

Comparison of Birth Weight Changes among Neonates Born by Vaginal Delivery and Caesarean Delivery

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KEYWORDS

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ABSTRACT

Objective: A normal Indian newborn weighs between 2500 to 3500 grams at birth. This study aims at comparison of the birth weight changes among neonates born by vaginal delivery (VD) and Caesarean delivery (CS).

Methods: Descriptive research design was adopted. One hundred neonates from the postnatal ward of a University teaching hospital with 50 neonates each delivered by VD and CS were selected conveniently. Data on demographic, maternal, neonatal variables and newborn weight after birth for three consecutive days were collected.

Results: Each group had 58% male and 42% female neonates. Birth weight loss ranged from 2% to 8% among the neonates delivered by VD and CS. About 30% of newborns delivered by VD lost 3-4% of weight compared to 7-10% weight loss among 48% CS born neonates on the first day after birth. Comparison of mean weight loss between the newborn delivered by VD (7.04 ± 3.35) and CS (7.47 ± 2.91) on the third day of birth had no statistical difference. Sex of the newborn and initiation of breast feeding had significant association with weight loss among neonates delivered by CS ($p < 0.05$).

Conclusion: Change in birth weight is an indicator to assess newborn wellbeing and breastfeeding adequacy in the first few days of life. The study shows that type of delivery, SVD or LSCS does not influence the percentage of weight loss among the neonates.

Introduction

A healthy newborn born at term, weighs between 2500 to 3500 grams, cries immediately following birth, establishes independent rhythmic respiration, and adapts to the external environment that differs from in-utero conditions (Dutta, 2013). Newborn's immediate birth weight is an important factor for monitoring weight loss. Health team members utilize the percentage of weight change from birth weight as an assessment parameter to confirm feeding sufficiency. Weight loss in a newborn is credited to deficiency in breastfeeding that arises physiologically due to less milk production or ineffective transmission of milk supply (Eltonsy et al., 2017). A weight loss of more

than 7% from the birth weight is considered as a clinically significant factor and often a cause for concern (Watson et al., 2012; DiTomasso & Cloud, 2019)

As a part of the normal physiological process, most of the babies lose their birth weight in the initial days of life that may be up to 10% (Miyayama et al., 2023; Miyoshi et al., 2020) According to American Pregnancy Association, a weight loss of 5% for a formula fed newborn and 7-10% weight loss for a breastfed baby during the first week is considered as normal (*Average Newborn Weight | American Pregnancy Association, 2024*). The main reason for this weight loss is excess excretion of the extra-cellular fluid. The weight loss may be influenced by certain factors such as: size of the baby, type of delivery, type of feeding, neonatal infections, insufficient fluid intake, any feeding difficulties, maternal indications, poor breast feeding, temperature of the day, etc (Miyoshi et al., 2020; Giudicelli et al., 2022; Sarmiento-Aguilar et al., 2022). Literature shows contradicting results with studies that found no association with weight loss and the variables, type of delivery and fluids received during labor, whereas others found a positive correlation between weight lost and maternal fluids received (da Silva et al., 2020). The weight loss was estimated as 4.4% on the third day of birth among breastfed newborn delivered in the tropical region (Rizik et al., 2018).

The birth of a newborn can be either through Vaginal Delivery (VD) – spontaneous / assisted or Cesarean delivery (CS) depending upon the maternal and fetal condition. It has been identified that cesarean birth is one of the major factor for the weight loss in neonates due to delayed initiation of breast feeding (Kelly et al., 2019; McAllister et al., 2023). Breast feeding can be initiated early in case of VD, usually within 30 minutes after the delivery unlike two to four hours in cesarean birth. The delay in breastfeeding is attributed to the post-operative anesthesia effect on the mother. Weight loss in the first three days adds stress to the newborn babies (De Bernardo et al., 2023).

Weight loss was influenced by the feeding pattern, the type of delivery; vaginal or cesarean birth. Female sex, Increased birth weight, use of epidural anaesthesia and longer hospital stay increased the percentage of weight loss in the neonates. Lower percentage of weight loss was seen in neonates with a greater gestational age and exclusive breastfeeding (DiTomasso & Paiva, 2018; Mackay, 2019; Sarmiento-Aguilar et al., 2022).

A retrospective chart review among 200 exclusively breastfed babies born by cesarean birth identified losses approximately $7.2\% \pm 2.1\%$ of average birth weight, comparatively a greater value than proposed by the American Academy of Pediatrics. The main reason for the greater percentage of weight loss in the newborn was absence of labour prior to the delivery ($p = 0.0004$) (Preer et al., 2012).

A recent integrative systematic review on neonatal weight loss and gain patterns in caesarean section born infants found that newborn delivered by CS lost more weight during the early days of life than the newborns delivered by VD (Kelly et al., 2019). Similarly, a prospective observational study in 104 exclusively breastfed infants of which 52.9% were born vaginally and 47.1% by CS in a rural tertiary hospital in Bangalore, India, found that infants born by CS had a greater mean weight loss than those born vaginally both at 24 hr (3.2 and 2.2%, respectively, $p = 0.0016$) and at 72 hr (5.9 and 4.7%, respectively, $p = 0.0314$) (Samayam et al., 2016).

The risk factors for birth weight loss differ among term neonates among countries. Contradictory results are projected on relationship between type of delivery and weight loss. A study in Japan

found 41% newborns had higher weight loss. The factors attributed to the higher weight loss were increased maternal age, primiparity, and antepartum Caesarean section, with adjusted odds ratios (95% Confidence Intervals) of 1.07 (1.02, 1.11), 2.72 (1.69, 4.38), and 2.00 (1.09, 3.65), respectively (Miyoshi et al., 2020). Another study in Italy found that parity and type of delivery was not significant factors but exclusive breast feeding was the most significant impacting factor for birth weight loss (Delfino et al., 2022). To establish evidence, this current study compares the birth weight changes among neonates born by VD and CS and determines the factors associated with birth weight loss.

Materials and Methods

The study design was non experimental descriptive research design conducted in the postnatal ward of a multispecialty, tertiary care University teaching hospital in the suburbs of Chennai, India among the neonates born by VD and CS. The sample selected purposively consisted of 100 neonates; 50 neonates each in VD and CS group. The inclusion criteria for sample selection were: Term newborn delivered by VD or CS, roomed in with mothers and exclusively breast fed. The exclusion criteria were: Newborn delivered by assisted delivery, born either preterm or post-term or with complications such as respiratory distress, admitted in neonatal intensive care unit or newborn delivered by high risk pregnant women.

Instrument

The tool used for this study had three sections: (1) demographic variables that included age (in years), type of family, educational status, type of living, and monthly income of the family. (2) Maternal and neonatal variables that included 22 items such as gravida, parity, gestational age (in weeks), type of delivery, amount of oxytocin infusion, induction / augmentation during labour, 2 hour pre-birth IV fluids, duration of labour, maternal haemoglobin (in grams), baseline weight of the mother (kg), pre-labour weight (kg), weight gain during pregnancy (kg), height (cm) and BMI of the mother (kg/m^2); newborn details namely sex, birth weight, length of the baby; time of initiating breast feeding, previous breast feeding experience, history of receiving advice on breast feeding and frequency of feeding. (3) Daily baby weight monitoring chart that depicted the changes of weight for three consecutive days from the date of delivery. The percentage of weight loss was categorized as follows: 1–5%, 6–10%, 11–15% and above 15%. The tool was validated by medical and nursing experts. Calibrated standardized digital weighing machine was used to assess the weight of the neonates.

Data Collection Procedure

Ethical permission was obtained from the Institutional Ethics Committee (students) of the University. Permission to conduct the study was obtained from administrative officials of concerned departments Neonates born by VD or CS were selected based on inclusion criteria in the postnatal wards of the selected hospital. The objective of the study was explained to each mother and written consent was obtained from them for participating in the study. The information regarding demographic and few maternal and neonatal variables were obtained by interviewing the mothers. Other details like IV fluids received, labour details were retrieved from the hospital record of the mother. The changes in the weight among neonates were assessed by using baby weight monitoring scale. The weights of the undressed neonates were checked for 3 consecutive days beyond the date of delivery at the same time using the same calibrated digital weighing machine in the postnatal ward. The data obtained were documented in the daily baby weight

monitoring chart and the percentage of weight loss of each day was assessed at the end of the observation.

Result

The background variables indicated that majority of mothers of neonates of both the groups were aged between 21 to 30 years. About 54% of the women in VD group and 58% of CS group were from the joint family. Around 36% of the women in the VD group and 44% of them in the CS group were graduates. Comparison of demographic variables between the VD and CS group showed homogeneity between the groups.

The results showed that 46% of the VD group and 42% of the CS group women were primiparous. All the women in the VD group were subjected to induction/ augmentation of labour with oxytocin and had received pre-birth intravenous fluids. Around 54% of VD group and 30% women in CS group received about 500ml of pre-birth intravenous fluids. About 62% of women in VD group and 28% in CS group had duration of labour between 7–12 hours. Around 80% of women in both the groups had mild anaemia. Majority of women in both the groups had normal pre-pregnant BMI. About 46% women in VD group and 32% in the CS group had a weight gain of 10-13kgs during the time of pregnancy (Table 1).

Table 1: Distribution of maternal variables in the VD and CS groups

Maternal variables	VD (n=50)		CS (n=50)		χ^2 p value
	No.	%	No.	%	
Parity					
1	23	46	21	42	0.012
2	23	46	24	48	0.921
3 and more	04	08	05	10	NS
Duration of Labour					
1-3	00	00	18	36	29.80 0.0005***
4-6	15	30	18	36	
7-9	12	24	03	06	
10-12	19	38	11	22	
Above 12	04	08	00	00	
Amount of IV fluid infused (in ml)					
500	27	54	15	30	15.44 0.003**
1000	20	40	17	34	
1500 and more	03	06	18	36	
Weight gain in pregnancy (in Kgs)					
< 10	12	24	22	44	6.25 0.100 NS
10.1 – 12.9	23	46	16	32	
13 – 15.9	09	18	10	20	
16- 22	06	12	02	04	

Maternal variables	VD (n=50)		CS (n=50)		χ^2 p value
	No.	%	No.	%	
Haemoglobin(gm/dl)					
<10	16	32	14	28	0.31
10.1 – 12	26	52	27	54	0.646
12.1 - 14	08	16	09	18	NS
Pre-pregnant BMI of the mother					
< 18 (Underweight)	05	10	05	10	0.437
18.5-25 (Normal)	29	58	31	62	0.932
26-30 (Overweight)	14	28	13	26	NS
> 31 (Obese)	02	04	01	02	
Weight gain during pregnancy (kg)					
Less 10	12	24	22	44	6.25
10.1 – 12.9	23	46	16	32	0.100
13 – 15.9	09	18	10	20	NS
16- 22	06	12	02	04	

NS - Non significant, ***p <0.001, *p <0.05

Table 2: Distribution of neonatal variables in the VD and CS groups

Neonatal Variables	VD (n=50)		CS (n=50)		χ^2 p value
	No.	%	No.	%	
Sex of the baby					
Male	29	58	29	58	0.04
Female	21	42	21	42	0.841
Birth weight (in Kgs)					
< 2.5	03	06	07	14	2.222
2.5 - 3	26	52	23	26	0.527
3 - 3.5	20	40	18	36	
>3.5	01	02	02	04	
Length (in cms)					
44 – 48	02	04	17	34	12.74
48 – 52	48	96	33	66	0.004**
Previous breastfeeding Experience					
Yes	29	58	27	54	0.04
No	21	42	23	46	0.841
Feeding Frequency (in hrs)					
One	12	24	11	22	
Two	16	32	15	30	0.98
Three	09	18	12	24	0.729
Four	13	26	10	20	
Demand feeding	00	00	02	04	

NS - Non significant, ***p <0.001, *p <0.05

Each of the group had 29 male and 21 female neonates. The neonates in both groups were term, born between 38-41 weeks. Anthropometric measurements showed that 92% of neonates in VD group and 62% in CS group weighed between 2.5-3.5kgs at birth, figure 1 describes the average birth weight between the groups. Around 96% of neonates in the VD group and 66% in CS group had a length between 48 to 52cms. About 32% of VD group neonates and 30% of CS group neonates were breastfed every 2nd hourly (Table 2).

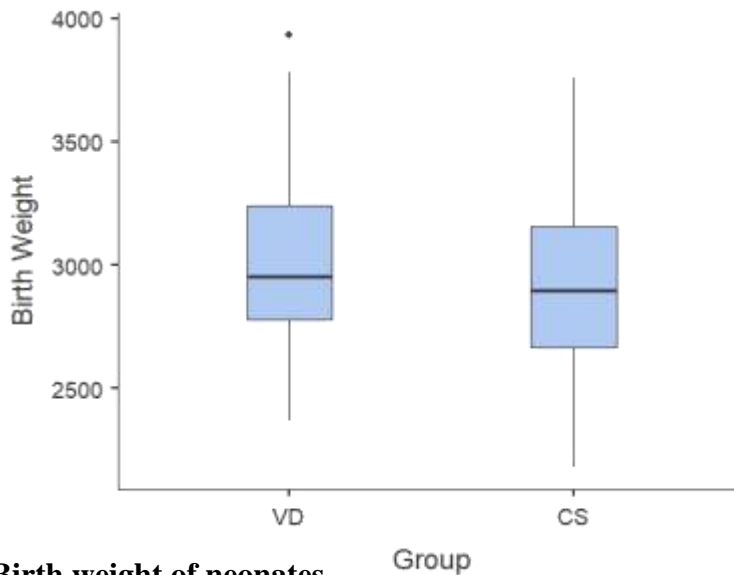


Figure 1. Birth weight of neonates

Note: VD - Vaginal Delivery; CS- Caesarean Section

Table 3: Comparison of loss of birth weight between VD and CS born neonates

Weight loss (%)	1 st day		2 nd day		3 rd day	
	VD	CS	VD	CS	VD	CS
< 1	15 (30%)	10(20%)	03(6%)	01(2%)	00(0%)	00(0%)
1 - 2	10(20%)	07(14%)	07(14%)	02(4%)	03(6%)	03(6%)
3- 4	15(30%)	18(36%)	12(24%)	07(14%)	08(16%)	05(10%)
5- 6	09(18%)	11(22%)	12(24%)	16(32%)	09(18%)	05(10%)
7 - 10	00(0%)	24(48%)	14(28%)	24(48%)	21(42%)	26(52%)
11-16	01(2%)	00(0%)	02(4%)	00(0%)	09(18%)	11(22%)
χ^2 & p value	25.37, 0.0002***		13.29, 0.038*		2.56, 0.632 NS	

NS - Non significant, ***p <0.001, *p <0.05

Table 3 shows the Comparison of loss of birth weight between VD and CS born neonates. The results indicate a significant difference in loss of weight between the newborn delivered by VD and CS (p <0.001) on first day, and (p <0.05) on the second day, with no difference between the groups on the third day

Table 4. Comparison of Weight loss percentage between VD and CS born neonates (N=100)

Day	Median (IQR)		U Value	Z Score	p-Value
	VD	LSCS			
1 st	2.11 (0.92-3.62)	3.35 (1.35-4.50)	987.5	-1.81	0.068
2 nd	4.46 (2.84-6.61)	6.05 (4.77-7.09)	914.5	-2.31	0.021*
3 rd	6.92 (4.51-9.23)	7.82 (6.10-9.66)	1107.5	-0.98	0.334

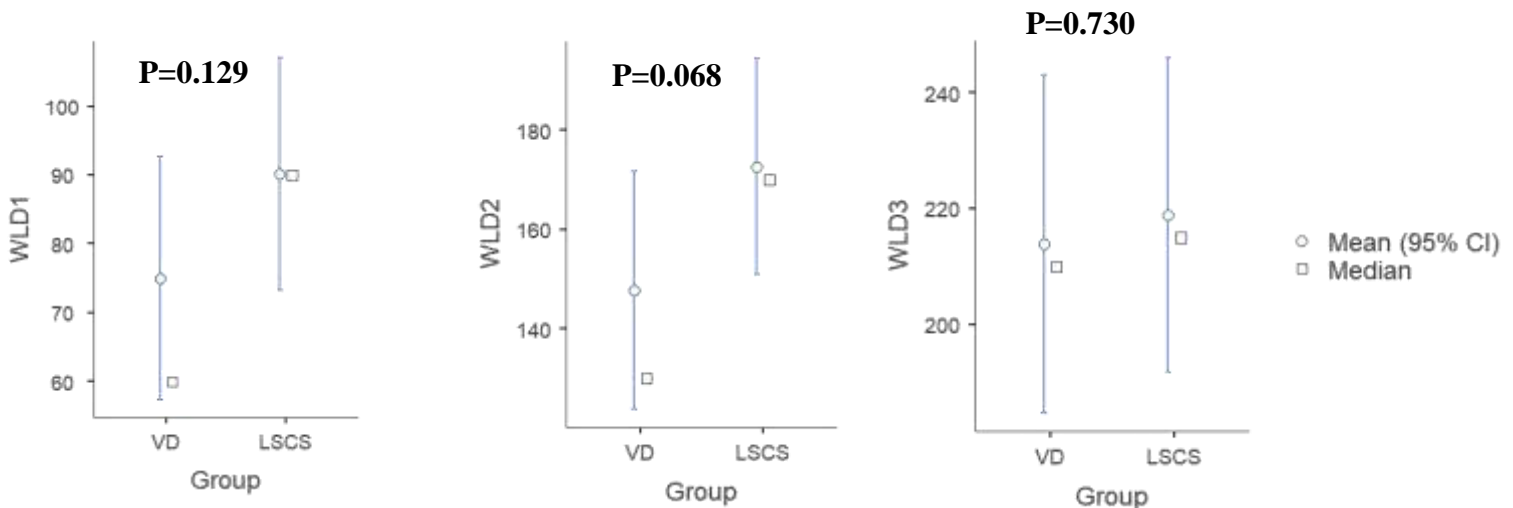


Figure 2. Comparison of Weight loss (in grams) between VD and CS born neonates (N=100)

Note: WLD- Weight Loss Day; VD-Vaginal Delivery; CS-Caesarean Section

Figure 2 indicates that the comparison of mean weight loss in grams between the newborn delivered by VD and LSCS does not have any statistical significance on first three days of birth. Table 4 illustrates that the weight loss percentage was more among newborn delivered by CS than VD ($p < 0.05$) on the second day of birth.

The association of background variables with weight loss showed that newborn of women who took <4 hours to initiate breastfeeding had higher percentage of weight loss on the first and second day ($p < 0.05$), and male neonates had more weight loss compared to female on the second and third day of birth ($p < 0.05$) in the CS group.

Discussion

The comparison of birth weight changes between the neonates delivered by VD and CS showed that the weight loss was slightly higher in the CS group on the first day ($p < .001$) and on the second day ($p < .05$), but the difference became non significant between groups on the third day. The mean weight loss was slightly higher in the LSCS group compared to the neonates in the NVD group though statistically non-significant. Similarly, a previous study indicated that the type of delivery was not associated with weight loss in first week of life of neonate. The current study findings

showed that the mean weight loss was almost similar among neonates in the VD (7.04%) and CS (7.47%) groups on the third day, statistically non significant (Ditomasso & Paiva, 2018). Similar results mean weight loss of 8% (n = 286, 7.9% ± 2.2%) on day three among newborns born by CS (Thulier, 2017). Another study found that the maximum weight lost by neonates was 4.4% (95% CI 4.1 - 4.6 %) on day three (Turner et al., 2013). Though few Indian babies lost more than 7% of their birth weight, the overall mean percentage of weight loss among Indian babies was within the recommended limits of American Academy of Paediatrics that permits a physiological weight loss of 7%, irrespective of the type of delivery (Ginsburg et al., 2023). Even a systematic review on birth weight changes among term breastfed neonates in the early weeks of life highlighted that the mean weight loss among neonates was 6% to 7% of birth weight by two days after birth and 7% to 8% by the third day. The loss of birth weight was lowest on the days 2, 3 or 4 after birth (Hamilcikan et al., 2017).

Among the maternal variables; gravida, parity, amount of IV fluids infused, previous breast feeding experience, duration of feeding, weight gain during pregnancy, BMI of the mother, and duration of labour did not have any significant association with birth weight changes among neonates delivered by VD and CS. The current study results were alike to another study that highlighted that gravida, parity, age of the mother, gender of the newborn, Apgar scores, and previous cesarean delivery were not significantly associated. Contrary to these studies, the multivariate logistic regression of another study found that cesarean delivery, summer season, formula feeding, and physiological jaundice that do not necessitate phototherapy were independently associated with neonatal weight loss of more than 8% (Haseli et al., 2017). The current study results showed that weight loss of the neonates delivered by CS had significant association with initiation of breast feeding. Mothers who took more than 4 hours to breastfeed had higher percentage of weight loss on the first and the second day after birth ($p < 0.05$) in the CS group. This result emphasizes the need for early initiation of breast feeding by women subjected to CS. Male neonates had more weight loss compared to the female neonates in the CS group on the second and third day after birth ($p < 0.05$). Contradictorily another study found significantly increasing percentage of weight loss among female sex (Gallardo López et al., 2018). Further research is necessary to determine the association between gender and weight loss in newborns. The results of the present study suggest that nurses closely monitor and analyze the weight changes in a newborn. Early initiation of breast feeding has to be promoted as recommended by WHO and UNICEF within an hour after birth irrespective of the type of delivery to prevent excessive weight loss in newborns delivered by CS (Global Breastfeeding Collective et al., 2023; Zong et al., 2021).

Certain limitations of this study to be considered include limited sample size and assessment of weight loss for the first three days only following birth as the neonates delivered by VD were discharged by third day from the hospital. Another limitation is that though all the neonates were exclusively breastfed, the amount of feed taken by each neonate was not measurable. The recommendations for future study include extending the period of weight loss assessment for first at least seven days, establishing evidence on the effect of seasonal variations on birth weight changes and comparing the differences in weight changes among newborn from various countries.

Conclusion

Health professionals often use weight as an indicator to assess newborn wellbeing and check the adequacy of breast feeding in their first few days of life (Boer et al., 2016; Perumal et al., 2023). Results of this study have shown that the type of delivery, VD or CS does not influence the percentage of weight loss among the neonates. The study concludes that the weight loss among Indian babies is within the normal limits recommended by American Academy of Paediatrics (Levinson, 2020). Nurses has to play a vital role in careful monitoring of birth weight changes to detect deviations at the earliest and avoid further complications.

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Conflict of Interest

The authors have no conflict of interest to declare.

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