.79 (0.42 - 1.48)	0.456
Number of pregnancy				
Primigravida	734(29.96)	119(40.89)	Ref.	
Gravida 2-5	1175(47.96)	113(38.83)	0.59 (0.45 - 0.78)	<0.001
Gravida 6 or more	541(22.08)	59(20.27)	0.67 (0.48 - 0.94)	0.019
Gestational age (weeks)				
≥37 weeks	2149 (90.10)	219 (77.66)	Ref.	
<37 weeks	236 (9.90)	63 (22.34)	2.62 (1.92 - 3.57)	<0.001
ANC visits				
None	101(4.12)	17(5.84)	Ref.	
1-4 visits	1311(53.51)	150(51.55)	0.68 (0.39 - 1.17)	0.162
>4 visits	1038(42.37)	124(42.61)	0.71 (0.41 - 1.23)	0.219
IPTp-SP doses				
None	439(17.93)	66(22.68)	Ref.	
1-3 doses	1767(72.15)	198(68.04)	0.75 (0.55 - 1.00)	0.053
>3 doses	243(9.92)	27(9.28)	0.74 (0.46 - 1.19)	0.212
Birth Weight (Kg)				
≥2.5kg	2260(92.40)	244(83.85)	Ref.	
<2.5kg	186(7.60)	47(16.15)	2.34 (1.66 - 3.31)	<0.001
Mode of delivery				
Vaginal Delivery	1985(82.30)	166(61.03)	Ref.	
caesarean delivery	427(17.70)	106(38.97)	2.97 (2.28 - 3.87)	<0.001
Sex of child				

Female	1202(49.16)	126(43.30)	Ref.	
Male	1243(50.84)	165(56.70)	1.27 (0.99 - 1.62)	0.059

Table 3 Factors associated with low fifth minute Apgar score among term singleton live births delivered at the Baptist Medical Centre between January 2018 and December 2018

Variables			**Bivariate analysis**	
			OR (95% CI)	**P value**
	Term infants with Apgar score ≥7 at 5 minutes	**Term infants with Apgar score <7 at 5 minutes**		
Age (years)				
<20	371 (17.30)	42 (19.18)	Ref.	
20-30	1274 (59.39)	131 (59.82)	0.91 (0.63 - 1.31)	0.607
31-40	459 (21.40)	43 (19.63)	0.83 (0.53 - 1.29)	0.406
>40	41 (1.91)	3 (1.37)	0.65 (0.19 - 2.18)	0.481
Occupation				
Housewife	1511 (70.64)	159 (72.94)	Ref.	
Self-employed	230 (10.75)	23 (10.55)	0.95 (0.60 - 1.50)	0.828
Farmer	225 (10.52)	19 (8.72)	0.80 (0.49 - 1.32)	0.385
Formal sector employee	71 (3.32)	11 (5.05)	1.47 (0.76 - 2.84)	0.248
Student	102 (4.77)	6 (2.75)	0.56 (0.24 - 1.29)	0.174
Number of pregnancy				
Primigravida	646 (30.06)	86 (39.27)	Ref.	
Gravida 2-5	1032 (48.02)	85 (38.81)	0.62 (0.45 - 0.85)	0.003
Gravida 6 or more	471 (21.92)	48 (21.92)	0.77 (0.53 - 1.11)	0.160
ANC visits				
None	88 (4.10)	11 (5.02)	Ref.	
1-4 visits	1139 (53.03)	108 (49.32)	0.76 (0.39 - 1.46)	0.410
>4 visits	921 (42.88)	100 (45.66)	0.87 (0.45 - 1.68)	0.676
IPTp-SP doses				
None	379 (17.65)	45 (20.55)	Ref.	
1-3 doses	1560 (72.66)	150 (68.49)	0.81 (0.57 - 1.15)	0.240
>3 doses	208 (9.69)	24 (10.96)	0.97 (0.58 - 1.64)	0.915
Birth Weight (Kg)				
≥2.5kg	2007 (93.57)	208 (94.98)	Ref.	
<2.5kg	138 (6.43)	11 (5.02)	0.77 (0.41 - 1.44)	0.414

Mode of delivery					
Vaginal Delivery	1748 (82.69)	119 (58.62)	Ref.		
caesarean delivery	366 (17.31)	84 (41.38)	3.37 (2.49 - 4.56)	<0.001	3.
Sex of child					
Female	1041 (48.55)	91 (41.55)	Ref.		
Male	1103 (51.45)	128 (58.45)	1.33 (1.00 - 1.76)	0.049	

Table 4 Factors associated with low fifth minute Apgar score among preterm singleton live births delivered at the Baptist Medical Centre between January 2018 and December 2018

Variables			**Bivariate analysis**	
	preterm infants with Apgar score ≥7 at 5 minutes	**preterm infants with Apgar score <7 at 5 minutes**	**OR (95% CI)**	**P value**
Age (years)				
<20	42 (17.80)	17 (26.98)	Ref.	
20-30	141 (59.75)	32 (50.79)	0.56 (0.28 - 1.11)	0.096
31-40	50 (21.19)	12 (19.05)	0.59 (0.25 - 1.38)	0.226
>40	3 (1.27)	2 (3.17)	1.65 (0.25 - 10.75)	0.602
Occupation				
Housewife	167 (71.67)	46 (74.20)	Ref.	
Self-employed	28 (12.02)	7 (11.29)	0.91 (0.37 - 2.21)	0.831
Farmer	21 (9.01)	4 (6.45)	0.69 (0.23 - 2.12)	0.518
Formal sector employee	6 (2.58)	2 (3.23)	1.21 (0.24 - 6.19)	0.819
Student	11 (4.72)	3 (4.84)	0.99 (0.27 - 3.69)	0.988
Number of pregnancy				
Primigravida	74 (31.49)	29 (46.03)	Ref.	
Gravida 2-5	109 (46.38)	23 (36.51)	0.54 (0.29 - 1.00)	0.051
Gravida 6 or more	52 (22.13)	11 (17.46)	0.54 (0.25 - 1.18)	0.121
ANC visits				
None	13 (5.51)	6 (9.52)	Ref.	
1-4 visits	135 (57.20)	39 (61.90)	0.63 (0.22 - 1.75)	0.373
>4 visits	88 (37.29)	18 (28.57)	0.44 (0.15 - 1.32)	0.144
IPTp-SP doses				
None	47 (19.92)	19 (30.16)	Ref.	

1-3 doses	159 (67.37)	42 (66.67)	0.65 (0.35 - 1.23)	0.187
>3 doses	30 (12.71)	2 (3.17)	0.16 (0.04 - 0.76)	0.021
Birth Weight (Kg)				
≥2.5kg	189 (80.43)	31 (49.21)	Ref.	
<2.5kg	46 (19.57)	32 (50.79)	4.24 (2.35 - 7.65)	<0.001
Mode of delivery				
Vaginal Delivery	184 (78.63)	44 (72.13)	Ref.	
caesarean delivery	50 (21.37)	17 (27.87)	1.42 (0.75 - 2.69)	0.282
Sex of child				
Female	130 (55.32)	31 (49.21)	Ref.	
Male	105 (44.68)	32 (50.79)	1.28 (0.73 - 2.23)	0.388