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Impending macrosomia: will induction of labour modify the risk of caesarean delivery?

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Abstract

Objective—To compare the annual incidence rates of caesarean delivery between induction of labour and expectant management in the setting of macrosomia.

Design—This is a retrospective cohort study.

Setting—Deliveries in the USA in 2003.

Population—Singleton births of macrosomic neonates to low-risk nulliparous women at 39 weeks of gestation and beyond.

Methods—Women who had induction of labour at 39 weeks of gestation with a neonatal birthweight of 4000 ± 125 g (3875–4125 g) were compared with women who delivered (either induced or spontaneous labour) at 40, 41 or 42 weeks (i.e. expectant management), assuming an intrauterine fetal weight gain of 200 g per additional week of gestation. Similar comparisons were made at 40 and 41 weeks of gestation. Chi-square test and multivariable logistic regression analysis were used for statistical comparison.

Main outcome measures—Method of delivery, 5-minute Apgar scores, neonatal injury.

Results—There were 132 112 women meeting the study criteria. In women whose labours were induced at 39 weeks and who delivered a neonate with a birthweight of 4000 ± 125 g, the frequency of caesarean was lower compared with women who delivered at a later gestational age (35.2% versus 40.9%; adjusted OR 1.25, 95% CI 1.17–1.33). This trend was maintained at both 40 weeks (36.1% versus 42.6%; adjusted OR 1.31, 95% CI 1.23–1.40) and 41 weeks (38.9% versus 41.8%; adjusted OR 1.16, 95% CI 1.06–1.28) of gestation.

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Details of ethics approval This study was approved by the Committee on Human Research at the University of California, San Francisco on 23 August 2010.

Conclusions—In the setting of known birthweight, it appears that induction of labour may reduce the risk of caesarean delivery. Future research should concentrate on clinical and radiological methods to better estimate birthweight to facilitate improved clinical care. These findings deserve examination in a large, prospective, randomised trial.

Keywords

Induction of labour; macrosomia; mode of delivery

Introduction

Neonatal macrosomia, often defined as birthweight exceeding 4000 g regardless of gestational age, is relatively common with approximately 10% of neonates falling into this range; using a threshold of 4500 g reduces the prevalence of macrosomia to approximately 1.5%.¹ Macrosomia has been associated with adverse maternal and neonatal outcomes. These include labour dystocia, caesarean delivery, severe perineal laceration, postpartum haemorrhage and puerperal infection for the mother^{2–5} and low 5-minute Apgar scores, shoulder dystocia, birth trauma, brachial plexus injury, admission to the intensive-care nursery, and increased perinatal mortality for the newborn.^{6–8}

When fetal macrosomia is suspected in pregnancies that are complicated by diabetes, improved glycaemic control can decrease the risk of perinatal complications.^{9,10} For women without diabetes, however, currently there is no proven intervention to treat or curb fetal growth.¹ A large number of caesarean deliveries would need to be performed to prevent one brachial plexus injury for suspected macrosomia, so routine caesarean delivery in this scenario has not been recommended.^{1,4,11,12}

Can induction of labour confer improved perinatal outcomes in women without diabetes who are suspected of having fetal macrosomia? The evidence is unclear. Although retrospective cohort studies that examined elective induction in women with suspected macrosomia generally report an associated increase in caesarean delivery without reducing shoulder dystocia, most of these studies compared women who were induced with those who were in spontaneous labour.^{13–15} Yet, in the clinical setting, clinicians are faced with the decision of recommending either induction of labour or expectant management (and cannot recommend spontaneous labour). Hence, these observational studies did not use the appropriate comparators; namely, induction of labour versus expectant management rather than spontaneous labour. Furthermore, these studies did not account for the effect of expectant management, which includes continued intrauterine fetal growth. The largest randomised controlled study that examined the effect of induction of labour versus expectant management for 273 women without diabetes but suspected of having fetal macrosomia at term, reported that rates of caesarean delivery (19.4% for the induction group and 21.6% for the expectant management group) and shoulder dystocia were not significantly different.¹⁶

Given the paucity of data on management of suspected macrosomia and associated perinatal outcomes in women without diabetes, we designed a retrospective cohort study to examine the association between induction of labour and mode of delivery in low-risk women with neonatal macrosomia. Specifically, women who underwent induction of labour were compared with women who did not have induction, accounting for the effect of increased gestational age among those who were managed expectantly and delivered at a later gestational age. We hypothesised that induction of labour is not associated with increased caesarean delivery.

Methods

This is a retrospective cohort study of low-risk nulliparous women with singleton live births delivered in 2003 in the USA using the Vital Statistics Natality birth certificate registry provided by the Center of Disease Control and Prevention. The 2003 natality data includes births to US and non-US residents that occurred in the 50 states plus the District of Columbia, the Virgin Islands and US territories. The 2003 birth data were compiled using either the 2003 Revision (by Pennsylvania and Washington) or the 1989 Revision of US Standard Certificate of Live Birth (by the remaining 48 states and the District of Columbia). Exclusion criteria were multiparity, multifetal gestations, deliveries before 39^(0/7) weeks of gestation or at 43^(0/7) weeks of gestation and beyond. Women with medical or obstetric conditions complicating pregnancy were also excluded, including women with chronic hypertension, pregnancy-associated hypertension (gestational hypertension and/or pre-eclampsia), eclampsia, pre-gestational or gestational diabetes mellitus, cardiac, lung and renal diseases, placenta praevia, placental abruption, oligohydramnios or polyhydramnios. Because much of this information was available only in the 1989 Revision of US Standard Certificate of Live Birth, we chose 2003 as the study period to capture live births in the USA, which was reflective of today's obstetric climate. We limited study analysis to nulliparous women who delivered between 39 and 42 weeks of gestation. For this study, the gestational age was based on the obstetric/clinical dating because studies have shown that such estimates provide the best approximation for dates.^{17,18} Gestational age at delivery was categorised as 39, 40, 41 or 42 completed weeks. Institutional Review Board approval was obtained from the Committee on Human Research at the University of California, San Francisco.

To create a reasonable population sample, pregnancies involving a known birthweight of 4000 ± 125 g (i.e. birthweight between 3875 and 4125 g) would be considered as having suspected fetal macrosomia for this study. To examine the effect of induction of labour in women with macrosomia at a given gestational age (e.g. 39 weeks) compared with expectant management (e.g. delivery at 40, 41 or 42 weeks by either spontaneous labour or induction of labour), we assumed an intrauterine fetal weight increase of 200 g/week (Figure 1). This assumption is consistent with a recent growth chart of fetal weight by gestational age based on data from several large population studies.¹⁹ To illustrate, we assigned women at 39 weeks of gestation with birthweight 3875–4125 g who were induced as the 'induction' group and women who delivered at a later gestation (40 weeks with birthweight 4075–4325 g, 41 weeks with birthweight 4275–4525 g, and 42 weeks with birthweight 4475–4725 g) as the 'expectant' group. Women designated as the 'expectant' group can either undergo spontaneous labour, or induction of labour. Additionally, this study design minimised the incorporation of women who would have had elective caesarean delivery (for suspected macrosomia or other obstetric/medical indications) because elective caesareans are generally performed between 39 and 40 weeks of gestation and these women would have been excluded from analysis because we examined only women who had induction at 39 weeks and compared them with deliveries at 40 weeks and beyond. According to this analytic scheme, women who had caesarean delivery without induction of labour at 39 weeks of gestation were not included in the analysis because the objective of our study was to examine management of pregnancy with macrosomia by either induction or expectant management, and not to study elective caesarean delivery for macrosomia, since this topic has been studied previously.¹ Similarly, women who had induction at 40 weeks of gestation with known neonatal birthweight of 3875–4125 g were designated as the 'induction' group, and they were compared with the 'expectant' group—women who delivered at either 41 weeks of gestation (with birthweight 4075–4325 g) or 42 weeks (with birthweight of 4475–4725 g).

To examine the association between induction of labour and expectant management in pregnancies involving macrosomia of varying thresholds, we made a similar comparison among women whose infant weighed 4250 ± 125 g delivered at 39 weeks gestation, to deliveries later and assumed 200 g of intrauterine fetal weight gain per week. In this analysis, women induced at 39 weeks of gestation with a neonatal birthweight of 4125–4375 g (the 'induced' group) were compared with the 'expectant' group: delivery at 40 weeks with birthweight of 4325–4575 g, at 41 weeks with birthweight of 4525–4775 g, or at 42 weeks with birthweight of 4725–4975 g). We also examined the association between induction and expectant management in women with neonatal birthweight of 4500 ± 125 g at 39 weeks of gestation, following the same assumption of 200 g intrauterine fetal growth per week and group designations similar to those described above.

The primary outcome was the incidence rate of caesarean delivery. Secondary outcomes included 5-minute Apgar score <7 , neonatal injury (in vaginal deliveries only), meconium aspiration, and combined neonatal morbidity (a composite variable of 5-minute Apgar <7 , meconium aspiration syndrome, birth injury, use of mechanical ventilation >30 minutes, and neonatal seizure). In the 2003 Natality data, Apgar scores were not collected by California or Texas; therefore, 5-minute Apgar scores were available for 77.5% of births in 2003.²⁰ The definition and diagnostic criteria of outcomes in the birth data were based on definitions compiled by a committee for Federal and State health statistics.^{21,22}

We compared incidence rates of caesarean and other perinatal outcomes in women who had induction of labour with those in women who had expectant management, using the chi-square test. Multivariable logistic regression models were used to control for potential confounders, which included maternal age, race/ethnicity, gestational weight gain, cigarette use during pregnancy, and prenatal visits. Induction at each gestational age was designated as the referent comparison group. Statistical analysis was performed using stata v11.0 (StataCorp, College Station, TX, USA). Statistical significance was indicated using $P < 0.05$ and 95% confidence intervals.

Results

There were 132 112 nulliparous women who met the study criteria and delivered in the USA in 2003. Most were between 20 and 34 years of age (76.8%), of non-Hispanic White race/ethnicity (69.9%), had between 9 and 16-plus - years of education (93.7%), had gestational weight gain above 16 kg (60.2%), and had at least eight prenatal care visits (94.2%; Table 1). Most women (88.7%) initiated prenatal care in the first trimester; 8.5% had initial care in the second trimester, 1.5% had late care that started in the third trimester, and only 0.3% did not have prenatal care.

Among pregnancies with neonatal birthweight 4000 ± 125 m (3875–4125 g), those who had induction at 39 weeks of gestation had a lower rate of caesarean delivery than those who were expectantly managed and delivered at a later gestational age (either at 40, 41, or 42 weeks of gestation with assumed intrauterine fetal growth of 200 g/ week: 35.2% versus 40.0%, $P < 0.0001$; adjusted odds ratio [aOR] 1.25, 95% CI 1.17–1.33). Compared with later delivery, pregnancies with neonatal birthweight of 4000 ± 125 g that were induced at 40 or 41 weeks had lower rates of caesarean delivery (Table 2). When potential confounding factors were adjusted using multivariable logistic regression models and compared with women induced at a particular gestational age (39, 40, or 41 weeks), women who were expectantly managed had a higher odds of caesarean delivery (Table 2). With similar comparisons, neonates with birthweight 4000 ± 125 g had higher odds of 5-minute Apgar <7 when expectantly managed at 40 weeks (aOR 1.31, 95% CI 1.23–1.40). The odds of neonatal injury were two-fold higher (aOR 2.04, 95% CI 1.07–3.87) when women were

expectantly managed until 42 weeks of gestation compared with being induced at 41 weeks of gestation. The risk of meconium aspiration was not different for the induction or expectant groups nor for fetal weight categories (results not shown).

Using the same analytic scheme, we estimated the risk of caesarean delivery and neonatal outcomes when fetal birthweight was 4250 ± 125 g by gestational age (Table 3). Induction at 39 weeks of gestation was associated with a lower risk of caesarean delivery compared with delivery at a later gestation (aOR 1.45, 95% CI 1.30–1.62). This association persisted for induction of pregnancies with birthweight of 4250 ± 125 g at 40 and 41 weeks of gestation compared with delivery later (Table 3). The association between induction and neonatal outcome did not reach statistical significance (Table 3).

For pregnancies with neonatal birthweight 4500 ± 125 g, we similarly observed that the odds of caesarean section was higher in women who were expectantly managed to a later gestation compared with women who underwent induction, either at 39 weeks (aOR 1.30, 95% CI 1.09–1.56) or 40 weeks (aOR 1.31, 95% CI 1.12–1.54). There was no difference in neonatal outcome in this comparison (Table 4).

In women with neonatal birthweight 4000 ± 125 g and induced at 40 weeks, expectant management was associated with higher odds of composite neonatal morbidity (aOR 1.34, 95% CI 1.05–1.71; Table 5). In women with neonatal birthweight 4250 ± 125 g, expectant management, compared with induction at 39 weeks, was associated with higher odds of composite neonatal morbidity (aOR 1.38, 95% CI 1.05–1.81) as were those with birthweight 4500 ± 125 g and delivered later compared with being induced at 40 weeks (aOR 1.79, 95% CI 1.15–2.77; Table 5).

Of note, for the group that we defined as expectantly managed, the majority of women did experience spontaneous labour at a later gestation: for the estimated fetal weight of 4000 ± 125 -g category and did not have induction at 39 weeks, 70% had spontaneous labour and 30% were induced at 40, 41, or 42 weeks; for those who did not have induction at 40 weeks, 65% had spontaneous labour and 35% were induced at 41 or 42 weeks; for those who did not have induction at 41 weeks, 66% had spontaneous labour and 34% were induced at 42 weeks. These proportions of women expectantly managed and delivered at a later gestation either by spontaneous or induced labour were similar for the 4200 and 4500 g thresholds.

Discussion

In this large cohort of low-risk women with singleton pregnancies who delivered between 39 and 42 weeks of gestation in the setting of neonatal macrosomia, induction of labour at a given gestational age may be associated with decreased risk of caesarean delivery compared with expectant management. Our findings did not support previous retrospective cohort studies,^{21–23} which report that induction for suspected fetal macrosomia is associated with increased risk of caesarean delivery. This discrepancy probably resides in differences in study design and designation of comparison groups. Previous observational studies compared women who had induction of labour with women who had spontaneous labour at similar gestational age. This comparison scheme is inappropriate because clinical choices are not induction now or spontaneous labour now. Rather, the choices are either to undergo induction now, or to continue pregnancy/expectant management, leading to delivery at a later gestational age—either by entering spontaneous labour, or induction of labour for other indications.²³ In this study we compared women who had induction to women who delivered later (i.e. were expectantly managed) and we accounted for continuing intrauterine fetal growth with ongoing pregnancy by assuming 200 g fetal weight gain per week of gestation. With this analytic scheme, our findings are consistent with the randomised,

prospective study that examined induction of labour versus expectant management in the setting of suspected macrosomia.¹⁶ With this large cohort of women with known macrosomic birthweight, we reported a larger difference between the induction and expectant groups that was statistically significant in all gestational age categories and fetal weight estimates. Given this finding, further evidence from large, prospective studies is needed to elucidate and validate whether intervention may lead to reduced risk of caesarean delivery in the setting of fetal macrosomia.

A recent systematic review reports that existing studies have not demonstrated that induction of labour in the setting of macrosomia improves neonatal outcomes.²⁴ Our study suggested that expectant management, compared with induction, may be associated with increased risk of neonatal morbidity. In this analysis, the incidence risk of low 5-minute Apgar scores, neonatal birth injury and mechanical ventilation use remained relatively consistent and accounted for the vast majority of the composite morbidities across varying gestational age groups, hence supporting the association between neonatal outcomes and induction in the setting of macrosomia. However, despite the large sample size, our study probably still lacks statistical power to examine whether induction in the setting of macrosomia can prevent birth injury.

While clinical or sonographic estimation of fetal weight had been notoriously inaccurate, this is an area of active research.^{25–27} For example, fetal anthropometric measurements, incorporation of normograms/regression equations and clinical factors can potentially improve the reliability of estimated birthweights and identification of macrosomic fetuses.^{28–31} Perhaps with improved ability to identify pregnancies at risk of fetal macrosomia, clinicians can better assess the actual perinatal risks associated with suspected macrosomia to further counsel and manage pregnancies accordingly.

This study is one of the largest to date to examine the association between induction and expectant management in the setting of known macrosomia and mode of delivery/neonatal outcomes, but it has limitations. We designated pregnancies as involving macrosomia based on known birthweight; unfortunately, this information is not available to clinicians before actual delivery. As errors in fetal weight estimates can be either overestimations or underestimation, such misclassification may bias the effect of estimates; but with large sample size, the net bias may become negligible. However, there will still be women diagnosed with macrosomia who have an actual birthweight below this threshold. To represent such misclassification, we included neonates above and below the birthweight thresholds in our study population. This population-based study aimed to examine a low-risk population. Although we attempted to exclude most women with obstetric or medical conditions complicating their pregnancies, there may be some that remained high-risk in the study population. Given that women with medical/obstetric conditions are more likely to undergo induction and they are also more likely to have caesarean deliveries, the incorporation of these high-risk women in the induction group may result in higher estimates of caesarean section in the induction group, biasing our actual estimates towards the null. Hence, our effect estimates of higher risk of caesarean delivery in the expectant management group would prove to be conservative. As our study aim was to examine induction versus expectant management in women with fetal macrosomia, we attempted to exclude women with elective caesareans by study design. As the natality data do not provide information regarding elective caesarean deliveries these women could not be excluded directly, inasmuch as our study population may have included some women who had undergone elective caesareans at 40 weeks and beyond. Further, we attempted to account for the effect of ongoing pregnancy by assuming a linear intrauterine fetal weight gain of 200 g/week, which can be an overestimate for some while underestimate for others. However, on average, this estimate is consistent with a report that the average fetal weight gain is a linear

function of gestational age at term, with a weekly weight gain of 5.2% of the expected term birthweight,³² as well as with a growth chart of fetal weight by gestational age.¹⁹ Also, we use multivariate logistic regression to control for potential bias in effect estimation because of confounding; however, there may be residual confounding from unobserved or uncontrolled covariates. For example, we did not have information on maternal pre-pregnancy weight/body mass index (BMI) or cervical status, nor could we control for clinical factors such as clinicians' a priori perception or anxiety towards fetal macrosomia at various weeks of gestational age. While cervical status may influence a clinician's assessment of the risk/benefits of induction of labour, recent studies suggest that elective induction of labour (compared with expectant management) increased the use of labour and delivery resources but did not differ in perinatal outcomes among nulliparous women with a favourable cervix³³ and those with unfavourable cervical status.³⁴

Conclusion

In summary, our retrospective study examines whether intervention (induction compared with expectant management) for suspected fetal macrosomia may be associated with decreased risk of caesarean delivery. As we note above, these findings are based on actual birthweight, so further efforts in fetal weight estimation will prove clinically beneficial. Although our study supports the idea that induction may provide improved perinatal outcomes, future large prospective, randomised, clinical trials are necessary to further assess the potential benefit in the low-risk population in such a clinical setting.

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Figure 1.

Study comparison groups and assumed 200-g intrauterine fetal weight gain with each additional week of gestation: women who underwent induction of labour at 39 weeks of gestation with designated fetal weight range (highlighted with solid line) were compared with women who had delivery at a later gestational age by either spontaneous labour or induction at 40, 41, or 42 weeks of gestation (each week of gestation and fetal weight range highlighted with broken lines). IOL, induction of labour.

Table 1Maternal characteristics (total $n = 132\,112$)

	Number of women (%)
Age (years)	
19	19 216 (14.6)
20–34	101 493 (76.8)
35	11 403 (8.6)
Race/ethnicity	
Non-Hispanic white	92 374 (69.9)
African American	9761 (7.4)
Latina/Hispanic	23 553 (17.8)
Asian	5175 (3.9)
Other	1249 (1.0)
Education	
0–8 years (less than high school)	4231 (3.2)
9–12 years (some high school/grad)	49 184 (37.2)
13–16+ years (some college/grad+)	77 261 (58.5)
Not stated/unknown	1436 (1.1)
Gestational weight gain (kg)	
16	43 126 (39.8)
>16	65 289 (60.2)
Prenatal care visits	
< 8 visits	7563 (5.8)
8 visits	122 425 (94.2)
Gestational age at delivery (weeks)	
39	36 412 (27.6)
40	51 850 (39.2)
41	34 646 (26.2)
42	9204 (7.0)

Source: National Center for Health Statistics (2003).

Table 2

Frequency and adjusted odds ratio of caesarean delivery and neonatal outcome by gestational age at delivery in women with neonates with birthweight 4000 ± 125 g at time of induction compared with delivery at a later gestational age (expectant management), assuming an intrauterine weight gain of 200 g/week

4000 $\pm$ 125 g	Caesarean delivery (%)	aOR*	95% CI
39 weeks of gestation			
Induction (<i>n</i> = 10 381)	35.2	Referent	1.17–1.33
Expectant (<i>n</i> = 32 042)	40.9	1.25	
40 weeks of gestation			
Induction (<i>n</i> = 10 119)	36.1	Referent	1.23–1.40
Expectant (<i>n</i> = 14 245)	42.6	1.31	
41 weeks of gestation			
Induction (<i>n</i> = 5722)	38.9	Referent	1.06–1.28
Expectant (<i>n</i> = 3509)	41.8	1.16	

4000 $\pm$ 125 g	5 min Apgar <7	aOR*	95% CI
39 weeks of gestation			
Induction (<i>n</i> = 8780)	0.47	Referent	0.68–1.48
Expectant (<i>n</i> = 24 537)	0.57	1.00	
40 weeks of gestation			
Induction (<i>n</i> = 8595)	0.51	Referent	1.20–2.53
Expectant (<i>n</i> = 10 822)	0.63	1.75	
41 weeks of gestation			
Induction (<i>n</i> = 3826)	0.39	Referent	0.88–2.26
Expectant (<i>n</i> = 2631)	0.57	1.40	

4000 $\pm$ 125 g	Neonatal injury	aOR*	95% CI
39 weeks of gestation			
Induction (<i>n</i> = 2927)	0.75	Referent	0.63–1.64
Expectant (<i>n</i> = 12 642)	0.74	1.02	
40 weeks of gestation			
Induction (<i>n</i> = 4795)	0.63	Referent	0.70–1.88
Expectant (<i>n</i> = 6855)	0.66	1.15	
41 weeks of gestation			
Induction (<i>n</i> = 3968)	0.63	Referent	1.07–3.87
Expectant (<i>n</i> = 1610)	1.18	2.04	

Referent comparison group: non-Hispanic white; women induced at specific gestational age (either 39, 40, or 41 weeks).

Source: National Center for Health Statistics (2003).

* Multivariable logistic regression controlling for: maternal age, race/ethnicity, number of prenatal care visits, gestational weight gain, cigarette smoking during pregnancy.

Table 3

Frequency and adjusted odds ratio of caesarean delivery and neonatal outcome by gestational age at delivery in women with neonates with birthweight 4250 ± 125 g at time of induction compared with delivery at a later gestational age (expectant management), assuming an intrauterine weight gain of 200 g/week

4250 $\pm$ 125 g	Caesarean delivery (%)	aOR*	95% CI
39 weeks of gestation			
Induction (<i>n</i> = 4740)	42.3	Referent	1.30–1.62
Expectant (<i>n</i> = 8690)	51.6	1.45	
40 weeks of gestation			
Induction (<i>n</i> = 5189)	42.6	Referent	1.20–1.46
Expectant (<i>n</i> = 4319)	51.1	1.32	
41 weeks of gestation			
Induction (<i>n</i> = 3082)	45.7	Referent	1.03–1.45
Expectant (<i>n</i> = 1040)	50.2	1.22	

4250 $\pm$ 125 g	5-min Apgar <7	aOR*	95% CI
39 weeks of gestation			
Induction (<i>n</i> = 4039)	0.77	Referent	0.62–2.40
Expectant (<i>n</i> = 6692)	0.75	1.21	
40 weeks of gestation			
Induction (<i>n</i> = 4362)	0.60	Referent	0.51–1.57
Expectant (<i>n</i> = 3262)	0.86	0.90	
41 weeks of gestation			
Induction (<i>n</i> = 2620)	0.65	Referent	0.34–2.36
Expectant (<i>n</i> = 775)	0.65	0.89	

4250 $\pm$ 125 g	Neonatal injury	aOR*	95% CI
39 weeks of gestation			
Induction (<i>n</i> = 1107)	0.90	Referent	0.70–2.98
Expectant (<i>n</i> = 2494)	1.28	1.44	
40 weeks of gestation			
Induction (<i>n</i> = 1984)	1.11	Referent	0.76–2.74
Expectant (<i>n</i> = 1654)	1.27	1.44	
41 weeks of gestation			
Induction (<i>n</i> = 1708)	0.95	Referent	0.15–3.07
Expectant (<i>n</i> = 386)	0.78	0.69	

Referent comparison group: Non-Hispanic white; women induced at specific gestational age (either 39, 40, or 41 weeks).

Source: National Center for Health Statistics (2003).

* Multivariable logistic regression controlling for: maternal age, race/ethnicity, number of prenatal care visits, gestational weight gain, cigarette smoking during pregnancy.

Table 4

Frequency and adjusted odds ratio of caesarean delivery and neonatal outcome by gestational age at delivery in women with neonates with birthweight 4500 ± 125 g at time of induction compared with delivery at a later gestational age (expectant management), assuming an intrauterine weight gain of 200 g/week

4500 $\pm$ 125 g	Caesarean delivery (%)	aOR*	95% CI
39 weeks of gestation			
Induction (<i>n</i> = 1700)	42.3	Referent	1.09–1.56
Expectant (<i>n</i> = 4159)	51.6	1.30	
40 weeks of gestation			
Induction (<i>n</i> = 1975)	42.6	Referent	1.12–1.54
Expectant (<i>n</i> = 2259)	51.1	1.31	
41 weeks of gestation			
Induction (<i>n</i> = 1308)	45.7	Referent	0.88–1.42
Expectant (<i>n</i> = 600)	50.2	1.12	

4500 $\pm$ 125 g	5-min Apgar <7	aOR*	95% CI
39 weeks of gestation			
Induction (<i>n</i> = 1444)	0.76	Referent	0.53–6.28
Expectant (<i>n</i> = 3160)	0.89	1.83	
40 weeks of gestation			
Induction (<i>n</i> = 1667)	0.42	Referent	0.95–6.33
Expectant (<i>n</i> = 1730)	1.21	2.46	
41 weeks of gestation			
Induction (<i>n</i> = 1106)	0.45	Referent	0.50–5.76
Expectant (<i>n</i> = 443)	0.90	1.69	

4500 $\pm$ 125 g	Neonatal injury	aOR*	95% CI
39 weeks of gestation			
Induction (<i>n</i> = 305)	0.66	Referent	0.53–10.5
Expectant (<i>n</i> = 1011)	1.58	2.36	
40 weeks of gestation			
Induction (<i>n</i> = 582)	2.41	Referent	0.25–1.60
Expectant (<i>n</i> = 649)	1.69	0.63	
41 weeks of gestation			
Induction (<i>n</i> = 595)	0.50	Referent	0.53–10.6
Expectant (<i>n</i> = 185)	1.08	2.38	

Referent comparison group: Non-Hispanic white; women induced at specific gestational age (either 39, 40, or 41 weeks).

Source: National Center for Health Statistics (2003).

* Multivariable logistic regression controlling for: maternal age, race/ethnicity, number of prenatal care visits, gestational weight gain, cigarette smoking during pregnancy.

Table 5

Frequency and adjusted odds ratio composite neonatal morbidity (5-minute Apgar <7, meconium aspiration syndrome, birth injury, use of mechanical ventilation >30 minutes, and neonatal seizure) by gestational age at delivery in women with suspected macrosomia

4000 ± 125 g	Composite morbidity	aOR*	95% CI
39 weeks of gestation			
Induction (<i>n</i> = 10 381)	1.36	Referent	0.90–1.34
Expectant (<i>n</i> = 32 041)	1.36	1.10	
40 weeks of gestation			
Induction (<i>n</i> = 10 119)	1.19	Referent	1.05–1.71
Expectant (<i>n</i> = 14 245)	1.40	1.34	
41 weeks of gestation			
Induction (<i>n</i> = 5722)	1.26	Referent	0.62–1.40
Expectant (<i>n</i> = 3509)	1.11	0.93	
4250 ± 125 g			
39 weeks of gestation			
Induction (<i>n</i> = 4740)	1.71	Referent	1.05–1.81
Expectant (<i>n</i> = 8694)	2.09	1.38	
40 weeks of gestation			
Induction (<i>n</i> = 5189)	1.56	Referent	0.89–1.71
Expectant (<i>n</i> = 4319)	1.78	1.24	
41 weeks of gestation			
Induction (<i>n</i> = 3082)	2.04	Referent	0.32–1.19
Expectant (<i>n</i> = 1040)	1.25	0.62	
4500 ± 125 g			
39 weeks of gestation			
Induction (<i>n</i> = 1700)	2.12	Referent	0.74–1.64
Expectant (<i>n</i> = 4519)	2.04	1.10	
40 weeks of gestation			
Induction (<i>n</i> = 1975)	1.77	Referent	1.15–2.77
Expectant (<i>n</i> = 2258)	2.66	1.79	
41 weeks of gestation			
Induction (<i>n</i> = 1308)	1.61	Referent	0.69–3.00
Expectant (<i>n</i> = 600)	2.33	1.43	

Referent comparison group: Non-Hispanic white; women induced at specific gestational age (either 39, 40, or 41 weeks).

Source: National Center for Health Statistics (2003).

* Multivariable logistic regression controlling for: maternal age, race/ethnicity, number of prenatal care visits, gestational weight gain, cigarette smoking during pregnancy.