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Original Article

The effect of birth weight percentile on adverse neonatal morbidity in term uncomplicated pregnancies

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Abstract

Aim: The goal of the present study was to evaluate the effect of birth weight percentile on adverse neonatal morbidity in term uncomplicated pregnancies.

Material and Methods: This retrospective analysis comprised 7,817 pregnant women with uncomplicated pregnancies and single deliveries at term. The babies were divided into groups according to birth weight percentiles as follows: (1) Small for gestational age (SGA) (<10 percentile), (2) 10–25 percentile, and 26–90 percentile. The primary outcome was adverse neonatal morbidity (ANM), defined as any of the following: Apgar score <4 at 5 min; respiratory distress; mechanical ventilation; intraventricular hemorrhage, grade III or IV; necrotizing enterocolitis, stage 2 or 3; neonatal sepsis, stillbirth or neonatal death.

Results: Demographic and obstetric characteristics of the mothers were similar among the groups. ANM rates were 10.7% in the SGA group, 6.8% in the 10–25 percentile group, and 2.1% in the 26–90 percentile group, a significant difference. ANM was 5-fold higher in the SGA group and 3.2-fold higher in the 10–25 percentile group than in the 26–90 percentile group. Delivery induction or augmentation, cesarean delivery for non-reassuring fetal heart rate or fetal distress, Apgar score <4 at 5 min, mechanical ventilation, neonatal sepsis, stillbirth, or neonatal death significantly increased in the 10–25 percentile group compared with those in the 26–90 percentile group.

Conclusion: The present study indicated that in uncomplicated pregnancies, fetuses with birth weights within the 10–25 percentile had a significantly increased risk of ANM compared to those within the 26–90 percentile.

Keywords: Small for gestational age; SGA; adverse neonatal morbidity; birth weight percentile.

INTRODUCTION

Pregnant women have serious concerns about the wellbeing of their babies because of clinically inadequate fetal growth or a fetus that is small for its gestational age (SGA) as confirmed by ultrasound. SGA is a complex and multifactorial condition and an important risk factor for both neonatal morbidity and mortality (1). Gestational age at delivery, multiple gestation, presence of maternal comorbidity, hypertensive disease, and diabetes are the main determinants of adverse neonatal morbidity (ANM) in SGA fetuses (2-7). In clinical practice, the majority of SGA fetuses born are below the 10 percentile in terms of gestational age. Lee et al. (8) have shown that in 2010, 29 million SGA fetuses were born at term in 138 developing countries.

The literature has clarified that SGA is related to ANM in uncomplicated term pregnancies (9-12). The main hypothesis of our study was that when considering SGA, the birth weight between the 10th and 90th percentile is appropriate for gestational age (AGA), but that ANM can occur when the birth weight is nearer the 10th percentile. For example, although a fetus with a birth weight with in 11th or 12th percentile is defined as AGA, it is difficult to clearly distinguish these fetuses from those with SGA for ANM; therefore, in the present study we aimed to evaluate the effect of birth weight percentile on adverse neonatal morbidity in term uncomplicated pregnancies.

MATERIAL and METHODS

This was a retrospective cohort study approved by the Ethics Committee of Erciyes University (Decision no. 2019/283). The study was conducted at Kayseri City

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Hospital in accordance with the Declaration of Helsinki.

The study comprised 7,817 pregnant women who met the inclusion criteria and delivered at the Kayseri City Hospital between May 2018 and July 2019. Pregnant women who delivered singletons between 37 0/7 and 41 6/7 weeks of gestation were included in study. Last menstrual period was used to determine gestational week and gestational age was calculated according to ultrasonographic measurements performed in the first trimester when the last menstrual period was unknown. The exclusion criteria were as follows: 1) pregnant women with multiple pregnancies; 2) preterm delivery before 37 weeks of gestation; 3) fetal chromosomal or congenital anomalies; or 4) tobacco, alcohol, or drug use. Additionalally we excluded large for gestational age (LGA) fetuses. A pregnancy was considered complicated if a woman had any of the following: diabetes (pregestational or gestational), hypertensive disease of pregnancy (chronic hypertension, gestational hypertension, preeclampsia, or eclampsia), intrahepatic cholestasis of pregnancy, placenta previa, placental abruption, and non-obstetric morbidities. In the absence of any of these parameters, the pregnancy was defined as uncomplicated.

The 7,817 pregnant women were divided into three groups according to birth weight percentiles as follows: (1) SGA (<10 percentile) (n:390), (2) 10–25 percentile (n:750), and 26–90 percentile(AGA) (n:6,677). SGA and other percentiles were determined using the Alexander growth curve for neonatal gestational age at delivery, birth weight, and sex (13). Delivery induction or augmentation was preferred in the presence of oligohydramnios, anhydramnios, membrane rupture, or reduced fetal movements. Flowchart for the study design was illustrated in Figure 1.

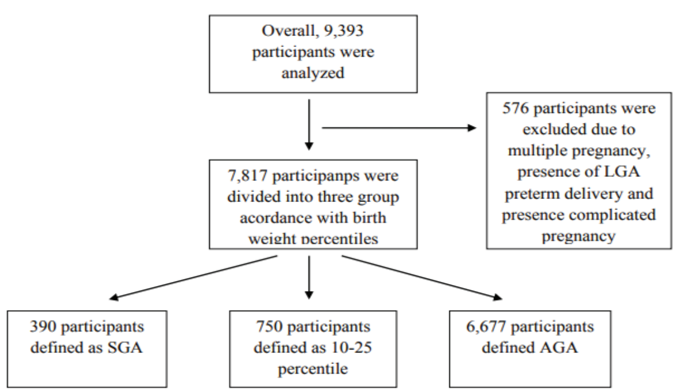

Figure 1. Evaluation of participants and classification of groups.

The primary outcome of study was the presence of ANM, which was defined as any of the following: Apgar score <4 at 5 min; respiratory distress syndrome; need for mechanical ventilation; intraventricular hemorrhage, grade III or IV; necrotizing enterocolitis, stage 2 or 3; neonatal sepsis, suspected or proved; confirmed seizure; stillbirth, or neonatal death. Mendez–Figueroa et al previously defined each ANM parameter in the study.(9).Stillbirth was defined as any fetal death occurring before or during labor, and neonatal mortality was defined as death after delivery or up to 28 d after birth. Maternal characteristics and ANM were compared among the groups.

Statistical analyses

To compare more than two groups, an analysis of variance followed by Tukey's post-hoc test analyzed using Minitab 16 (MinitabInc., State College, PA, USA) was used. To compare two groups, the Shapiro–Wilk test was used to determine the normality of the data, and the Levene's test was used to test the homogeneity of variance assumption. Values are expressed as the mean ± standard deviation. Parametric comparisons were made using the Student's t-test, and nonparametric comparisons were made using the Mann–Whitney U test. The difference among thegroups was considered statistically significant when p <0.05.

RESULTS

Of the 7,817 pregnant women with uncomplicated term pregnancies enrolled in the study, 390 neonates were in the SGA group (<10th percentile), 750 were in the 10–25 percentile group, and 6,677 were in the 26–90 percentile group. The demographic and obstetric characteristics of the mothers were compared and are provided in Table 1. Maternal age (p=0.470), BMI<30 kg/m2 rates(p=0.486), nulliparity rates (p=0.511), and previous cesarean delivery rates (p=0.785) were similar among the groups.

Table 1. Comparison of maternal characteristics among groups

	SGA group (<10 percentile) n:390	10-25 percentile group n:750	26-90 percentile group n:6677	P value
Maternal age (years)	25.7±6.0	25.2±5.7	25.1±5.9	0.470
BMI<30 kg/m2 (n%)	280 (71.7%)	548 (73.0%)	4733 (70.8%)	0.486
Nulliparity (n%)	102 (26.1%)	207 (27.6%)	1904 (28.5%)	0.511
Previous C-section history (n%)	106 (27.1%)	214 (28.5%)	1917 (28.7%)	0.785

SGA: small for gestational age, BMI: body mass index

Table 2 and Table 3 show the delivery outcomes and ANM results. The primary outcome assessed in the study was ANM, the rates of which were 10.7% in the SGA group, 6.8% in 10–25 percentile group, and 2.1% in 26–90 percentile group, which was a significant difference among the groups (p<0.001). ANM was 5-fold higher in the SGA group and 3.2-fold higher in the 10–25 percentile group than in the 26–90 percentile group. The gestational age at delivery was similar among the groups. The fetal birth weight was 2550±240g in SGA group, 2720±190 g in the 10–25 percentile group, and 3320±340g in the 26–90 percentile group, which was a significant difference among the groups (p<0.001).Although not as high as in SGA deliveries, delivery induction or augmentation, cesarean delivery for non-reassuring fetal heart rate or fetal distress, Apgar score <4 at 5 min, neonatal sepsis, stillbirth, or neonatal death significantly increased within the 10–25 percentile group compared with these in the 26–90 percentile group (p<0.001, p<0.001, p=0.042, p<0.001, p<0.001, respectively).In addition, mechanical ventilation rates significantly increased in the 10–25 percentile group compared with those in the 26–90 percentile group (p=0.001).

Table 2. Comparison of adverse neonatal morbidity among groups

	SGA group (<10 percentile) n:390	10-25 percentile group n:750	26-90 percentile group (AGA) n:6677	P value
Gestational age at delivery (weeks)	39(38-40)	39(38-40)	39(38-40)	0.570
Fetal birth weight (gr)	2550±240[a]	2720±190[b]	3320±340[c]	<0.001
Delivery induction or augmentation (n%)	188(48.2%)[a]	241(32.1%)[b]	1617(24.2%)[c]	<0.001
Cesarean delivery for non-reassuring fetal heart rate testing or fetal distress (n%)	79(20.2%)[a]	112(14.9%)[b]	780(11.6%)[c]	<0.001
Apgar score <4 at 5 min (n%)	2(0.51%)	5(0.66%)	8 (0.11%)	0.051
RDS (n%)	13(3.3%)	23(3.0%)	127(1.9%)	0.145
Mechanical ventilation (n%)	9 (2.3%)[a]	15(2.0%)[a]	38 (0.4%)[b]	0.001
IVH grade 3/4 (n%)	2(0.51%)	0(0%)	0(0%)	0.091
NEC grade 2/3 (n%)	0(0%)	0(0%)	0 (0%)	NA
Neonatal sepsis (n%)	12(3.0%)[a]	13(1.7%)[b]	47(0.7%)[c]	<0.001
Periventricular leukomalacia (n%)	2(0.51%)	0(0%)	0(0%)	0.091
Stillbirth or neonatal death (n%)	9(2.3%)[a]	5(0.6%)[b]	6(0.08%)[c]	<0.001
Adverse neonatal morbidity (n%)	42 (10.7%)[a]	51 (6.8%)[b]	145 (2.1%)[c]	<0.001

SGA: small for gestational age, RDS: Respiratory distress syndrome, IVH: Intraventricular hemorrhage NEC:NecrotizingenterocolitisNote: Different superscripts indicate statistically significant differences

Table 3. Comparison of adverse neonatal morbidity between 10-25 percentile and 26-90 percentile group

	10-25 percentile group n:750	26-90 percentile group (AGA) (n:6677)	P value
Gestational age at delivery (weeks)	39 (38-40)	39 (38-40)	0.680
Fetal birth weight (gr)	2720±190	3320±340	<0.001
Delivery induction or augmentation (n%)	241 (32.1%)	1617(24.2%)	<0.001
Cesarean delivery for non-reassuring fetal heart rate testing or fetal distress (n%)	112 (14.9%)	780(11.6%)	<0.001
Apgar score <4 at 5 min (n%)	5 (0.66%)	8 (0.11%)	0.042
RDS (n%)	23 (3.0%)	127 (1.9%)	0.270
Mechanical ventilation (n%)	15(2.0%)	38 (0.4%)	0.001
IVH grade 3/4 (n%)	0 (0%)	0 (0%)	NA
NEC grade 2/3 (n%)	0 (0%)	0 (0%)	NA
Neonatal sepsis (n%)	13(1.7%)	47 (0.7%)	<0.001
Periventricular leukomalacia (n%)	0 (0%)	0 (0%)	NA
Stillbirth or neonatal death (n%)	5 (0.6%)	6 (0.08%)	<0.001
Adverse neonatal morbidity (n%)	51 (6.8%)	145 (2.1%)	<0.001

SGA: small for gestational age, RDS: Respiratory distress syndrome, IVH: Intraventricular hemorrhage NEC:Necrotizingenterocolitis

DISCUSSION

Today, it is well documented that about 30% of stillbirths and infant deaths occur at term in developed countries(14). There are different definitions a small fetus or infant at term and many different methods have been used, including statistical thresholds outside the expected birth weight for gestational age or absolute birth weight (15, 16). Whether these thresholds optimally define the risk of neonatal morbidity at term is not clear.

The present study showed that in uncomplicated pregnancies, ANM for SGA fetuses born at term is significantly worse than that of AGA fetuses. In addition, fetuses with birth weights within the 10–25 percentile had a significantly increased risk of ANM compared to those within the 26–90 percentile, and this risk was significantly lower than that in SGA fetuses. Specifically, ANM was 5-fold higher in the SGA group and 3.2-fold higher in the 10–25 percentile group than that in the 26–90 percentile group.

In their multicenter prospective study, Mendez-Figueroa et al.(9) reported that composite neonatal outcomes were significantly higher in SGA newborns than in AGA newborns at term in uncomplicated pregnancies. Their study compared 5,416 SGA newborns with 44,595 AGA newborns for composite neonatal outcomes and their results showed that SGA newborns had 60% higher rates and 3-fold and 2-fold higher rates of stillbirth and neonatal mortality (9). In another study, Chauhan et al.(11) reported that hypoxic composite neonatal morbidity was significantly higher in SGA fetuses compared to that in AGA fetuses in uncomplicated term pregnancies. Recently, the results of a large retrospective Australian study by Madden et al. (17) comprising 95,900 infants suggested that term SGA infants from low-risk women are at a significantly increased risk of neonatal mortality and morbidity. The study results showed that composite neonatal morbidity was 11.1% in the AGA group, 13.7% in the <10 percentile group, and 22.6% in the <5 percentile group (17). The results of our study suggest that ANM for SGA fetuses born at term after uncomplicated pregnancies are significantly worse than that inAGA fetuses. These findings together with those of three recent publications (9, 11, 17) provide evidence of the ANM risks for SGA fetuses, even those born at term.

Additionally we showed that 10–25 birth weight percentile group has significantly increased risk for ANM compared to 26-90 percentile group. Our study results also indicated that ANM was 5-fold higher in the SGA group and 3.2-fold higher in the 10–25 percentile group than that in the 26–90 percentile group. The ANM rates were 10.7% in the SGA group, 6.8% in the 10–25 percentile group, and 2.1% in the 26–90 percentile group. When the literature is examined, there are some studies supporting the results of our study. In a study S. Iliodromiti et al they reported that birth weight ≤25th percentile was associated with higher risk for all mortality and morbidity outcomes (18). In another study Julia H. Francis et al declared that babies with a 10–25th birth weight percentile had a two-fold increased risk of perinatal death (AOR 2.10, 95% CI 1.6, 2.7) (19).

The results of our study might contribute the following important indications in clinical practice:1) sound evidence from ultrasound examinations that detect SGA fetuses conflict with the results of other studies that show no benefit of these tests (20, 21), while others have shown detection rates >50% (22-24). In addition, Cochrane reviews have not confirmed any advantage to using either routine late-pregnancy ultrasound or umbilical artery Doppler in low-risk populations (25, 26); however, there is evidence that shows that SGA is associated with ANM, even in a low-risk population, and that a late-pregnancy ultrasound will help to reduce the risk of ANM in SGA fetuses. It is possible to suggest that this evaluation is valid for fetuses within the 10–25 percentile; 2)our findings of increased ANM for SGA fetuses born at term support the American Congress of Obstetricians and Gynecologists (ACOG) guidelines and consensus that fetuses with restricted growth (weight in the < 10th percentile) without other risk factors should be delivered by 39.0 weeks (1). Because our results showed an increased risk of ANM in the 10–25 percentile group, obstetricians might plan to deliver these fetuses at 39 weeks to reduce that risk.

Our study had both strengths and limitations. The strengths were its large sample size from a tertiary institution with clear evidence-based protocols that guided management. The main limitations were related to its retrospective nature and its focus within a single institution. In addition, newborns were divided into groups based on the Alexander growth curve instead of a customized growth curve because the latter has not consistently identified the characteristics of pregnancies with adverse outcomes and, more importantly, is not recommended by ACOG guidelines (1).

CONCLUSION

The present study indicated that in uncomplicated pregnancies, fetuses with birth weights within the 10–25 percentile had a significantly increased risk of ANM compared to those within the 26–90 percentile. Specifically, ANM was 5-fold higher in the SGA group and 3.2-fold higher in the 10–25 percentile group than that in the 26–90 percentile group.

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