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ORIGINAL RESEARCH

Neonatal macrosomia and associated morbidities in Sagamu, Nigeria

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Abstract

Background: The incidence of neonatal macrosomia is on the increase in many parts of the world. The impact of the condition on baby and child health has not received adequate research attention.
Objective: To determine the prevalence, baby and maternal characteristics, the pattern of neonatal morbidity and perinatal outcome of macrosomia.
Methods: A retrospective study of all singleton deliveries with birth weight ≥ 4.0 kg was conducted at a tertiary facility in the south-western part of Nigeria between January 2013 and December 2014.
Results: Eighty-eight newborn babies were macrosomic out of 1854 deliveries, resulting in a prevalence rate of 4.7%. The male-to-female ratio was 2:1, while the mean (±SD) birth weight was 4.2 ± 0.3 kg. There was no significant difference in the mean birth weights of the male and female babies (t = 1.24, p = 0.218). The mean maternal age was 31.7 ± 5.1 years. Multiparous mothers had the highest proportion of macrosomic babies, while majority of mothers (77.3%) were either overweight or obese. One-minute Apgar score <7 was observed among 28 (31.8%) babies. Twenty-three (26.1%) babies were hospitalized for further management. Birth asphyxia, hypoglycaemia and hyperbilirubinaemia were the leading morbidities. The perinatal mortality rate for macrosomic babies was 102.2 per 1000 total births.
Conclusion: The incidence of neonatal macrosomia is relatively low in our study population but falls within the range of prevalence rates reported from other parts of the country. Birth asphyxia, hypoglycaemia and hyperbilirubinemia are common morbidities among affected babies.

Keywords: Hospital deliveries, macrosomia, neonatal hypoglycaemia, perinatal mortality.

Introduction

Macrosomia, defined as a birth weight of 4.0kg and above, is a frequent occurrence among newborns all over the world. It has a varied prevalence rate across the globe, ranging from 2.3% to 29.2%. [1, 2] Predisposing factors which have been highlighted in various studies include previous delivery of a macrosomic baby, maternal obesity, maternal diabetes mellitus, excessive gestational weight gain and male foetal sex. [3-8]According to Richardson and

Trotman, maternal obesity, maternal height >164cm, gestational age> 40 weeks, and male gender were found to significantly increase the risk of delivering a macrosomic baby by 2-fold. The most significant risk factor, however, was that of having had a previous macrosomic baby which increased the risk of delivering a macrosomic baby by as much as 6-fold. [6]

Due to its effect on the size of affected foetuses, macrosomia has the propensity to cause cephalo-pelvic disproportion (CPD), which can lead to maternal and foetal complications during obstetric labour. Frequently documented maternal complications include prolonged labour, perineal lacerations and post-partum haemorrhage. [9-11] In addition, there is an increased risk of Caesarean delivery and this risk increases with a higher birth weight of the baby. [12]

It has been noted recently that much of the available studies on the subject of foetal macrosomia have focused mainly on its effect on maternal reproductive health, while the impact of the condition on baby and child health has not received adequate research attention. [1] Furthermore, Nigerian studies on the subject have been conducted mainly in urban centres, and it has not been determined whether the condition occurs at the same frequency in the semi-urban and rural parts of the country. It is in the light of the above that the present study was conceived to investigate the prevalence of neonatal macrosomia and its associated morbidities among Nigerian babies delivered at a tertiary care centre in a semi-urban area of the South-western part of the country.

Methods

The retrospective study was conducted at the Olabisi Onabanjo University Teaching Hospital, Sagamu. Sagamu is a semi-urban town within the Yoruba-speaking south-western part of Nigeria. The delivery records of the hospital for the period between January 2013 and December 2014 were studied. All singleton newborn babies of booked mothers weighing 4.0kg and above were classified as macrosomic and were included in the study. Maternal sociodemographic and clinical parameters, as well as the perinatal history, were extracted from the antenatal care and labour records of the mothers of the selected cases. The case records of selected babies who were hospitalized for various reasons were also studied to document data on diagnoses, treatment given, laboratory parameters, duration of hospitalisation and outcome of treatment.

Maternal anthropometric parameters (body weight and height) were measured at first contact in the ante-natal clinic of the hospital while the newborn babies' birth weight, length and occipitofrontal circumference (OFC) were measured within one hour of birth in accordance with standard practice.
Concerning clinical parameters, neonatal hypoglycaemia was diagnosed based on a random blood glucose level less than 40mg/dl (2.2mmol/L) in the first 24 hours of life and less than 45mg/dl (2.5mmol/L) thereafter. Serum bilirubin levels of babies with the clinical appearance of jaundice were analysed and appropriate therapeutic measures taken as indicated. Apart from anthropometric measurements, full physical examination was conducted on each newborn baby within the first hour of birth to identify birth injuries, congenital malformations and cardio-respiratory disorders. Only babies with the defined clinical condition were admitted to the neonatal ward of the hospital for further management.

The study was carried out in accordance with the principles of the Helsinki Declaration on human subject research. Data analysis was performed with the aid of SPSS version 24

software. Continuous variables were compared using Student's t-test and one-way ANOVA while Chi-Square test was used for categorical variables. *P* values less than 0.05 were deemed to be statistically significant.

Results

There were 1,854 deliveries, 88 of which were macrosomic babies, constituting a prevalence rate of 4.7%. Fifty-seven (64.8%) of the macrosomic babies were males while 31 (35.2%) were females, giving a male-to-female ratio of 2:1. Birth weight of the babies ranged from 4.0kg to 5.5kg with a mean of 4.2 ± 0.3 kg. The male babies weighed slightly more than the female babies on the average (4.2 ± 0.3kg vs 4.2 ± 0.2kg); the difference was not statistically significant (t = 1.241, p = 0.218). The mean length and mean OFC for the babies were 52.1 ± 2.6cm and 36.5 ± 1.4 cm, respectively.

Table I shows further that the mean maternal weight was 76.8 ± 14.9kg while the mean maternal height and mean maternal BMI were 1.6 ± 0.1m and 29.1 ± 5.4kg/m^2, respectively.

Table I: Maternal and baby characteristics

Parameters	Range	Mean (SD)
Birth weight (kg)	4.0 - 5.5	4.23 (0.29)
Length (cm)	47.0 - 58.0	52.12 (2.58)
OFC (cm)	34.0 - 39.0	36.47 (1.38)
Gestational age (wks)	36 – 41	39.28 (1.17)
Maternal age (yrs)	18 -41	31.74 (5.12)
Maternal height (m)	1.37 – 1.84	1.62 (0.08)
Maternal PCV (%)	25 – 39	31.37 (3.40)

Forty-seven (53.4%) babies were delivered via Caesarean section [emergency in 42.0% and elective in 11.4%] while the remaining 41 (46.6%) were products of vaginal delivery including 2 (2.3%) forceps deliveries. Gestational age at birth ranged from 36 to 41 weeks, while the mean gestational age was 39.3 ± 1.2weeks. Following delivery, 60 (68.2%) babies had normal one-minute Apgar score of ≥7. Of the remaining 28 babies, 14 (15.9%) had moderately abnormal Apgar scores of 4-6 while 5 (5.7%) had very low Apgar scores of ≤ 3. Nine (10.2%) babies were stillborn. There was no correlation between the birth weight of subjects and one-minute Apgar score (r = -0.096, p = 0.202). Only 4 (4.5%) babies had a five-minute Apgar score <7.

Maternal age ranged between 18 and 41 years, with a mean of 31.74 ± 5.12 years. The distribution of the babies according to mothers' age group is presented in Table II. Mothers belonging to the age group of 30 – 34 years had the highest number of macrosomic babies (33.0%) while those of 40 years and above had the least (4.5%). Out of 75 mothers with recorded ethnicity, 66 (88%) were Yorubas, 5 (6.7%) were Igbos, and 2 (2.7%) each were Hausas and Edos. Ethnic origin was not recorded for 13 mothers. The mean birth weight for macrosomic babies born to Yoruba mothers was 4.2 ± 0.3kg compared to 4.3 ± 0.3kg for those born to Non-Yoruba mothers (F = 2.472, p = 0.067).

Table II: Distribution of babies according to maternal age group

Maternal age groups (Years)	Frequency	Percentage
≤ 19	1	1.1
20 – 24	6	6.8
25 – 29	23	26.1
30 – 34	29	33.0
35 -39	25	28.4
≥ 40	4	4.5

Concerning maternal parity, Figure 1 shows a double maxima pattern indicating that previously nulliparous and para-2 mothers both had the highest number of macrosomic babies [24 (27.3%)] followed by para-1 mothers with 18 (20.5%) while the grand-multiparous among them altogether had the least number of macrosomic babies [4 (4.5%)]. The parity of 4 mothers was not available. Based on the body mass index (BMI), mothers were classified into various nutritional status. Most of the mothers (77.3%) were either overweight or obese, as shown in Table III. Only 2 (2.3%) of the mothers were underweight while the remainder (20.5%) had their nutritional status within normal limits.

Figure 1: Maternal parity and frequency of macrosomia

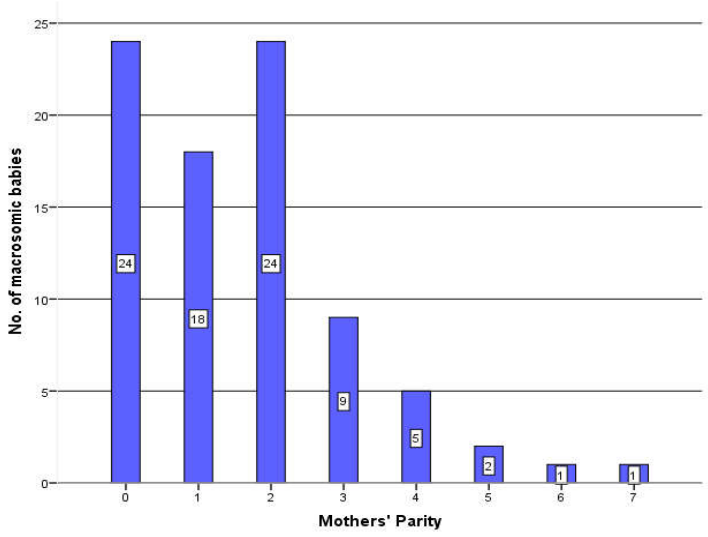

Table III: Distribution of subjects based on their mothers' nutritional status

Nutritional Status	BMI (kg/m²)	Frequency	Percentage
Underweight	< 18.5	2	2.3
Normal	18.5 – 24.9	18	20.5
Overweight	25.0 – 29.9	32	36.4
Obese	≥ 30	36	40.9

Concerning maternal haematocrit, anaemic mothers with PCV < 30% had slightly bigger babies on the average than mothers with PCV > 30%. However, the difference was not significant [4.37 ± 0.43kg vs 4.21 ± 0.24kg; F = 2.087, p = 0.13)]. Pearson's correlation coefficient (r) between maternal PCV and babies' birth weight was - 0.256 (p = 0.067). Only 2 (2.3%) of the mothers were diagnosed with diabetes mellitus.

Nine (10.2%) of the babies were stillborn while 23 (26.1%) babies were hospitalized for further management. Birth asphyxia, hypoglycaemia and hyperbilirubinaemia were the leading morbidities, affecting 20 (22.7%), 14 (15.9%) and 12 (13.6%) babies respectively. The duration of hospitalization ranged from 3 to 14 days, with a mean of 5.0 ± 1.8days. Twenty-one (91.3%) babies responded well to treatment while 2 (8.7%) were discharged against medical advice. No death was recorded among the hospitalized macrosomic babies.

Overall, there were 129 perinatal deaths (stillbirths and early neonatal deaths) out of the 1854 deliveries resulting in a perinatal mortality rate of 69.6 per 1000 total births. The perinatal mortality rate among the macrosomic babies was 102.2 per 1000 total births, made up of 9 stillbirths out of the total number of 88 macrosomic babies. The difference in perinatal mortality rate was not statistically significant (X^2 = 1.148, p = 0.285).

Discussion

The present study recorded an incidence rate of 4.7% of macrosomia among newborn babies delivered at our centre. Other Nigerian studies had reported prevalence rates of 2.5% in Aba, South-east, 3.5% in Ibadan, South-west, 7.7% in Abuja, North-central and 11.3% in Nnewi, South-east, thereby indicating a wide variation of the prevalence rates of the condition within the country.[10, 13-15] Elsewhere in Africa and other parts of the world, prevalence rates of 2.3%, 3.4%, 5.5%, 6.7%, 10.5%, 15.8% and 29.2% had been reported in Tanzania, South Africa, Spain, Ethiopia, Ghana, Tunisia and Canada respectively.[1,2, 16-20] It has been suggested that this variation in the prevalence of the condition could be a function of differences in the socio-economic conditions of the various populations.[1] Other researchers have also observed that racial and ethnic differences do, in fact, influence foetal growth and birth weight. [21]

Male preponderance among the macrosomic babies in the present study is in keeping with previous reports, [4, 6, 8] and it is most likely due to genetic factors. Similarly, the observed mean birth weight of 4.23kg in this series of macrosomic babies agrees with the findings of Osaikhuwuomwan *et al*. and Olokor *et al*. who reported mean birth weights of 4.23kg and 4.26kg respectively in their studies of macrosomia in Benin city, Nigeria.[22,23] Contrary to an earlier report; however, [24], no significant difference was observed between the average birth weights of male and female subjects in the present study.

Concerning maternal characteristics, it was observed that three-quarters of the mothers in this series were either overweight or obese. Other workers have highlighted the strong association between maternal obesity and foetal macrosomia. [3, 6, 25] It has been speculated that increased rate of neonatal macrosomia may contribute to the secular trend of overweight and obesity under affluent living conditions. [5] It is, therefore, imperative to develop effective means of reducing the occurrence of macrosomia to avoid a vicious cycle phenomenon whereby the increased rate of

macrosomia would lead to an increased level of adult/maternal obesity which would further lead to a higher prevalence of macrosomia. Towards this end, regular counselling of expectant mothers on healthy dietary habits and avoidance of excessive calorie intake would go a long way in preventing pregnancy-related over-nutritional disorders among mothers and their babies.

In addition to maternal obesity, excessive gestational weight gain has been widely reported to be a significant risk factor for foetal macrosomia. [3, 25] This could not be confirmed in the present study due to the non-availability of the pre-pregnancy weight of the mothers. The relationship between maternal parity and macrosomia appears to be inconsistent. Whereas Nwabong *et al*., [4] in their study in Cameroon reported that maternal parity of three or more was strongly associated with macrosomia, Agbozo *et al*., reporting from Ghana suggested a parity of 5 and above to be associated with foetal macrosomia. [26] The present study, on the other hand, observed that mothers who were either primiparous or para-2 had the highest number of macrosomic babies among them. The discrepancy notwithstanding, most authors agree that macrosomia is associated with multiparity rather than grandmultiparity or primiparity. [10, 27] The explanation for this observation may derive from the possibility of increased uterine vascularity laying the foundation for increased efficiency of the uteroplacental nutrient exchange with successive pregnancies. Further research is needed in this context.

Studies conducted in parts of Europe and Asia have reported a significant association of macrosomia with maternal diabetes mellitus (DM). [7,28,29] This is because maternal diabetes causes foetal hyperglycaemia and concomitant hyperinsulinemia resulting in excessive foetal growth. Our finding, however, is not in keeping with this observation as only a small percentage of the mothers in this series were diagnosed with DM. In an earlier report from our centre, it has been pointed out that DM is relatively uncommon among pregnant women in the study population. [30] This is most likely due to hereditary or genetic factors.

The spectrum of neonatal morbidities among the babies in the present study included birth asphyxia, hypoglycaemia and hyperbilirubinemia. This observation is in agreement with other reports. [1,14,17] One significant difference, however, is the fact that the incidence of birth trauma among the babies was remarkably low at 2.3% compared to 14.4% reported by Said and Manji from Tanzania. [1] The reason for this may be attributed to the high rate of surgical deliveries and the judicious use of elective Caesarean section. Birth trauma is more commonly associated with vaginal delivery of macrosomic babies due to shoulder dystocia. [1] Furthermore, it is interesting to note that two of these neonatal illnesses, namely birth asphyxia and hyperbilirubinemia were listed as leading causes of morbidity affecting the general population of newborns admitted into the NNW from the Labour and Post-natal Wards of our centre. [31] Therefore, these are not peculiar to macrosomic babies. Hypoglycaemia, on the other hand, appears to be commoner among macrosomic babies than other newborns, most probably due to the increased rate of substrate consumption emanating from a larger body mass.

The perinatal mortality rate of 102.2 per 1000 total births observed in the present study compares well with the rate of 112.5 /1000 reported by Kamanu *et al*. from Aba, South-east Nigeria. [10] It is also not significantly higher than the rate of 69.6/1000 observed in the general population of all newborns at the same centre during the period of study. Unfortunately, this finding buttresses the fact

that perinatal mortality is still very high in many countries of Africa, Nigeria inclusive. Therefore, there is an urgent need for substantial improvement in the antenatal and obstetric care of pregnant women in these countries to ensure more favourable newborn health indices.

The present study encountered some limitations. Available data was not sufficient to determine the socio-economic status of the parents and whether or not it had any influence on the prevalence of neonatal macrosomia as suggested by some researchers. [14] In addition, the use of body weight at booking to compute maternal BMI was necessitated by the non-availability of the pre-pregnancy weight of the mothers. Further research is required to clarify these issues.

Conclusion

The incidence of neonatal macrosomia in this study population is relatively low but falls within the range of prevalence rates reported from other parts of the country. There is a high prevalence of overnutrition among the mothers of affected babies. Birth asphyxia, neonatal hypoglycaemia and hyperbilirubinemia are leading causes of morbidity among macrosomic babies.

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Authors' Contributions: OBO conceived and designed the study. OBO, TOS and VAA supervised data collection. OBO and TAO conducted data analysis and interpretation as well as manuscript preparation. All authors participated in manuscript review and approval of the final version.

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