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Research Article

# The prevalence and pregnancy-related outcomes of small-for-gestational-age newborns in Johannesburg, South Africa

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## ABSTRACT

**Background:** Small-for-gestational-age (SGA) newborns are those whose birth weight is less than the 10th percentile for their gestational age. SGA is associated with a high risk of morbidity and mortality during the perinatal period. The objective of this study was to determine the prevalence and perinatal outcomes of SGA newborns.

**Method:** The study involved 291 singleton newborns who were born small for gestational age between 33 weeks and 0 days and 42 weeks and 6 days at a large public hospital in South Africa. Neonates who are small for gestational age were identified from the birth register using the Intergrowth-21 chart. Data on the perinatal outcomes of SGA newborns were collected from their mothers' maternity records and analysed using descriptive statistics.

**Results:** During the study period, there were a total of 7,837 births, of which 10.6% (834) were SGA. Among the SGA babies, the majority were male (56.0%), and about half of them had low birth weight (49.9%). Most (83.5%) of SGA newborns were born at term, while 16.5% were born preterm. Approximately two-thirds of the SGA newborns (71.5%) were delivered by caesarean section, with foetal compromise being the reason for the caesarean delivery in 69.7% of cases. Almost all SGA newborns (96.6%) had APGAR scores of 7 or higher at five minutes. Approximately 29.5% of the neonates were admitted to the neonatal nursery, and one out of 291 SGA newborns died within the first 24 hours of life.

**Conclusion:** One in ten neonates born at a large urban hospital in South Africa is small for gestational age. Although SGA status is linked to a higher incidence of caesarean delivery, most of these newborns do not demonstrate adverse perinatal outcomes, indicating that many may be constitutionally small rather than pathologically small for gestational age.--

**Keywords:** Small for gestational age, perinatal outcomes, caesarean section, APGAR scores

## INTRODUCTION

The weight of a newborn at birth is a crucial parameter in determining immediate and future health conditions. The World Health Organization (WHO) defines low birth weight as a weight of less than 2,500 g. This definition is comprehensive and includes premature infants who, despite being small, have weights and lengths appropriate for their gestational age.(1) In 1967, Lubchenko and Battaglia introduced the terms small-for-gestational-age (SGA), appropriate-for-gestational-age (AGA), and large-for-gestational-age (LGA).(2) This classification of neonates by birth weight percentile offers significant prognostic advantages by enhancing the detection of neonates with growth issues who are at increased risk for adverse health events.(3) Small for gestational age is defined as a birth weight that falls below the 10th percentile for gestational age.(4) SGA newborns are categorized into two major groups: constitutionally normal SGA and SGA due to foetal growth restriction (FGR). Constitutionally normal SGA arises from inherent factors such as maternal height, weight, ethnicity, and parity, accounting for 50% to 70% of SGA foetuses.(5,6) Conversely, foetal growth-restricted SGA (FGR SGA) newborns result from the foetus's inability to achieve its genetic growth potential. Maternal factors, including chronic medical conditions, placental issues, and genetic disorders, commonly contribute to FGR



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SGA.(5,6) Therefore, SGA and FGR are not synonymous. Some, but not all, growth-restricted foetuses are small for gestational age.(6) Infants born SGA are at risk of developing health problems in the neonatal period and chronic diseases in adulthood, such as cardiovascular diseases, diabetes mellitus, and systemic arterial hypertension.(7) Small for gestational age newborns represent a significant global health burden, particularly in low- and middle-income countries (LMICs).(8)There is a lack of data on the prevalence of SGA newborns in most countries because birth weight and gestational age are rarely recorded in national databases.(1) In 2012, 23 million babies in LMICs worldwide were born small for gestational age.(9) The estimated prevalence of SGA newborns is approximately double that of low birth weight (LBW) newborns globally (10) and varies widely, from 3.5% to 17.9%, in several studies in the literature. This wide range is due to the different definitions and references used. The prevalence of SGA is highest in South Asia and the Sahelian countries of Africa.(10,11) In Nepal, for instance, the estimated prevalence was as high as 30% to 40% in 2010.(9) There are no studies assessing the prevalence of SGA in South Africa.

Many SGA foetuses are merely constitutionally small and therefore likely not at increased risk for poor perinatal and long-term adverse health outcomes. Similarly, a foetus may experience impaired growth or placental function without having a foetal weight below the 10th percentile. (12) Compared to AGA newborns, SGA newborns are generally more susceptible to stillbirths, preterm births, severe acidosis at birth, a five-minute Apgar score of ≤3, neonatal infections, perinatal respiratory complications, jaundice, polycythaemia, hypothermia, poor feeding, and admission to the neonatal intensive care unit.(13)

Most studies on small newborns relate to LBW, with research involving SGA newborns being limited due to the underreporting of gestational age at birth.(7) Given that SGA significantly impacts the health of newborns, research focusing on the prevalence and perinatal outcomes associated with SGA births is essential for enabling sustainable interventions to reduce adverse perinatal and neonatal outcomes. This study aims to determine the prevalence and perinatal outcomes of small for gestational age newborns in South Africa.

## METHODS

This was a hospital-based, retrospective, descriptive study conducted at a major public tertiary hospital, Chris Hani Baragwanath Academic Hospital (CHBAH), Johannesburg, South Africa, over 6 months between October 1, 2020, and March 31, 2021.

Singleton newborns between 33 weeks and 0 days to 42 weeks and 6 days who met the criteria for being small for gestational age were identified from the birth register using the Intergrowth-21 chart and included in the study. Consecutive sampling techniques were used to select the SGA newborns included in this study. The gestational age range used in this study is determined by the range covered on the Intergrowth-21 chart. The Intergrowth-21 chart is a global, multi-ethnic, standardized chart for foetal growth and size, developed by the International Foetal and Newborn Growth Consortium for the 21st Century.(14) It serves as a reliable tool for identifying SGA newborns and is designed for worldwide application.

The birth weights of the newborns at delivery during the study period were plotted against their corresponding gestational age on the Intergrowth 21 chart to identify those that were SGA, using the birth register in the maternity ward. The files of the mothers who delivered the SGA newborns were retrieved from the hospital's records department. The gestational ages documented in the birth registers were verified against those in the retrieved files to ensure alignment before collecting the data from the files. The gestational ages of the cases in this study were those determined by either the last normal menstrual period or the first ultrasound. Considering a prevalence of 25%, a 95% confidence interval, 80% power, and a 5% permissible error, the sample size calculated was 288.

The mothers' demographic characteristics, medical conditions, and relevant events during the pregnancy, delivery, and the postpartum period were retrieved from the included files. Data on the perinatal outcomes of the SGA newborns were documented, captured, and managed using research electronic data capture (REDCap) tools hosted by the University of the Witwatersrand.(20)

Data analyses were conducted using Stata 17.0® (StataCorp, 4905 Lakeway Drive, College Station, Texas 77845, USA). The study utilized descriptive statistics to analyse both continuous and categorical variables. Frequencies with percentages were used to analyse the categorical data, while the median with interquartile ranges was employed for continuous data. The prevalence of SGA was calculated as the number of SGA newborns divided by the total number of newborns during the study period.

Ethical approval for the study was obtained from the Human Research Ethics Committee (HREC) at the University of the Witwatersrand.

## RESULTS

During the study period, there were 7,837 births, of which 834 were SGA. Therefore, the prevalence of SGA in this study was 10.6%. The total number of SGA newborns recruited in our study was 304, with 13 excluded due to incomplete data, and the remaining 291 SGA newborns included in the data analysis (Figure 1).

The sociodemographic details of the mothers are listed in Table 1. Among the mothers who delivered SGA newborns, 78% were single, and 72% were unemployed. Over two-thirds (72.2%) of the mothers of SGA newborns were between the ages of 20 and 34 years, with a median age of 28 years. Nearly one-third (32.7%) of the mothers were

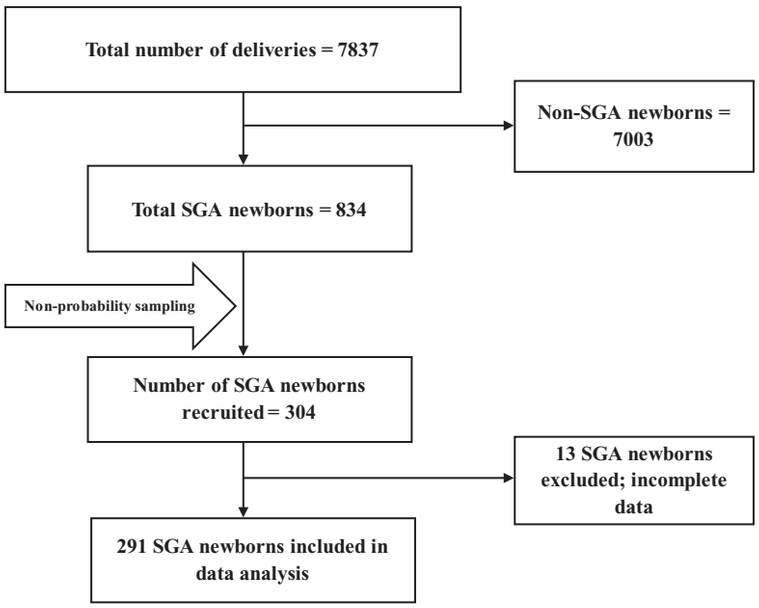



**Figure 1:** Case selection flow diagram

overweight, and 38.8% were obese, with BMI categories of 25.0 kg/m² – 29.9 kg/m² and ≥30.0 kg/m², respectively. Approximately three-quarters (75.6%) of mothers attended at least four antenatal visits during their pregnancies. The median gestational age (GA) at the first antenatal visit was 12 weeks (IQR, 7–18 weeks), and nearly three-quarters of mothers attended their first antenatal visit by 20 weeks of gestation (Figure 2). About two-thirds (67.8%) of the mothers were multiparous, and 38.8% had a haemoglobin level of less than 11 g/dL. Only 5 (1.7%) of mothers tested positive for COVID-19. One-third (29.2%) were positive for retroviral disease, and 1% screened positive for syphilis using the rapid plasma regain test.

The maternal outcomes are presented in Table 2. Approximately 15% of mothers developed a hypertensive disorder during pregnancy. Other medical conditions observed among the SGA mothers during pregnancy include urinary tract infections, acute gastroenteritis, asthmatic attacks, parasuicide, and preterm rupture of membranes. Nearly three-quarters (71.5%) of the women underwent a caesarean section (208/291), with the most common indication for the caesarean delivery being foetal compromise (69.7%).

The immediate newborn outcomes are presented in Table 3. A significant proportion (83.5%) of the SGA newborns were born at term, with half of the newborns (49.9%) having a birth weight of <2500g, indicating low birth weight (Table 2). The male SGA rate was 56.0%, while the female SGA rate was 44.0%. Nearly all the SGA newborns (96.6%) had an APGAR score of ≥7 at five minutes, and only one percent were stillborn. One out of the 291 SGA newborns died within the first 24 hours of life (early neonatal death). Approximately 29.5% of the cases required admission to the nursery or NICU for observation, oxygen therapy, or additional treatment. Minor congenital abnormalities were found in four of the SGA newborns, including extra digits, ambiguous genitalia, and hydrocephalus (Table 3).

## DISCUSSION

In this study, the prevalence of SGA was 10.6%, which aligns with the findings of a retrospective study in Iran and those of a multisite cross-sectional study conducted in Nepal, which reported prevalence rates of 10.6% and 11.9%, respectively.(9,16) In contrast, a secondary data analysis of the WHO Multi-country survey on maternal and newborn health, conducted across 29 countries by Ota et al.,(15) revealed that the prevalence of SGA deliveries was highest in Cambodia (18.8%). On the other hand, our study showed a higher prevalence of SGA births compared to a multi-country study conducted in other low- and middle-income countries,(15) which reported prevalence rates of SGA births in Afghanistan and Uganda of 4.8% and 6.6%, respectively. This suggests that birth outcomes, such as small for gestational age, could still be improved in South Africa.

In the current report, 75.6% of mothers attended at least four antenatal visits during pregnancy, and more than 75% attended their first antenatal visit before 20 weeks of gestation. These findings reflect a higher rate compared to the 2023/24 District Health Information System (DHIS) report, which documented a 69.9% first antenatal care attendance rate before 20 weeks of gestation.(21) These findings align with DHIS's reported decline in

**Table 1:** Mothers' baseline sociodemographic characteristics

| Sociodemographic characteristics | Frequencies n (%) |
|---|---|
| **Age** | |
| 14–20 years | 27 (9.3) |
| 20–34 years | 210 (72.2) |
| 35 years and above | 54 (18.6) |
| **Parity** | |
| Nullipara | 94 (32.3) |
| 1–3 | 150 (51.6) |
| >3 | 47 (16.2) |
| **Employment status** | |
| Employed | 73 (25.1) |
| Unemployed | 208 (71.5) |
| Unspecified | 10 (3.4) |
| **Marital Status** | |
| Single | 226 (77.7) |
| Married | 31 (10.7) |
| Widowed | 1 (0.3) |
| Partner | 23 (7.9) |
| Unspecified | 10 (3.4) |
| **BMI** | |
| Underweight (*<18.5kg/m²*) | 5 (1.7) |
| Healthy (*18.5 kg/m²-24.9 kg/m²*) | 78 (26.8) |
| Overweight (*25kg/m²-29.9kg/m²*) | 95 (32.7) |
| Obese (*>=30kg/m²*) | 113 (38.8) |
| **COVID-19 Status** | |
| Positive | 5 (1.7) |
| Negative | 216 (74.2) |
| Unspecified | 70 (24.0) |
| **Number of antenatal visits** | |
| <4 | 71 (24.4) |
| ≥4 | 220 (75.6) |
| **RVD Status** | |
| Positive | 85 (29.2) |
| Negative | 196 (67.4) |
| Unspecified | 10 (3.4) |
| **Haemoglobin** | |
| <11 g/dl | 113 (38.8) |
| ≥11 g/dl | 178 (61.2) |
| **RPR tests** | |
| Positive | 3 (1.0) |
| Negative | 288 (99.0) |

**Table 2:** Maternal outcomes

| Parameters | Frequencies n (%) |
|---|---|
| **Gestational age at delivery** | |
| Preterm (<37 weeks) | 48 (16.5) |
| Term (≥37 weeks) | 238 (83.5) |
| **Mode of delivery** | |
| Vaginal | 83 (28.5) |
| Caesarean Section | 208 (71.5) |
| **Indication of Caesarean section (N = 208)** | |
| Fetal compromise | 145 (69.7) |
| Previous Caesarean section | 24 (11.5) |
| Hypertensive disorders – Eclampsia, HELLP syndrome | 17 (8.2) |
| Failed induction of labour | 5 (2.4) |
| Malpresentation | 3 (1.4) |
| Prolonged labour | 3 (1.4) |
| Antepartum haemorrhage | 3 (1.4) |
| Others | 8 (3.9) |
| **Complications during pregnancy** | |
| Pregnancy-induced hypertension | 42 (14.4) |
| Gestational diabetes | 1 (0.3) |
| Antepartum haemorrhage | 3 (1.0) |
| Other – UTI, AGE, Asthmatic attacks, parasuicide, PROM | 34 (11.7) |
| None | 211 (72.5) |

HELLP – haemolysis, elevated liver enzymes and low platelets, UTI – urinary tract infection, AGE – acute gastroenteritis, PROM – premature rupture of membranes

the antenatal care attendance rate noted since 2021/22. (21) Alternatively, these discrepancies may be attributed to the study site being a tertiary healthcare facility, where patients are often referred to from both obstetrics and non-obstetrics departments to access more specialized care.

A prospective cohort study conducted by Shrestha et al.(3) indicated that most women who delivered SGA newborns were in the 20–34 years age group, nulliparous, and delivered by caesarean section. This finding correlates with the results of our study; however, the majority of mothers in our study were multiparous. We found a caesarean section rate of 71.5% among the SGA neonates, which is significantly higher than the approximately 50% overall rate at CHBAH.(22) Similarly, Shrestha et al.'s study showed that the most common indication for caesarean section among SGA newborns was a non-reassuring non-stress test, which aligns with our research, which found that 69.7% of the indications for caesarean deliveries were due to foetal compromise. This highlights the added burden

**Table 3:** Immediate newborn outcomes of SGA neonates

| Parameter | Frequencies n (%) |
|---|---|
| **Infant Sex** | |
| Female | 128 (44.0) |
| Male | 163 (56.0) |
| **Birth weight** | |
| Very low birth weight (*<1500g*) | 13 (4.5) |
| Low birth weight (*≥1500g–<2500g*) | 132 (45.4) |
| Normal birth weight (*≥2500g - <4000g*) | 146 (50.2) |
| **Birth defects** | |
| Yes | 4 (1.4) |
| No | 285 (97.9) |
| Unspecified | 2 (0.7) |
| **APGARS at 5 minutes** | |
| <7 | 10 (3.4) |
| ≥7 | 281 (96.6) |
| **Resuscitation at birth** | |
| Yes | 44 (15.1) |
| No | 244 (85.9) |
| Unspecified | 3 (1.0) |
| **Admission to NICU or Nursery** | |
| Yes | 86 (29.5) |
| No | 201 (69.1) |
| Unspecified | 4 (1.4) |
| **Foetal status at or after delivery** | |
| Early neonatal death | 1 (0.3) |
| Stillborn | 3 (1.0) |
| Mild Neonatal Encephalopathy | 1 (0.3) |
| Healthy | 286 (98.3) |

on South Africa's healthcare budget resulting from SGA neonates.

Most SGA newborns in this study were delivered after 37 completed weeks, which aligns with a survey from New Zealand on Pacific infants.(17) Additionally, in the current study, half of the SGA newborns had low birth weights, while the other half had weights greater than 2,500 g. This is consistent with the findings that the prevalence of SGA newborns is approximately double the prevalence of LBW newborns globally.(10) This finding holds substantial clinical significance, as it highlights the need for healthcare professionals to recognize that infants who are not classified as low birth weight may still be small for gestational age.

Out of a total of 291 SGA infants included in the current study, 56.0% (163/291) were male, while 44.0% (128/291) were female. Similar findings were noted in a descriptive case series done by Joiya et al.(18) and in hospital-based prospective studies by Dey et al.(19)

A hospital-based prospective study conducted in Nepal, among 150 singleton pregnant women,(3) showed that more than three-quarters of the SGA newborns had APGAR scores of seven and above at 5 minutes, did not require resuscitation at birth, and had no immediate foetal complications. This finding correlates with the findings from our study, which showed that 96.6% of the SGA newborns had an APGAR score of seven or above at 5 minutes, 85.9% did not require resuscitation at birth, and 98.3% did not experience immediate neonatal complications at delivery. These results may suggest that most of the SGA newborns are constitutionally small for gestational age (SGA) and therefore not prone to adverse neonatal outcomes at delivery.

## LIMITATIONS OF THE STUDY

One of the important limitations of this study is that it was a retrospective analysis and was based at a single hospital. The latter limits the generalisability of our findings to a broader South African cohort. Additionally, there was no comparative group to evaluate the strength of the associations between the identified risk factors and neonatal outcomes. Furthermore, some data on variables of interest were missing from the mothers' files due to poor documentation.

## CONCLUSION

The rate of small for gestational age newborns at Chris Hani Baragwanath Academic Hospital is high, with approximately one in every ten newborns being born small for gestational age. SGA is associated with an increased likelihood of caesarean delivery. However, most of these newborns do not experience adverse perinatal outcomes and may simply be constitutionally small. Further research is needed in South Africa to classify small for gestational age foetuses and determine the proportion of SGA newborns who are constitutionally small, as well as those who are SGA due to genetic, maternal, or placental factors.

## CONFLICT OF INTEREST

None.

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None.

**Authors' contributions**
CSU, ON, GC, and FN participated in the initial conceptualization and drafting of the research topic and protocol. CSU, ON, and SA collected, analysed, and interpreted the data. CSU prepared the initial manuscript. All authors reviewed and approved the final manuscript.

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