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Original Research Article

Neonatal birth weight as a predictor of mode of delivery in singleton term pregnancies at a tertiary level maternity hospital in Urban Mumbai

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ABSTRACT

Background: Mode of delivery is determined by a variety of feto-maternal factors like fetal presentation, maternal age, parity as well as environmental factors such as place of residence, quality of ANC care etc. Aim was to assess if neonatal birth wight (NBW) affected the mode of delivery at a tertiary level maternity hospital in urban Mumbai.
Methods: Ours was an observational study having cross sectional design, utilizing data retrieved from hospital records, conducted at Cama and Albless Hospital in Mumbai over 3 months- July 2023 -September 2023. Data regarding maternal parity, age, mode of delivery and neonatal birth weight was compiled in Microsoft Excel 2017 from hospital records after taking Ethics Committee permission for the same.
Results: In n=104 live viable term singleton pregnancies observed over 3 months LSCS rate of 25.96% was observed, higher Neonatal birth weight (NBW) was associated with caesarean delivery. 89% of the underweight neonates (<2.5kg) delivered vaginally while 100% of the macrocosmic neonates (>4kg) were delivered by LSCS. Maternal age correlated positively with neonatal weight and parity. Neonatal sex was not associated with mode of delivery or NBW.
Conclusions: Mode of delivery is affected by NBW, but not by maternal age or neonatal sex. Mode of delivery in first pregnancy significantly determines mode of delivery in subsequent pregnancies.

Keywords: Mode of delivery, Neonatal birth weight

INTRODUCTION

A secular trend of increasing rates of caesarean delivery has been observed globally over the past decades. The obstetrician's decision to terminate a pregnancy by caesarean section or allowing it to progress vaginally is an important determinant of feto-maternal outcome of pregnancy.

While intra-partum complications such as labour dystocia, cord prolapse, placental abruption, non-reassuring foetal status or impending feto-maternal mortality are common indications of emergency caesarean sections, mode of delivery is also determined by a variety of other factors. Foetal factors such as, presentation, weight, congenital anomaly; and maternal factors such as, stature, mode of delivery in previous pregnancy, pelvic deformity, cephalopelvic disproportion, history of pelvic, uterine, cervical or ano-rectal surgery, abnormal placentation (such as placenta previa, placenta accreta), reproductive tract infections etc maternal comorbidities such as, psychiatric

illness ,cerebral aneurysm or arteriovenous malformation are also determinants of mode of delivery.[1,2]

Caesarean delivery is known to pose a high risk of maternal complications like intra-operative haemorrhage, shock, need for blood transfusion, anaesthesia complications, cardiac arrest, need for hysterectomy, sepsis, longer hospital stay, intra-abdominal adhesion formation, risk of abnormal placentation in future pregnancy, need for repeat caesarean section in future pregnancy, as well as higher incidence of neonatal complications such as transient tachypnoea, foetal injury, higher NICU admission rate, neonatal hypoglycaemia etc.[3,4]

Regardless of mode of delivery, 30% of women tend to suffer from neonatal or obstetric complication during childbirth, as both modes of delivery are associated with known maternal complications and benefits, and it is the treating obstetrician's duty to customize the same for each patient.

Intra-uterine growth restricted fetus are more likely to suffer from fatal hemodynamic changes and asphyxia, or acidosis during the process of labor, and a caesarean delivery might be protective against the hypoxic stressors of labor and improve perinatal outcome in IUGR and low birth weight babies.[5]

Macrosomic babies delivered vaginally were found to be more likely to predispose to adverse-feto-maternal complications like perineal tear, post-partum haemorrhage, anal sphincter injury, need for blood transfusion, asphyxia neonatorum, obstructed labour, birth trauma neonatal hypoglycemia and NICU admission.[6,7] Thus Nguyen et al suggested the need to curate the mode of delivery and consider elective caesarean delivery when foetal macrosomia is known or suspected.[10]

While caesarean section reduces the incidence of some of the above mentioned complications associated with vaginal birth in cases of foetal macrosomia, the risks are eliminated entirely.[9,10]

Additionally, most of the current studies about feto-maternal outcome in cases of fetal macrosomia include patients where labor was induced rather than allowed to progress spontaneously. Induction of labour appeared to independently increase rate of cesarean delivery.[11]

Similarly, Boyle et al found expectant management for term IUGR pregnancies to be safe and early perinatal outcomes between either modes of delivery groups were similar at term.[12] Alfirevic and colleagues in 2013 observed no significant long term perinatal benefits in IUGR babies delivered by caesarean section, and observed a higher risk of maternal morbidity in the same.[13] Induction of labor was found to independently increase the rate of LSCS in IUGR babies as well.[12]

Unindicated caesarean section have an adverse impact upon feto-maternal outcomes, increase morbidity and health expenditure for families and health systems. Mahadik et al. documented a list of modifiable factors that maybe considered by an obstetrician before taking the decision to take up a patient for caesarean section- labour dystocia, non-reassuring foetal heart rate, and suspected foetal macrosomia. Thus it is important to assess for any modifiable predictors of caesarean delivery for anticipatory individualization of birth plan for patients in order to reduce the LSCS rate in any population.[14,15]

Thus, while route of delivery seems to be modified by foetal weight, the evidence so far appears to be equivocal and further studies are needed to get a better insight regarding the significance of neonatal weight as a predictor for mode of delivery.

Ours is a referral centre with high proportion of referred cases, and the aim of our study was to assess if mode of delivery was indeed significantly affected by neonatal weight. We thus conducted a retrospective observational study aimed at correlating neonatal weight and mode of delivery at a tertiary level maternity hospital in urban Mumbai.

This study aimed to assess the significance of neonatal weight as a predictor of mode of delivery in singleton pregnancy, to assess rate of LSCS in low birth weight, normal birth weight and high birth weight neonates and to assess rate of vaginal deliveries in low birth weight, normal birth weight and high birth weight neonates.

METHODS

Ours was an observational study having cross sectional design, utilizing data retrieved from hospital records, conducted at Cama and Albless Hospital in Mumbai over 3 months from July 2023 to September 2023. Data regarding maternal parity, age, mode of delivery and neonatal birth weight was compiled in Microsoft Excel 2017 from hospital records after taking Ethics Committee permission for the same. Confidentiality of patient identity was maintained at the time of data analysis. Inclusion criteria used was- term pregnancy (≥37 weeks of gestation), singleton pregnancy, live birth, maternal age 19 years and above at time of delivery. Data entries having maternal age less than 18 years at time of delivery, multifetal pregnancies, preterm birth (<37 weeks of gestation) and still births were excluded from our study. Statistical Package of Social Sciences, version 23 was used for conducting statistical analysis of the compiled data. Qualitative data was analysed using the Chi-Square test, which was used to assess the difference in proportions of rate of caesarean delivery and vaginal deliveries across normal neonatal birth weight (2.5kg-4kg), high neonatal birth weight (>4kg) and low neonatal birth weight (<2.5kg) categories, as well as the association between neonatal sex and mode of delivery. Normal distribution of quantitative data points was assumed and parametric tests

like Pearson's correlation test and unpaired t test were used to analyse the quantitative data. Pearson's correlation test was used to assess correlation among quantitative data entries like maternal age, neonatal birth weight and maternal parity. Unpaired t test was used to compare mean birth weights across LSCS and vaginal delivery groups.

RESULTS

Study included n=104 subjects, the demographic data is represented in Table 1. Maternal age was not associated with mode of delivery (Unpaired t test p=0.784). The mean parity of the subject pool was 1.8±0.896 (range 1 to 4).

Table 1: Demographic factors of subject population.

Parameter	Range		Mean	Standard Deviation
	Minimum	Maximum		
Maternal age (years)	19	39	25.4	3.97
Maternal parity	1	4	1.8	0.89
Neonatal weight (grams)	1570	4260	2904	480

Neonatal birth weight (NBW) was not associated with neonatal sex (p=0.100) or maternal parity (Pearsons correlation coefficient p=0.824), while the maternal age and NBW were found to correlatesignificantly and positively (r=+0.262 p=0.025), a positive trend of 262g increase in NBW observed per year increase in maternal age. Incidence of low birth weight (LBW) neonates (<2.5kg) was 18.2% (n=19/104), 89% LBW delivered vaginally while 100% of high birth weight (>4kg) babies delivered by caesarean delivery.

The frequency distribution of NBW across modes of delivery as well as mean NBW across modes of delivery have been represented in tables 2 and 3. Mean NBW was significantly higher in LSCS group 3.127Kg±0.463kg as compared to the vaginal delivery group 2.825kg±0.464kg (p=0.006). Neonatal birth weight category (LBW, NBW, HBW) was significantly associated with mode of delivery ($\chi 2$=7.848 dF= 2 p=0.021).

Table 2: Neonatal birth weight across modes of delivery.

Birth weight	Mode of delivery		Total
	Vaginal delivery	Cesarean delivery	
<2.5kg	17	2	19
2.5Kg-4kg	60	23	83
>4KG	0	2	2
Total	77	27	104

Table 3: Mean birth weight across modes of delivery.

Mode of delivery	Frequency	Mean weight	Standard deviation
Vaginal delivery	77	2.825kg	464g
Caesarean delivery	27	3.127Kg	463g
Total	104	-	-

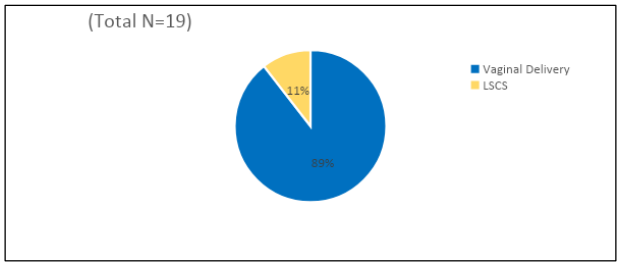

Figure 1: Distribution of mode of delivery in low birth weight (<2.5kg) neonates.

Neonatal sex has been cross tabulated with mode of delivery in Table 4. Neonatal sex was not associated with mode of delivery ($\chi 2$=0.566, dF=1, p=0.5).

Table 4: Mode of delivery across neonatal sex.

		Mode of delivery		Total
		Vaginal	LSCS	
Neonatal sex	Male	45	18	63
	Female	32	9	41
Total		77	27	104

Table 5: Parity wise mode of delivery.

		Mode of delivery		Total
		Vaginal	Cesarean	
Parity	1	25	22	47
	2	35	3	38
	3	11	1	12
	4	6	1	7
Total		77	27	104

Parity wise mode of delivery has been tabulated in table-5. Parity was found to be associated with mode of delivery (χ^2=19.516 dF= 3 p<0.0001), and correlate significantly and positively with maternal age(r= 0.250, p=0.025). Of the total 57 multiparous women (parity >2), 8.7% underwent caesarean delivery, while over 91% of the multiparous women delivered vaginally.

Indications of caesarean delivery have been listed in Table 6. Previous LSCS was the indication for majority of (60%) of caesarean deliveries in multiparous women, while non-progression of labor (>45%) and non-reactive NST (>36%) were most common indications for the same in primiparous women.

Table 6: Indications of caesarean delivery.

		Frequency	Percent
Indication	Cephalo pelvic disproportion	3	13.6
	Meconium stained liquor	3	13.6
	Non-progression of labor	5	22.7
	Non-progression of labor with non reactive NST	3	13.6
	Non-progression of labor with non reactive NST with post datism	2	9.1
	Non reactive NST	3	13.6
	PPROM	3	13.6
	Total	22	100.0

DISCUSSION

The Caesarean delivery rate in our study was 25.96%, this was found to significantly higher than the national average LSCS rate of 21.5% in India as per the latest analysis of National Family Health Survey documented by Pandey et al in 2023.[16] All the LSCS in our study were observed to be undertaken for emergency indications, with non-reactive NST, and non-progression of labor being the most common indication for the same. Additionally, the study site being a tertiary level maternity hospital located in Mumbai also catered to a large number of cases referred for caesarean delivery from peripheral centres. The higher incidence of LSCS in emergency obstetrics cases referred to tertiary centres in India has been found consistent with other studies undertaken in similar populations.[17]

The mean birth weight was 2904g±480.6g in our subject pool primarily based in and around Mumbai was found to be significantly higher than the national average neonatal birth weight of 2781 g±0.591g as computed by Unisa et al in 2022 from the recent National Family Health Survey (NFHS) and the Comprehensive National Nutrition Survey (CNNS).[18] This is reflective of better access to antenatal maternal healthcare in urbanised area having significantly better socio-economical indices as compared to rural areas.

Neonatal birth weight was not associated with maternal parity. This contrasts with the findings of Hinkle et al 2015 who found in a longitudinal study that birth weight increased with maternal parity.[19] This may be explained by the cross sectional design of our study as compared to the longitudinal design of the study by Hinkle et al, as the increase in neonatal birth weight was documented mainly in when the maternal parity increased from nulliparity to primiparity but not in subsequent pregnancies. The inter-pregnancy interval is also known to mediate the effect of maternal parity on neonatal birth weight, with shorter inter-pregnancy interval leading reduction in subsequent birth weight.[20] We found the maternal parity increased by 1 for a 4 year increment in maternal age, hence the mean inter-pregnancy interval for our cohort can be estimated to be an average more than 3 years and may ameliorate the impact of increasing parity on neonatal birth weight.

Male neonates are known to have significantly higher birth weights than their female counterparts, primarily due to in-utero action of androgens and higher muscle mass in male neonates as compared to androgen insensitivity and relatively higher concentration of the lighter adipose tissue in females.[21] Recent studies have observed a significant reduction in sex based difference in neonatal birth weight in face of increasing environmental toxins that apparently disrupt this endocrine axis of weight gain.[22,23] Pervasive maternal malnutrition ubiquitous in India may factor in uniformly reducing the difference of weight across neonatal sex, however further studies are needed to further understand this finding.

While the mean maternal age was 25 years, lower than the national median childbearing age of 28years, the maternal age ranged from 19 to 39 years, and neonatal birth weight showed a positive trend with increasing maternal age.[24] Higher incidence of maternal malnutrition in younger mothers (<21yrs) and higher prevalence of obesity and insulin resistance (>30yrs) with increasing age as well as an increase in maternal bodily conditioning for childbirth on subsequent births maybe responsible for this trend.[25-28] Maternal obesity maybe responsible in enhancing the state of insulin resistance of pregnancy [d11] and lead to higher fetal weight, not always leading to overtly macrosomic fetus. This may also be responsible for the higher neonatal birth weight in our study with subject population primarily involving an urban population.

Mean weight in caesarean delivery group was significantly higher in the LSCS group. And 89% of the LBW neonates were delivered vaginally while 100% of high birth weight (>4kg) babies delivered by caesarean delivery. Walsh et al. documented similar results in 2015, and found an increase in caesarean delivery rates that for each 500g increase in neonatal birth beyond 3kg.[29] Higher incidence adverse

feto-maternal outcomes like shoulder dystocia, birth asphyxia, meconium aspiration, primary post partum hemorrhage and perineal tears are observed when higher birth weight neonates were delivered vaginally.[29] Routine prophylactic cesarean birth had been advocated for LBW fetus to thereby reducing hypoxic stress, asphyxia and intraventricular hemorrhage (IVH) in the neonate during parturition but recent meta-analyses suggest that the route of birth is not a significant independent factor affecting perinatal mortality or neurodevelopment.[13]

While the rate of vaginal births is higher in centres where labor is allowed to progress spontaneously irrespective of neonatal birth weight, the rate of cesarean sections tends to increase significantly in higher birth weight babies when labour is induced.[29,30] All the caesarean sections in our study were undertaken for emergency indications in parturient women. Normal birth weight and low birth weight neonates are more likely to be delivered vaginally irrespective of whether labor is induced or spontaneous.[31]

Advanced maternal age years is a significant risk factor for caesarean delivery.[32] Gondwe et al in 2019 found maternal age beyond 25 years to significantly increase the risk of caesarean delivery.[33] Our study has found no association between age and mode of delivery, primarily cause of this difference can be explained by the higher prevalence of primary caesarean deliveries in the study by Gondwe and colleagues, thereby increasing the rate of caesarean deliveries in subsequent pregnancies that inevitably followed with increasing maternal age. Also, our policy of giving trial of vaginal deliveries to maximum possible patients as well as conducting caesarean deliveries only for emergency rather than elective indications may explain these results.

Parity was also found to be significant predictor of mode of delivery with more than 91% of the multiparous women delivering vaginally, as is consistent with current literature. In our study majority of caesarean deliveries were conducted in primiparous women, due to our policy of conducting caesarean deliveries for emergency indications; non-reactive NST and non-progression of labour being the indication for majority of caesarean deliveries in our study.

Primary review of secular trends of mode of delivery and birth weights in India reflect an overall increase in birth weight and caesarean delivery rate with an increase in urbanisation and improvement socio-economic indices as well as healthcare services and may also be responsible for an observed higher neonatal birth weight in caesarean birth group.[16,34]

Our study was not without limitations. Firstly, it had a cross sectional design which does not reflect the cumulative effect of advancing maternal age and parity on mode of delivery on the parturient woman. Secondly, we included a large number of emergency referred cases who did not receive ANC care at our centre but were referred for emergency obstetric intervention this can have a confounding effect on the neonatal birth weight. Lastly, the non-referred patients booked at our centre were primarily residents of urbanised Mumbai having access to standardized ANC care, this too can bias our results. Hence an adequately powered multicentric observational study is needed to further confirm the predictors of mode of delivery in parturient women.

CONCLUSION

Mode of delivery is significantly associated with neonatal weight, maternal parity and mode of delivery in first pregnancy, but not with neonatal sex or maternal age. Maternal age had a positive association with neonatal birth weight and parity but not on mode of delivery. Primiparous parturients with higher fetal weight were more likely to undergo Cesarean delivery.

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