# Relationship of Oxygen Saturation with Neonatal and Maternal factors in Vaginal and Cesarean Deliveries

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## ABSTRACT

**Introduction:** Hypoxemia is the major cause of neonatal morbidity and mortality. The study aims to determine the influence of birth weight, Apgar score, gestation age, body mass index and hemoglobin of mother on levels of $SpO_2$ in healthy newborns born vaginally and through cesarean section.

**Methods:** A hospital Based, observational study conducted in Department of Pediatrics, Universal College of Medical Sciences-Teaching Hospital, Bhairahawa, Lumbini, Nepal; on 49 vaginal and 49 cesarean deliveries with Apgar Score ≥ 6. $SpO_2$ was estimated by pulse oximeter post-ductally between 1 to 30 minutes of birth. The observed $SpO_2$ values were correlated with neonatal and maternal factors.

**Results:** Vaginal and Cesarean deliveries $SpO_2$ were comparable for birth weight, gestational age, Apgar score of neonates, body mass index and hemoglobin of the mother. Birth weight in vaginally delivered babies and Apgar score in cesarean births showed significant change in $SpO_2$ ($P<0.05$). At all points of time the $SpO_2$ values were higher in neonates, born by cesarean than those born out of spontaneous vaginal deliveries ($P<0.001$).

**Conclusions:** $SpO_2$ levels in neonates born through cesarean section were higher in comparison to thoseborn by vaginal route. Birth weight and Apgar score had correlation with $SpO_2$ in vaginal and cesarean births, respectively.

**Keywords:** *Apgar score; birth weight; newborn; pulse oximeter; $SpO_2$.*

## INTRODUCTION

Hypoxemia is an important and potentially avoidable cause of morbidity and mortality especially in newborn at birth. Rapid and accurate detection of hypoxemia is critical to prevent serious complications of brain growth and its function.[1]

Oxygenation is difficult to assess by physical examination alone. Blood gas analysis for many years was the only method of detecting hypoxemia in critically ill patients, but this technique is painful, has potential complications, and does not provide immediate or continues data.[2]

Pulse oximetry is an easy, noninvasive, reliable and commonly used method for measurement of arterial oxygen saturation in ICU settings, with immediate results that help in decision making. Over the past 30

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years, pulse oximetry has become the standard for continues and noninvasive assessment of $SpO_2$.[3] This study aims to determine the levels of $SpO_2$ in healthy newborns born via vaginal and cesarean sectionand correlated with neonatal and maternal factors.

## METHODS

This Hospital Based, Observational study conducted between October to December 2013 in the Department of Pediatrics, Universal College of Medical Sciences-Teaching Hospital, Bhairahawa, Lumbini, Nepal. Total of 98 neonates (49 NVD and 49 LSCS) with Apgar score ≥ 6 were taken for study. Babies were subjected for $SpO_2$ monitoring by pulse oximeter (Ramsonsoxee check-Masimo SET technology) post-ductally (Left foot) at 1,5,10,15,20,25,and30 minutes of birth. The observed $SpO_2$ values were correlated with neonatal and maternal factors.Newborns with appropriate weight for gestational age (between gestation age of 37-42 wks) irrespective of gender, delivered by vaginal or cesarean section were included. Babies with congenital anomalies, twin deliveries, intra uterine growth retardation, Apgar ≤6 at 1 minute of life (newborn with perinatal asphyxia who required resuscitation), heart rate <100/min at 2 min, respiratory rate <50/min or apnea, maternal use of steroid, morphine, pethidine and magnesium sulphate or LSCS under general anesthesia were excluded. In LSCS cases during spinal anesthesia oxygen was provided for very short period. All babies were given routine care as per standard protocol, in an environment with temperature of 36.5 C ±1. The newborn was wiped with a pre-warmed cloth, and watched for cry and vitals. Color of amniotic fluid was noted. Simultaneously, Apgar scoring to assess the cardio-pulmono-cerebral status was done at 1 min and newborns with Apgar score of ≤6 was discontinued from the study and resuscitated as per NRP guidelines. Apgar scoring was continued simultaneously along with $SpO_2$ recordings for the further study period. After 30 min of study period, newborns were weighed on an electronic weighing scale (KINLee), assessed for gestation and initiation of breastfeeding was done. Ethical clearance was taken from the institutional ethical committee and permission from the parents were obtained in writing in local language. The data were entered in Microsoft excel database. Percentage, proportions and contingency tables were made. The analysis was done using paired t-test for difference of means and Pearson correlation for analysis using SPSS.

## RESULTS

49 neonates, each born via NVD (Male-32, Female-17) and LSCS (Male-31, Female- 18) were subjected for analysis, with no significant statistical difference in gender of the babies born via two modes of deliveries (p =0.833).

**Table 1.** Comparison of NVD and LSCS groups in relation to maternal and newborn characteristics.

| Characteristics of the mother and baby | Mode of delivery | Mean | p-value (Unpaired t test) |
|---|---|---|---|
| Maternal age(yr) | NVD<br>LSCS | 24.7±4.96<br>25.1±4.39 | 0.73 |
| Maternal height(cm) | NVD<br>LSCS | 152.2±4.93<br>151.7±5.72 | 0.64 |
| Maternal weight(kg) | NVD<br>LSCS | 51±6.24<br>53.7±7.90 | 0.06 |
| Maternal BMI(kg/m$^2$) | NVD<br>LSCS | 22.1±2.62<br>23.4±3.34 | 0.04* |
| Maternal Hb(g%) | NVD<br>LSCS | 11.2±1.23<br>11.5±1.65 | 0.37 |
| Birth weight(kg) | NVD<br>LSCS | 2.8±0.34<br>3.0±0.38 | 0.01* |
| Apgar score at 1min | NVD<br>LSCS | 6.7±0.50<br>6.7±0.76 | 1.0 |
| Apgar score at 5 min | NVD<br>LSCS | 8.3±0.49<br>8.5±0.50 | 0.04* |

The mean age of mothers in NVD and in LSCS groups were 24.7± 4.96 and 25.1 ± 4.38 which are comparable ( p>0.05;unpaired test).The mean height of the mothers in NVD was 152.2± 4.93cm and in LSCS was 151.7± 5.72cm, being similar (p >0.05) in two groups. The mean weight of the mother in NVD was 51.0± 6.24kg and in LSCS was 53.7± 7.90 kg, being similar (p >0.05). The mean BMI (kg/m$^2$) values of the mother in the two groups were 22.1 ±2.62 in NVD and 23.4± 3.34 in LSCS, the difference being significant (p <0.05). The mean maternal hemoglobin values in NVD and LSCS were 11.2±1.23 and 11.5± 1.65gm%, respectively being comparable (p >0.05). On the other hand, the mean birth weight of neonates in NVD was 2.8± 0.34kg whereas in LSCS 3±0.38kg, later being statistically significant(p <0.05) .The mean Apgar score at 1 min in NVD was 6.7 ±0.50 and in LSCS was 6.7 ±0.76 being similar (p >0.05). whereas, the Apgar score at 5 min NVD was 8.3± 0.49 and in LSCS was 8.5± 0.50 which was found to be statistically significant(p <0.05) (Table 1).

Correlation of different variants with the $SpO_2$ in neonates born by NVD, starting from 1minute to 30 minutes after birth with interval of 5 min Apgar score at 1 and 5 min, BMI (kg/m$^2$) of mother, and age of mother (yearsr) did not show any correlation with $SpO_2$ levels. The maternal hemoglobin showed correlation with $SpO_2$ at 20 minutes (p<0.01) and 25 minutes (p<0.05). The

birth weight showed significant correlation with $SpO_2$ at 10,15,20 and 25 min($p<0.05$).On the other hand, LSCS group showed positive correlation between $SpO_2$ and Apgar score at 1 as well as 5 min ($p<0.05$ for both).However, no significant correlation was found with birth weight, maternal age, hemoglobin and BMI (Table 2).

**Table 2. Correlations of maternal and newborn characteristics with SPO2 in NVD and LSCS groups.**

| Maternal and baby characteristics | r-value in | Time(min)after birth | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 5 | 10 | 15 | 20 | 25 | 30 |
| Birth weight(kg) | NVD | 0.12 | 0.07 | 0.32* | 0.41** | 0.30* | 0.29* | 0.10 |
| | LSCS | -0.03 | -0.20 | -0.28 | -0.17 | -0.16 | -0.01 | -0.07 |
| Apgar score at 1 min. | NVD | 0.11 | 0.05 | 0.17 | 0.23 | 0.20 | 0.20 | 0.25 |
| | LSCS | 0.47** | 0.49** | 0.50** | 0.29* | 0.24 | 0.36* | 0.46** |
| Apgar score at 5 min. | NVD | -0.16 | -0.11 | 0.06 | 0.25 | 0.29* | 0.23 | 0.29* |
| | LSCS | 0.36* | 0.39** | 0.42** | 0.31* | 0.11 | 0.26 | 0.28* |
| Maternal BMI($kg/m^2$) | NVD | -0.18 | -0.83 | 0.23 | 0.19 | 0.09 | 0.09 | -0.05 |
| | LSCS | 0.16 | 0.16 | -0.07 | -0.12 | -0.11 | -0.09 | -0.05 |
| Maternal age(yrs) | NVD | -0.01 | -0.02 | 0.10 | 0.04 | -0.03 | -0.11 | 0.02 |
| | LSCS | -0.07 | -0.28 | -0.33* | -0.27 | -0.24 | -0.05 | -0.17 |
| Maternal Hb(gm%) | NVD | -0.09 | 0.09 | 0.22 | 0.25 | 0.37** | 0.32* | 0.24 |
| | LSCS | 0.10 | 0.26 | 0.21 | 0.23 | 0.19 | 0.14 | 0.18 |

***Correlation is significant at the p < 0.05 level (2-tailed).**

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**Table 3. Comparison of $SpO_2$ levels at different times in NVD and LSCS.**

| Time(min) after birth | NVD(n=49) Mean $SpO_2$ ± | LSCS(n=49) Mean $SpO_2$ ± | P value (Repeated Measure ANOVA) |
|---|---|---|---|
| 1 | 75.0 ± 7.32 | 76.4 ±13.09 | <0.001 |
| 5 | 81.5 ± 5.22 | 83.9 ± 9.3 | |
| 10 | 86.4 ± 3.56 | 89.1 ± 4.56 | |
| 15 | 89.4 ± 3.2 | 91.6 ± 3.75 | |
| 20 | 92.0 ± 3.18 | 93.0 ± 3.31 | |
| 25 | 94.0 ± 1.86 | 94.9 ± 2.12 | |
| 30 | 95.5 ± 1.5 | 96.2 ± 1.35 | |

Mean $SpO_2$ levels in neonates born by NVD at 1,5,10,15,20,25 and 30 min of life after birth were 75%,81.5%,86.4%,89.4%,92%,94% and 95.5%, respectively. Similarly, in neonates born via LSCS, the $SpO_2$ levels at 1,5,10,15,20,25 and 30 min were 76.4%, 83.9%, 89.1%, 91.6%, 93%, 94.9% and 96.2%, respectively. The above findings show a significantly higher $SpO_2$ levels in neonates born by LSCS in comparison to neonates born by NVD at every point of time in study [p=<0.001; ANOVA]. In the NVD, the mean $SpO_2$ levels of >70%,>80%,>90% and >95% were reached at 1,5,20 and 30 min whereas in neonates born by LSCS, the mean SpO2 levels>70%,>80%,>90% and >95% were reached at 1,5,15 and 30 min respectively. But in all neonates the mean $SpO_2$ of >70%, >80%, >90% and >95% reached at 1,5,20 and 30 minutes respectively. On applying repeated measure ANOVA, there were highly significant differences between the NVD Vs LSCS groups, at all time points (P< 001) (Table 3).

## DISCUSSION

The findingsof present study show significantly higher $SpO_2$ levels in neonates born via LSCS in comparison to NVD born at every point of time. The $SpO_2$ rise, though faster in LSCS than NVD, in all neonates the mean $SpO_2$ of >70%, >80%,>90% and >95% reached at 1,5,20 and 30 minutes respectively. Hulsooreet al[4] and Rosviket al[5] in their studies also showed similar results that $SpO_2$ was independently related to the mode of delivery and was higher in those born by cesarean delivery. This lower saturation among vaginally delivered newborns, though statistically insignificant can be postulated to be due to some intranatal asphyxia associated with vaginal birth process. Several studies using pulse oximetry in the delivery room have documented that it takes more than 5 min for a newborn undergoing normal postnatal transition to attain an oxygen saturation >80% and

almost 10 min to reach 90%.[6,7] In contrast, studies have also demonstrated that $SpO_2$ in cesarean delivered newborns was lower than NVD and also took longer time to reach a level of 90%[8,9,10] as much as 3 times longer for cesarean to reach a level of 85%–90% $SpO_2$. This being probably secondary to delayed clearance of lung fluid during operative delivery without adequate period of labor.

The findings of present study for Apgar score showingrelationship with $SpO_2$ in LSCS only, are inconsistent with the findings of House et al;[11] andHulsooreet al,[4]who showed that Apgar score had a direct relationship with the $SpO_2$, regardless of the mode of delivery.On the other hand, Dimich et al[12] found Apgar score to be potentially misleading predictor of $SpO_2$. Birth weight in NVD birth showed relationship with $SpO_2$, whileRosviket al[5] did not show any relationship of $SpO_2$ with the neonatal birth weight.

In the present study, $SpO_2$ of neonates born via NVD or LSCS did not show any significant change with maternal age, hemoglobin and BMI, being similar to the study conducted by Hulsooreet al.[4]

## CONCLUSIONS

In the present study, significantly higher $SpO_2$ levels in neonates born by LSCS were seen in comparison to neonates born by NVD at every point of study time. The $SpO_2$ rise, though faster in LSCS than NVD, in all neonates the mean SpO2 of >70%, >80%, >90% and >95% reached at 1,5,20 and 30 min respectively. Maternal hemoglobin and BMI did not have any correlation with $SpO_2$. The relationship of birth weight in NVD and Apgar score in LSCS have shown variability. One should be aware of the fact that Apgar score and birth weight of the babies do have significant effect of the level of $SpO_2$ and act accordingly.

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