

## Oxygen Saturation Trend in Normal Healthy Term Newborn

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## Abstract

## Original Research Article

**Background:** An infant after birth goes transition from foetal circulation to neonatal circulation. Changes in ventilation and circulation occur during this time indicated by the changes in heart rate, respiratory rate and APGAR score. **Aim:** To form a normative data of pulse oxymetry readings in newborns at 1st, 5th, and 10th minute of life, in healthy term newborn. **Material Methods:** The study was conducted in tertiary care hospital in India during the period of 2 years. All the full term healthy newborns and no resuscitation required at birth were included in the study after taking voluntary informed consent of their parents. Predesigned semi-structured questionnaire was prepared based on the review of literature on pulse oxymetry in healthy newborns. **Results:** Total 2873 babies out of 4326 born were included in the study. Mean heart rate was 139 per minute at 1 minute which gradually reduced to 122 per minute at the end of 10 minutes. Mean respiratory rate was 45 per minute at 1 minute which gradually reduces to 40 per minute at the end of 10 minutes. Mean APGAR score was 9 at 1 minute which increased to 10 at the end of 10 minutes. Mean SpO<sub>2</sub> was 67% at 1 minute which increased to 83% at the end of 5 minutes and 91% at the end of 10 minutes of life. **Conclusion:** the study concluded saturation trends didn't vary according to the gender, birth weight in term infants.

**Keywords:** Oxygen saturation, Term neonate, Pulse oxymetry.

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## INTRODUCTION

Initial few minutes are the most important and vulnerable period in a newborn's life as there is transformation of fetal circulation into the newborn circulation [1]. Along with all this the oxygen saturation of the newborn improves from an intrauterine Spo<sub>2</sub> of 40% to 90% [4]. In this study normative ranges of Spo<sub>2</sub> at 1<sup>st</sup>, 5<sup>th</sup>, and 10<sup>th</sup> minute of life in the healthy newborns born at our centre have been described. Pulse oxymetry is one of the noninvasive, reliable and cost effective tools for assessing the perfusion and the oxygen saturation [2].

## MATERIALS AND METHODS

A cross sectional study was conducted in tertiary care centre in India during the period of 2 years. All the full term healthy newborns (gestational age more than or equal to 37 weeks) and no resuscitation required at birth were included in the study after taking voluntary informed consent of their parents. Infants with hydrops fetalis, meconium stained amniotic fluid, respiratory distress or any gross congenital malformations were excluded. Predesigned semi-structured questionnaire was prepared based on the review of literature on pulse

oxymetry in healthy newborns which included gender of baby, gestational age and age of mother, gravid status, type of delivery, birth weight, clinical symptoms, blood pressure measurement, APGAR score at 1 and 5 min, congenital anomaly, antenatal illness, intrapartum risk factors and pulse oxymetry readings at 1<sup>st</sup>, 5<sup>th</sup> and 10<sup>th</sup> minutes.

A Nelcor technology based with silicone probe pulse oxymeter was used for the study. Probe was attached to the right wrist of the newborn immediately after receiving the newborn in the warmer and drying. Readings were taken at 1<sup>st</sup>, 5<sup>th</sup>, 10<sup>th</sup> minute of life once plethysmograph is stable and uniform.

### Statistical Analysis

Data management and analysis was done using Microsoft excel and Epi-info software. The frequency distribution and graph were prepared for the variables. The categorical variables were assessed using Pearson chi-square test.

### Ethical Considerations

The study protocol was approved by the Scientific and Ethical Committee of the Institution. All the participants' parent was informed about the study procedure and the information required from them for the study. A voluntary informed written consent was taken from the participant parent those who consented were included in the study. A strict confidentiality was

maintained about the personal details of the participants and information related to the study.

### RESULTS

Among the total 4326 live birth occurred in the institute of which 2873 newborns were included in the study fulfilling the inclusion and exclusion criteria.

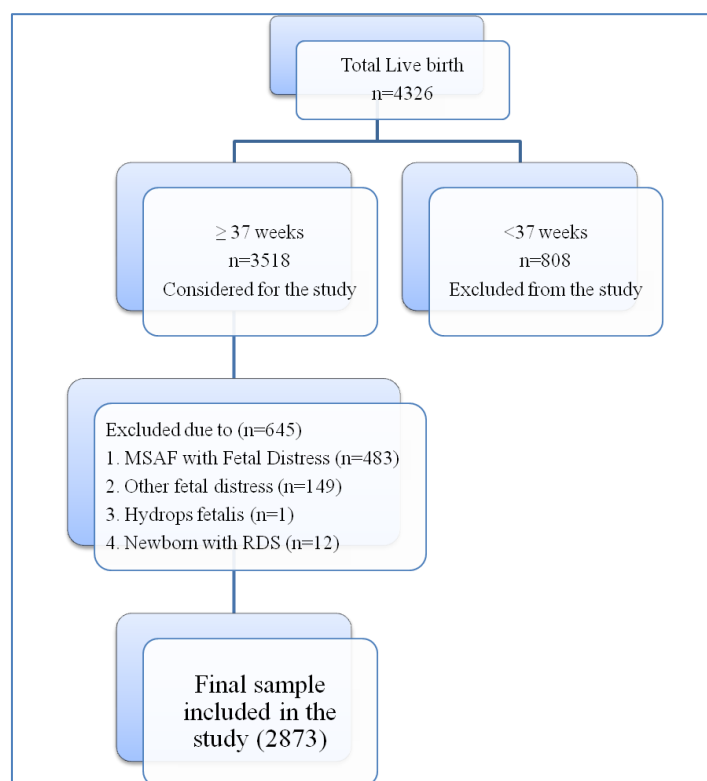


Fig-1: Sample inclusion of study

The observations showed the significant difference ( $p$  value  $< 0.01$ ) in the mean SpO<sub>2</sub> value at first min between the vaginally born and newborns born by LSCS which decreased till tenth minute of life (fig no. 1) The mean saturation of newborns born vaginally at 1 min was  $70 \pm 7.3\%$  and  $63 \pm 7.5\%$  born by cesarean section. No significant difference between the SpO<sub>2</sub> readings between the newborns born between 37 to 39 weeks of gestation and the newborns with gestational age more than 39 weeks between the two was observed ( $p > 0.05$ ) (fig no.2).

The mean SpO<sub>2</sub> was 67% at 1 minute which increased to 91% at the end of 10 minutes. The rate of change in SpO<sub>2</sub> was statistically significant ( $p < 0.01$ ).

SPO<sub>2</sub> values according to birth weight indicate that the SPO<sub>2</sub> level was not significantly lower in low birth weight babies compared to normal weight babies ( $p > 0.05$ ) as shown in table no. 1.

The mean heart rate was 139 per minute at 1 minute which reduced to 122 per minute at the end of 10 minutes; mean respiratory rate was 45 per minute at 1 minute which reduced to 40 per minute at the end of 10 minutes as shown in fig no. 3.

1<sup>st</sup> minute saturation values according to gender indicate that the saturation level was non-significantly lower in females compared to male babies (as  $p > 0.05$ ) as shown in fig no.3.

Table-1: Saturation trends in low birth weight newborns and newborns above or equal to 2500gm

Birth weight (gms)	No. of Newborn	Percentage	Mean saturation at		
			1 <sup>st</sup> min	5 <sup>th</sup> min	10 <sup>th</sup> min
<2500	713	24.82%	64± 7.7	83± 7.2	90± 6.8
≥2500	2160	75.18%	69± 7.4	86± 7.3	91± 6.8
Total	2873	100.00%	67	85	91



Fig-2: Box whisker plot showing variables against mode of delivery, LSCS=0, NVD=1

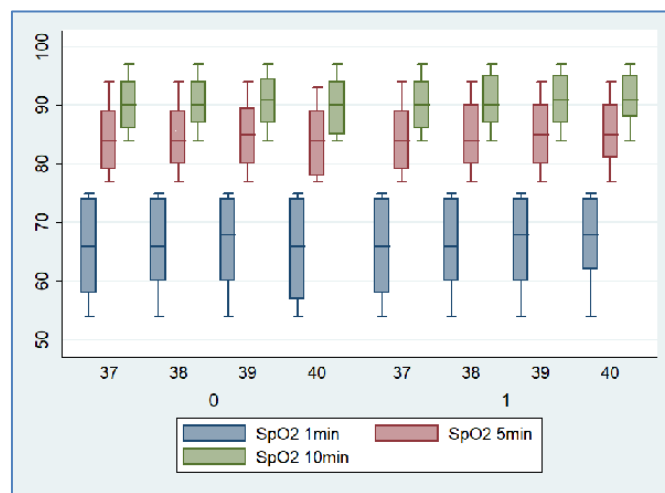


Fig-3: Box whisker diagram showing SpO2 (y axis) against period of gestation POG on x-axis

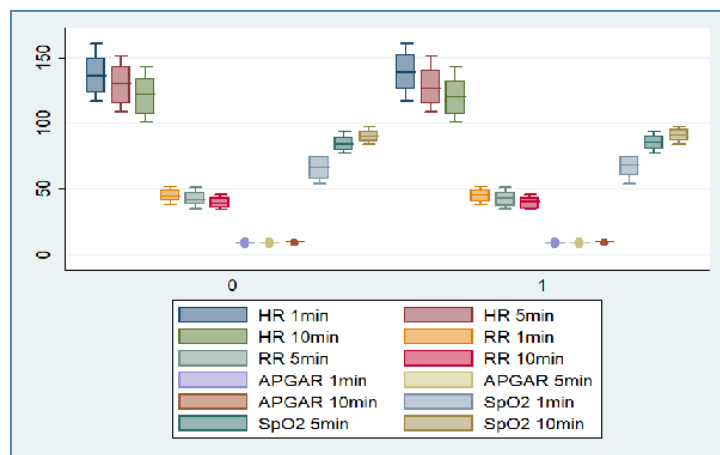


Fig-4: Box whisker showing variable against gender, male-1, female-2

## DISCUSSION

We have used Nelcor pulse oximeter with a neonatal silicon probe which is easily available in rural and remote areas whereas latest oxygen saturation measuring technology including signal extraction technology, Masimo, are costly and not easily available. Readings to be taken at 1<sup>st</sup>, 5<sup>th</sup>, 10<sup>th</sup> minute of life. Present

study was aimed towards obtaining normative data for the term newborns. We studied the trends of rise in saturation in newborns with gestational age 37-39 weeks and >39 weeks separately which did not show any significant difference in mean saturations at 1<sup>st</sup>, 5<sup>th</sup> and 10 min (as p-value >0.05).

The European Resuscitation Council guidelines advise to start resuscitation in term infants with air rather than 100% oxygen and to follow oxygen saturation (SpO<sub>2</sub>) targets for the first 10 min after birth. These targets are based on observational studies by Dawson *et al.* [2]. They measured SpO<sub>2</sub> in the first 10 min after birth in 468 infants who received no medical intervention in the delivery room. These data were used to develop reference ranges for SpO<sub>2</sub> in the first 10 min after birth for preterm and term infants i.e. median oxygen saturations rise steadily from around 60% at 1 min of age to above 90% by 10 min [2]. From this observational study we got mean SpO<sub>2</sub> levels of the healthy newborns born which will be helpful during resuscitation.

In the study conducted by Donia *et al.* [3] the postductal mean SpO<sub>2</sub> value was  $92 \pm 1\%$  (range: 88–94%) and  $93 \pm 1\%$  (range: 91–94%) at the initial and repeat tests respectively. S Richmond *et al.* [4] made use of pulse oxymetry as a screening test for critical congenital heart diseases along with ANC scans and clinical assessment at birth.

Harris *et al.* [5] found the mean SpO<sub>2</sub> at 1 min was 46% (3%) in the caesarean group and 61% (5%) in the vaginal delivery group ( $p, 0.05$ ), but by 5 min there was no significant difference. This difference in saturation decreased at 5 min and was insignificant at 10 min (as  $p > 0.05$ ), same finding was observed in present study in relation to heart rate, respiratory rate. Kamlin *et al.* [6] found that term infants born by elective caesarean section took on average 2 min longer to reach an SpO<sub>2</sub> of 90% than infants born by spontaneous vaginal delivery.

In the study by Kamlin *et al.* [6] on infants not receiving resuscitation, the time to reach an SpO<sub>2</sub> 90% was significantly longer in 54 preterm infants at 6.5 (4.9–9.8) min (median (IQR)) than in 121 term infants at 4.7 (3.3–6.4) min (median (IQR)) ( $p=0.001$ ).

Deckardt *et al.* [7] observed the effect of oximetry during resuscitation in 15 infants of < 30 weeks' gestation. CPAP was used only if the SpO<sub>2</sub> was <80% at 5 min and stopped once the SpO<sub>2</sub> reached 90%. (FiO<sub>2</sub>) was reduced from 1.0 to average 0.40 with help of oximetry [7].

In the study conducted by Habib *et al.* [8] the rate of change in APGAR Score was statistically significant ( $p < 0.01$ ) which indicate that in newborn APGAR score significantly improves within first 10 minutes of life which is consistent with our finding.

## CONCLUSION

From the study we concluded that the mean spo<sub>2</sub> of a newborn at 1<sup>st</sup>, 5<sup>th</sup>, and 10<sup>th</sup> minute was 67%, 83%, and 91% respectively. From the study we also found out that there was a difference in mean saturation levels at 1<sup>st</sup>, 5<sup>th</sup>, and 10<sup>th</sup> minute between vaginally born and those born by cesarean section. Saturation trends didn't vary according to the gender, birth weight in term infants.

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