

**TREND AND SEASONALITY IN ADMISSION AND OUTCOME OF LOW
BIRTHWEIGHT INFANTS IN GWAGWALADA-ABUJA, NIGERIA**

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27 **Abstract**

28 **Background:** Low birthweight is an important contributor to neonatal morbidity and mortality.
29 Various interventions have been instituted toward the reduction in the incidence of low
30 birthweight deliveries and admissions. Knowledge of the current trend and seasonality in low
31 birthweight admission is required in the control of the condition.

32 **Objectives:** To determine the trend and seasonality in admission and outcome of low birthweight
33 infants.

34 **Methods:** Retrospective review of records of babies admitted into the Special Care Baby Unit of
35 University of Abuja Teaching Hospital, with birthweights below 2500 grams over a 5-year
36 period, from January 2006 through December, 2010, was undertaken and the data obtained were
37 analyzed using Epi Info version 3.5.2 software. A p value of <0.05 was set as point of statistical
38 significance.

39 **Results:** A total of 4358 babies were admitted into the Special Care Baby Unit during the study
40 period, out of which 502 had low birthweight, giving an incidence of 11.5%. The proportion of
41 infants admitted with low birthweight was fairly constant over the years but there was variation
42 in monthly and seasonal distributions. On the overall, survival rate steadily increased from
43 65.5% in 2006 to 76.0% in 2009 at an average rate of 2.6% per annum. Babies admitted during
44 the first half of the year and during the wet/rainy season had higher mortality rate.

45 **Conclusion:** Low birthweight has continued to be one of the major reasons for admission of
46 infants in the locale of study. Significant seasonal pattern in the outcome of infants with low

birthweight exists. Reasons for seasonality in low birthweight admission and outcome are subjects of further studies.

Introduction

Low birthweight contributes a significant proportion to neonatal mortality. Efforts at reduction of low birthweight deliveries have reduced the incidence of low birthweight babies in some settings,¹ but the prevalence of the condition in Nigeria is still far beyond the average for the more developed countries of the world.² The National Demographic and Health Survey (NDHS, 2003)³ classed the north-central Nigeria among zones with the highest low birthweight rate, second only to the north-east region. Although the national average was 14% in 2004, a recent study⁴ from Enugu reported a lower incidence of 10.3%, suggesting a gradual decline in low birthweight rate. Concerted efforts at sustaining the reduction in prevalence of low birthweight infants are encouraged. Seasonal variation in incidence of diseases and hence outcome have provided caregiver ample opportunity to strategise for the control and prevention of some childhood illnesses like asthma, allergic dermatitis and other seasonal phenomena. Few studies^{5,6} have related seasonal variation with neonatal morbidity such as neonatal hypothermia and neonatal infection but with conflicting results. The study of Enabudoso et al⁷ suggests a significant association between season and delivery rate which was adjudged to be due to variation in conception rate at the various months of the year. There is however paucity of data on the influence of season on the admission rate and outcome of low birthweight infants in Nigeria, knowledge of which is required in the comprehensive package for the management of this group of infants. In addition, identification of causal environmental factors may have public health implications in the development of primary prevention programs for low birth weight in

developing countries. This study is structured to provide useful information on the trend and effect of season on admission and outcome of low birthweight infants in the central part of Nigeria.

Methods and Materials

A retrospective analysis of admission into the Special Care Baby Unit of University of Abuja Teaching Hospital between the months of January, 2006 and December, 2010 was conducted. The hospital is located in Gwagwalada, north central Nigeria and receives referral from different parts of the Federal Capital Territory and its neighbouring states. The unit has a bed capacity of thirty-two and admits about 900 babies annually. Approval was given by the hospital's ethics committee and consent was sought and obtained from the head of Health Information Department before extracting data from the patients' hospital records. Relevant information was obtained from admission records and patients folder with particular attention to infants weighing less than 2500 grams at birth. Extracted data included date of admission, birthweight, gestational age, place and time of delivery as well as outcome of management. Based on local climate, the year was divided into the following seasons: dry (November – April) and wet/ rainy (May – October).

Data analysis

Data obtained was entered into a personal computer and analyzed using Epi info statistical software version 5.3.2 (CDC, Atlanta, 2008). Frequency tables and proportions were calculated. Seasonality of admission, morbidity and outcome were examined by creating a frequency table and line diagram of proportion of infants admitted with birthweight below 2500 grams. Influence of delivery characteristics on outcome was also examined. Categorical variables were tested for

significance using Chi square with Yate's correction and Fisher exact tests where applicable. Statistical significance was set at $p < 0.05$.

Results

A total of 4358 babies were admitted into the Special Care Baby Unit during the study period, out of which 502 were recorded to have been of low birthweight (Table I). Thus the unit's prevalence of low birthweight is 11.5 percent. The proportion of infants admitted with low birthweight has remained fairly constant over the years, even though the figure fell slightly from 12.4% in 2006 to 9.4% in 2008 (Table I and Figure 1) but then rose again to 10.7% and 13.7% in 2008 and 2009, respectively.

Table II shows the annual trend in survival of low birthweight infants. On the overall, survival rate steadily increased from 65.5% in 2006 to 76.0% in 2009 at an average rate of 2.6% per annum. In a similar vein, the mortality pattern decreased, less predicatively, from 21.6% in 2006 to 19.0% in 2010. The year 2008 had the lowest mortality rate (12.6%), while the highest (28.6%) was recorded in 2007.

Monthly incidence and outcome of low birthweight infant's admission. The monthly distribution of admissions of low birthweight infants as shown on Table I revealed that the months of March, April, August and October had higher newborns admission rates and contributed 39.2% of total newborn admission and 36.3% of the low birthweight infants admitted. As shown on Figure 2, the proportion of babies with low birthweight varied from month to month but fluctuated between 8.3% and 15.6%. The incidence of low birthweight declined from its peak of 15.6% in January to values below 11.0% in the months of March

(8.3%), April (10.9%), May (9.3%) and June (8.4%) but rose to values above 12% in the months of July (12.5%), August (14.3%) and September (13.8%). There were 251 low birthweight babies admitted between the months of January and June, of which 164 (65.3%) survived, 59 (23.5%) died and in 28 (11.2%) cases, the outcome was unknown as parents either absconded or left with the baby against medical advice. On the contrary, as high as 191 (76.1%) of the 251 low birthweight infants admitted between July and December survived, 37 (14.7%) died while parent absconded or left against medical advice with 23 (9.2%) babies. The difference in survival rates was statistically significant ($\chi^2 = 6.44$, $p = 0.0111$). In addition, the relative risk of death in the first halve of the year ($RR = 1.63$, 95 % CI 1.13 to 2.35) was about 2.5 times those of the second halve of the year ($RR = 0.61$, 95% CI 0.42 to 0.89). Thus low birthweight infants admitted during the later halve of the year fared better than those between the months of January and June. With further categorization of the fatal cases based on the season of presentation, 71 (31.6%) of the 163 cases with known outcome died during the wet season (May-October), while 80 (36.2%) deaths occurred among the 288 babies with known outcome admitted during the dry season (November-April) (Table III). This difference was, equally, statistically significant ($\chi^2 = 5.51$, $p = 0.0189$). Babies delivered during the daytime (7 am-6 pm) fared better than those delivered between 7 pm and 6 am: the relative risk of death among those delivered between 7 am and 6 pm was 0.80 as against 1.25 for those delivered during the night hours (Table III), even though the observed difference fell short of statistical significance ($p = 0.3099$).

Influence of season on low birthweight infant's morbidity. Of the 502 low birthweight infants recruited, detailed day-to-day clinical notes were available for only 446 of them, thus these were the ones subjected to further analysis. The morbidity recorded among the 446 patients were numerous and varied but the common ones included jaundice, anaemia, malaria,

thrombocytopenia, recurrent apnoea and symptomatic hypoglycaemia (Table IV). Few cases (7) of respiratory distress syndrome were recorded. The frequency of occurrence of these morbid conditions was slightly, but insignificantly, higher in the wet season (May-October) than in the dry season (November-April) ($p > 0.05$).

Discussion

The result of this study showed that the incidence of low birthweight infants have not changed much over the years. This finding is unexpected, as reports¹ from some developing countries have upheld the view that improving the functionality of the health system in terms of preventive and curative services had positive impact on low birthweight rate. With the recent upgrading of the hospital to the status of a Teaching Hospital and the accompanying influx of personnel and facilities, it is expected that the health indices in the locality would have witnessed significant improvement and hence a declining low birthweight rate. However, that intervention to reduce the prevalence of low birthweight in developed countries are not yielding positive results suggesting that factors other than the strength of the health programmes may be contributing to the sustained prevalence of low birthweight infants.

Although the yearly distribution of low birthweight admissions did not reveal declining incidence rate, the incidence of 11.5% recorded in the present study is lower than the 16.0% documented in the 2003 National Demographic Health Survey³ report for the north central region of Nigeria but similar to the 12% in the northwest and the southwest region of the country. On the global scene, the incidence in this study is less than the 14.4% average for Africa and the 15.5% world average.² This observation suggests that there are yet unidentified factors that operate along the western axis of Nigeria (North west, south west Nigeria) that might be

operating in the locale of present study (Gwagwalada) to have accounted for the lower rate of low birthweight infants in the regions.

Furthermore, the lower incidence in the present study suggests a reduction in the prevalence of low birthweight deliveries in the sub-region, possibly due to the growing economic strength of the citizenry and/or increased awareness of the need to prevent low birthweight deliveries through the scale up of the primary health care activities in the locality. It is important to indicate that one of the WHO assisted comprehensive health centre is located in the community. The possibility of further reduction in low birthweight incidence is not predictable, as the trend may change from time to time. In a recent report from Ibadan,⁹ the incidence of 16.8% was recorded from a 10-year study that spanned 1995 to 2005, a figure much higher than the 12% earlier documented for the entire south west zone.³

The monthly distribution of low birthweight admissions suggests a bimodal distribution with peaks at January- February period, being the dry season and another in the months of August- September, being the rainy season period. This finding is similar to the observation made among 1916 live-born infants in some Gambian villages.¹⁰ In that study, the incidence of Small-for-gestational-age delivery was highest at the end of the annual hungry season, from August to December, with a nadir of 12.9% in June. But unlike the bimodal distribution in the present study, those of Rayco-Solon¹⁰ had higher prevalence of low birthweight admission during the rainy season (between the months of July to October).

The reasons for the bimodal distribution are not known with certainty but adverse environmental conditions¹⁰⁻¹⁶ has been adduced, including the effect of malaria transmission, environmental pollution and exposure to sunlight and low ambient temperatures. Women are at the greatest risk

of delivering low birthweight babies when they have been pregnant during most of the rainy season and deliver towards the end of it, or at the beginning of the dry season,¹¹ this might have accounted for the high proportion of babies admitted with low birthweight in the months of July, August and September, period with high malaria transmission. It was predicted by Wort et al¹¹ that the effect of malaria on birthweight could occur 3 months after the malaria peak and last for 5 months. This could probably account for the extension of periods of high low birthweight admission into the early part of the year (January and February) in the present study. Although there is still no agreement on the main mechanisms of reductions in birthweight in malaria, both malaria-induced anemia and placental malaria are thought to mediate reductions in birthweight primarily through intrauterine growth retardation.¹²

Furthermore, seasonal variation in carbon monoxide (CO) atmospheric pollution which appears to peak in December and January might have played at least a minimal role. A study by Araban et al from Iran¹³ showed a significant association between exposure to carbon monoxide and low birthweight (OR = 2.08, 95% CI: 1.70–4.60), particularly during the second trimester (OR = 3.96, CI: 1.83–12.5). During pregnancy, the endogenous production of carbon monoxide can be elevated to as much as 3-fold. Approximately 80–90% of the carbon monoxide binds with haemoglobin (Hb) which causes a reduction in the oxygen-carrying capacity of the blood.¹⁴ The affinity of haemoglobin for carbon monoxide is 200–250 times that for oxygen resulting in maternal COHb levels that are usually about 20% higher than the nonpregnant values.¹⁴ Carbon monoxide diffuses readily across the placental membranes, and the carbon-monoxide binding affinity of fetal haemoglobin is higher than that of adult haemoglobin. Moreover, carbon monoxide is cleared much more slowly from fetal blood than from maternal blood. At steady state, fetal COHb levels are up to 10–15% higher than maternal COHb levels.^{13,14} High vehicular

movement during the December and January months, occasioned by the multiple holidays and festivities that characterized the period, could increase the atmospheric CO level and hence high maternal plasma CO and fetal COHb levels with consequent restriction in fetal growth and low birthweight deliveries.

Other environmental factor associated with seasonality of low birthweight is exposure of the pregnant mothers and hence the fetus to cold temperatures. Exposure to low temperatures raises fibrinogen levels in plasma, increases blood viscosity, and might induce vascular constriction in the placenta, thereby diminishing uteroplacental blood flow.¹⁷ This may result in lower birth weight especially in mid or late gestation.¹⁷

Few studies¹⁸⁻²⁰ have shown the association of heavy physical exertion in the third trimester with low birthweight deliveries. In one study, a 150g – 400 g decrease in birthweight occurred in women who continued to work outside the home during the third trimester compared to those who remained at home during pregnancy.^{18,19} The detrimental effect of third trimester work on birthweight has been reported to be exacerbated if pregnant women worked in a standing position. High maternal physical activities during the harvest season and periods of increased household chores occasioned by the high festivity that characterized the last months of the year could be among the reasons for the high incidence of low birthweight admissions in the months of January and February.

The result of the study also showed that low birthweight infants admitted during the later halve of the year fared better than those between the months of January and June. Similarly, babies admitted during the rainy/wet season had higher mortality rate than those in the dry season. The reasons for this observation are not known, but it may not be unrelated to the high infection rate

that characterized the rainy season occasioned by the high humidity.⁶ Further studies are therefore recommended to determine reasons for the relatively poorer outcome among low birthweight infants admitted at those periods of the year as well the actual factors responsible for the seasonality in low birthweight admissions.

Conclusion

The incidence of low birthweight admissions has remained fairly constant over the years but with monthly and seasonal variations in proportion and in outcome. Low birthweight infants admitted in the more recent years fared better than those of earlier years. Mortality is highest during the wet season and during the first half of the year. Reasons for the trend in incidence and outcome are subject of further studies.

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332 Table I: Yearly and monthly distribution of low birthweight infants studied

Year of admission	Number of newborns admitted N(% of total)	Number of low birthweight infants n(% of N)	Number of low birthweight infants that survived (% of n)	Number of low birthweight infants that died (% of n)	Number of low birthweight with unknown outcome (% of n)
2006	937 (21.5)	116(12.4)	76(65.5)	25(21.6)	15(12.9)
2007	826 (19.0)	77(9.4)	50(64.9)	22(28.6)	5(6.5)
2008	1009 (23.2)	103(10.2)	73(70.9)	13(12.6)	17(16.5)
2009	886 (20.3)	121(13.7)	92(76.0)	20(16.5)	9(7.4)
2010	700 (16.1)	85(12.1)	64(75.3)	16(18.8)	5(5.9)
Total	4358(100.0)	502(11.5)	355(70.7)	96(19.1)	51(10.2)
January	307(7.1)	48(15.6)	28(58.3)	15(31.3)	5(10.4)
February	371(8.5)	57(15.4)	43(75.4)	9(15.8)	5(8.8)
March	434(10.0)	36(8.3)	23(63.9)	9(25.0)	4(11.1)
April	414(9.5)	45(10.9)	29(64.5)	6(13.3)	10(22.2)
May	376(8.6)	35(9.3)	24(68.6)	10(28.5)	1(2.9)
June	359(8.2)	30(8.4)	17(56.7)	10(33.3)	3(10.0)
July	271(6.2)	34(12.5)	28(82.3)	4(11.8)	2(5.9)
August	406(9.3)	58(14.3)	44(75.9)	10(17.2)	4(6.9)
September	349(8.0)	48(13.8)	38(79.2)	6(12.5)	4(8.3)
October	453(10.4)	43(9.5)	32(74.4)	5(11.6)	6(14.0)
November	319(7.3)	41(12.9)	27(65.8)	9(22.0)	5(12.2)
December	299(6.9)	27(9.0)	22(81.5)	3(11.1)	2(7.4)
Total	4358(100.0)	502(11.5)	355(70.7)	96(19.1)	51(10.2)

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336 Table II. Monthly and yearly rates of survival of low birthweight infants in percentages

Months	Rates of low birthweight survival					Overall
	Years of study					
	2006	2007	2008	2009	2010	
January	76.9	80.0	66.7	53.8	88.8	58.3
February	55.5	100	80.0	92.8	80.0	75.4
March	75.0	66.7	60.0	77.8	75.0	63.9
April	66.7	50.0	81.8	100	100	64.5
May	73.7	25.0	66.7	No LBW	100	68.6
June	81.8	50.0	0	57.1	66.7	56.7
July	90.0	80	100	90.9	66.7	82.3
August	72.7	66.7	100	70.0	87.5	75.9
September	50.0	100	100	81.8	91.7	79.2
October	100	85.7	88.8	100	50.0	74.4
November	75.0	75	80.0	80.0	66.7	65.8
December	80.0	80	100	100	66.7	81.5
Overall	65.5	64.9	70.9	76.0	75.3	70.7

NB. LBW = Low birthweight

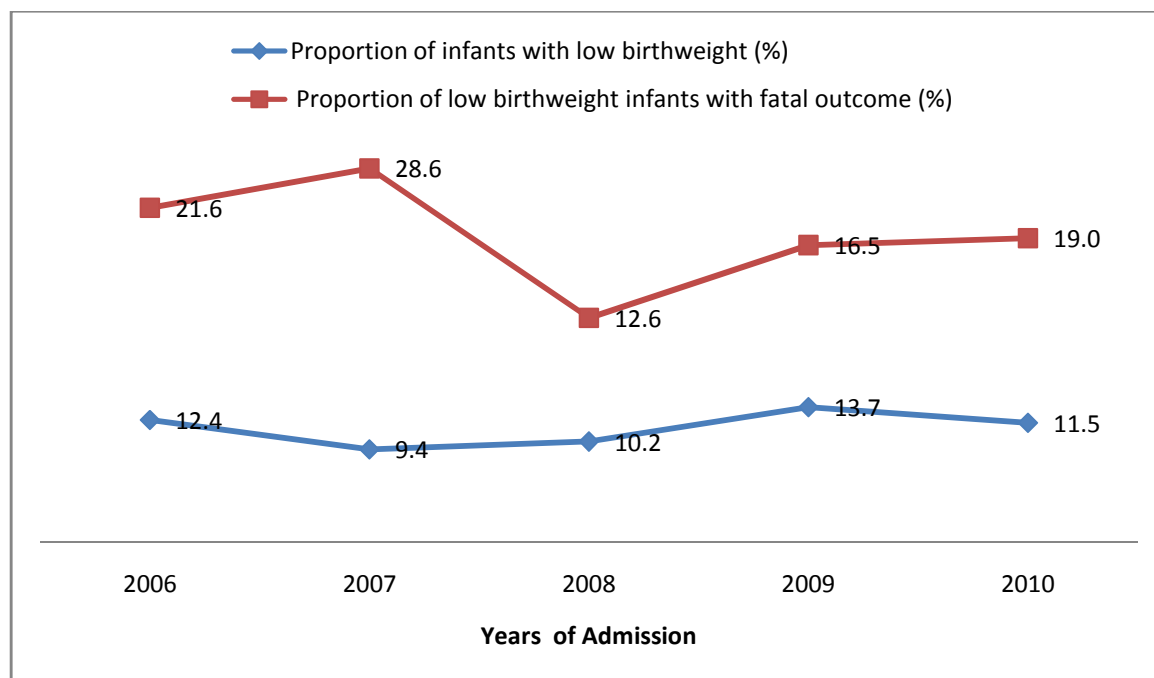


Figure 1: Trend in the yearly admission and outcome of low birthweight infants

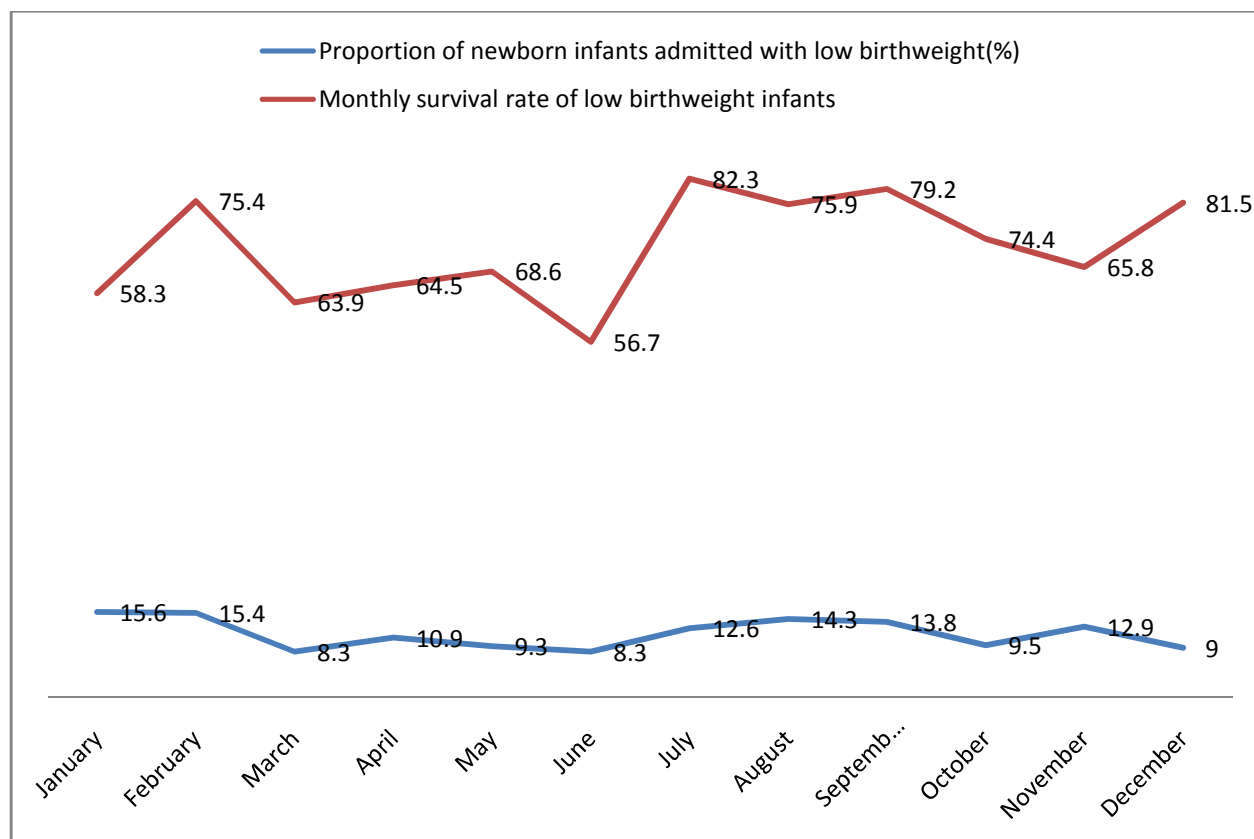


Figure 2: Trend in the monthly admission and outcome of low birthweight infants

Table III: Interplay of months, seasons and time of delivery on outcome of low birthweight infants

Variables	Outcome		RR (95% CI of RR)	p
	Died (% of n)	Survived (% of n)		
<i>Months</i>				
January-June (n = 223)	59 (26.5)	164 (73.5)	1.63(1.13-2.35)	0.0111
July-December (n = 228)	37 (16.2)	191 (83.8)	0.61(0.42-0.89)	
<i>Season</i>				
Wet (n = 163)	45 (27.6)	118 (87.2)	1.56 (1.10-2.22)	0.0189
Dry(n = 288)	51 (17.7)	237 (82.3)	0.64 (0.45-0.91)	
<i>Time of delivery</i>				
7am-6pm (n = 172)	37 (21.5)	135 (78.5)	1.25(0.85-1.84)	0.3099
7pm-6am (n = 156)	42 (26.9)	114 (73.1)	0.80(0.54-1.17)	

367 Table IV: Relationship between season and common morbidity among low birthweight infants

Conditions	Season		Total N=446	RR(95% CI)	P
	Wet (n=225)	Dry (n=221)			
Jaundice	84 (37.3)	69 (31.2)	153 (34.3)	0.87(0.71-1.07)	0.2078
Anaemia	33 (14.7)	32 (14.5)	65 (14.6)	1.06(0.65-1.59)	0.9370
Thrombocytopenia	30 (13.3)	22 (10.0)	52 (11.7)	1.34(0.60-2.25)	0.3350
Malaria	26 (11.6)	22(10.0)	50 (11.2)	1.06(0.63-1.75)	0.9340
Recurrent apnoea	18 (8.0)	13 (5.9)	31 (7.0)	1.35(0.68-2.71)	0.4883
Symptomatic hypoglycaemia	7 (3.1)	6 (2.7)	13 (2.9)	1.15(0.39-3.36)	0.9738
Respiratory distress syndrome	10 (4.4)	9(4.1)	19 (4.3)	1.09(0.45-2.63)	0.9681

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