ABSTRACT

**Background and Objectives:** Vital signs include: heart rate, respiratory rate, temperature, blood pressure, pain assessment, level of consciousness and recently oxygen saturation and can be an indicator of wellbeing of an individual. The main objective of this research was to establish longitudinal normative limits of oxygen saturation, heart rate and respiratory rate for healthy term neonates in Sudan.

**Methods:** This was a descriptive, cross sectional study that was conducted in Omdurman maternity hospital during the period January to June 2014. 500 neonates were included in the study. O2 saturation and heart rate were taken by using pulse oximeter, respiratory rate was measured by counting up to one minute. Data were collected using a structured questionnaire containing maternal and neonatal data. Data were analyzed by using Statistical Package for Social Sciences (SPSS) version 17.

**Results:** The main results showed that males were 48% and females were 52%. 38% of the neonates had respiratory rate between 40-45 cycles per minute, 24% between 46-50 cycles per minute, 9% between 51-55 cycles per minute and 28% had respiratory rate between 56-60 cycles per minute. Records of heart rate in neonates showed that 24% had heart rate of 100-115 beat per minute, 19% between 121 -125 beat per minute, 28% between 126 - 135 beat per minute, 11% between 136 -145 beat per minute, 8% between 146 - 160 beat per minute. The O2 saturation records were within the published normal ranges and most neonates reported O2 saturation between 96-99%.

**Conclusion:** The present study succeeded to establish longitudinal normative limits of oxygen saturation, heart rate and respiratory rate for healthy term neonates in Sudan.

**Keywords:** Heart rate; respiratory rate; O2 saturation; neonate; Sudan.

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1. INTRODUCTION

The health of an infant can be determined in various ways, whether by appearance or clinical situations that require detailed observation. Vital signs are physical signs that indicate the well-being of an individual. Vital signs include: heart rate, respiratory rate, temperature, blood pressure, pain assessment, level of consciousness and recently oxygen saturation. The vital signs may be observed, measured and monitored to assess individual’s level of physical functioning. Normal vital signs change with age, sex, weight and exercise tolerance. The transition from fetus to newborn is a complex physiological process [1].

Oxygen saturation alone does not indicate health status. Pulse oximetry is a noninvasive technique that is widely used to give data on capillary oxygen saturation (SpO2) that is not always close to blood gas measurements [2,3]. Many studies have documented a difference in oxygen saturation between the upper extremities (pre-ductal) and lower extremities (post ductal), with lower oxygen saturation observed in post-ductal sites within the first hour of life [4].

Checking a newborn’s heart rate is one of the first tests performed following birth. According to the New York State Department of Health, the pulse is the most consistent sign of circulation and oxygenation in newborn infants. A normal newborn pulse is between 120 and 180 beats per minute. A pulse of less than 100 beats per minute generally signifies low oxygen levels. Respiratory rates for newborns to infants one year in age are between 30 and 60 breaths per minute. This wide range is due to the irregularity of breathing at this age and accounts for normal periods of apnea. Infants generally breathe faster while awake and more slowly at rest [5].

The main objective of this research was to establish longitudinal normative limits of oxygen saturation, heart rate and respiratory rate for healthy term neonates in Sudan. More over to correlate heart rate, respiratory rate and O2 saturation values with maternal and neonatal variables like gestational age, analgesia during labour, Apgar score, oxygen given to the baby at the delivery room and gender.

2. MATERIALS AND METHODS

This was a descriptive, cross sectional hospital based study that was conducted in Omdurman maternity hospital during the period January to June 2014. 500 neonates were included in the study, those included were babies born by normal spontaneous vaginal delivery at term and who were outcome of uneventful pregnancy with normal Apgar score. Exclusion criteria were preterm babies, neonates delivered by caesarean section, either electively or emergency, neonates with major congenital anomalies, intrauterine growth restriction and low birth weight.

Vital signs were recorded for the selected group of neonates after 10 minutes of age. O2 saturation and heart rate were taken by using pulse oximeter. Pulse oximeter: Zondan A2 Pulse oximeter,

2.1 Manufacturer

ZONDAN Medical Equipment CO., LTD [China (Mainland)], 2008. The respiratory rate was measured by counting for one minute, using a stop watch. Data were collected using a structured questionnaire containing maternal and neonatal data. Data were analyzed by using Statistical Package for Social Sciences (SPSS ) version 17, frequency analysis for background variables was conducted, chi-square test was used to study the association between vital signs and maternal and neonatal variables. P value was set at 0.05 level of significance.

Ethical approval for conducting this research was granted by the ethical committee of Sudan medical specialization board. Prior informed consent was obtained from the caregivers of the babies with full explanation of the study.

3. RESULTS

During the study period a total of 500 babies who fulfilled the criteria were included in the study. Regarding the age distribution of the mothers, the study revealed that 18% were aged 20 years or less, 31% were between 21-25 years, 28% between 26-30 years, 13% between 31-35 years, 10% between 36-40 years and 1% were more than 40 years (Fig. 1).

With regards to gestational age, 4% of the mothers were of 37 weeks gestation, 11% were 38 weeks, 22% were 39 weeks, 33% were 40 weeks, 18% were more than 40 weeks gestation and 13% of mothers were uncertain.

The study showed that about one third of the mothers received primary school education, another third received secondary school education, 20% were university graduates and 9% were illiterate. Almost all the mothers (96%) didn’t receive any analgesia during labour and 2% of mothers received oxygen by face mask during labour. 92% of mothers had regular antenatal care, irregular among 3.8%, while 4.4% had no antenatal care visits.
With regards to neonatal data, males were 240 (48%) and females were 260 (52%) with ratio of 1: 1.1. The present study revealed that 38% of the neonates had respiratory rate between 40-45 cycles per minute, 24% between 46-50 cycles per minute, 9% between 51-55 cycles per minute and 28% had respiratory rate between 56-60 cycles per minute.

Records of heart rate in neonates showed that 24% had heart rate of 100-115 beat per minute (bpm), 10% between 116-120 bpm, 19% between 121 -125 bpm, 15% between 126 - 130 bpm, 13% between 131-135 bpm, 3% between 136 - 140 bpm, 8% between 141 - 145 bpm, 3% between 146-150 bpm, 3 between % 151-155 bpm and 2% between 156 - 160 bpm.

When the O2 saturation was measured, 7.2% of the neonates recorded 92%, 2.2% recorded 93%, 94% in 8.8%, 95% in 8.2%, 96% in 10.6%, 97% in 14.6%, 98% in 31%, 99% in 17.2% and one neonate recorded 100%.

**Fig. 1.** Distribution of the mothers according to age

**Fig. 2.** Distribution of neonates according to respiratory rate
The present study revealed significant association between O2 saturation and maternal age and gestational age \((P = .005, .00\) respectively), however the association between O2 saturation and analgesia given during labour was insignificant \((P = .095)\). Correlation between heart rate and maternal age, gestational age and analgesia given during labour showed significant association \((P = .01, .00\) and .005 respectively). When the association between respiratory rate and maternal variables was assessed the study showed significant association between respiratory rate and gestational age and antenatal care \((P = .036\) and .004 respectively), the study didn’t reveal any significant association between respiratory rate and analgesia given during labour \((P = .71)\).

4. DISCUSSION

O2 saturation, heart rate and respiratory rate remain an integral part of the standard clinical assessment of children presenting with acute illness, and are used in paediatrics as an early warning scores and triage...
The present study is an attempt to establish longitudinal normative limits of oxygen saturation, heart rate and respiratory rate for healthy term neonates in Sudan.

The present study showed that about one third of the mothers received secondary school education, 20% were university graduates and 9% were illiterate. Maternal education is reflected positively on their attitude and response towards antenatal care attendance and early response to neonatal problems. A study in Pakistan in 2014 concluded that, maternal education and income status play an important role in their knowledge and practices regarding newborn care [7]. Few mothers reported to have received analgesia during labour (4%). In a survey in the United States, the use of parenteral opioids was found to be between 39% and 56% in various hospital obstetrics units [8]. This difference might be due to the fact that, in Sudan most women present at stage two of labour or due to absence of facilities to control analgesia adverse effect on mother and baby.

The predominant range of respiratory rate among newborns in the current study was 40-50 cycle per minute in 62%, this is in consistent with the normal respiratory rate reported in a previous study [9]. Neonatal respiratory rate in the current population showed significant association with mother’s education, gestational age, antenatal care and medication during pregnancy apart of tonics, while there was no association detected with analgesia given during labour. Since all participants of the current study were term and delivered vaginally, literature of previous studies didn’t predict occurrence of respiratory distress [10].

The present study showed that most of the newborns had a heart rate that ranged between 100-135 bpm with a mean of 125.2, which is lower than that reported by Mehta SK and his colleagues in a study among newborns aged 24-72 hours, they reported mean heart rate of 130.28±8.2 [11]. Our study revealed statistically significant association between heart rate and other variables like analgesia and medications during pregnancy, antenatal care and O2 given to the baby, this is in line with a previous work which indicated the independence of fetal and maternal heart rates in the absence of maternal hemodynamic changes mediated by various factors [12].

In the current study most records of O2 saturation ranged between 96-99%. Neonates with low oxygen saturation might not indicate health defect, since it might be lower limit of normal oxygen saturation without intervention. The same findings were reported by Rabi and colleagues in 2006. The time required for this increase in oxygenation is partly dependent on the presence of residual cardiopulmonary shunts. They found that it took up to 8 minutes to reach a median SpO2 of 90%; other studies have reported times of between 8 and 15 minutes. These results support the assertion that during normal neonatal transition, it often takes 8 minutes or longer to achieve an oxygen saturation of 90% [13].

During the first day of life, healthy term infants have baseline SpO2 values that are very similar to those of older infants, with a range from 89–100% [14].

Our data indicated statistically significant association between O2 saturation and maternal and neonatal variables like gestational age, antenatal care, medications during pregnancy and O2 given to the baby, this is different from the findings of Tiwaria in 2013 who concluded that, values of neonatal oxygen saturation had no statistically significant correlation with neonatal or maternal factors [15].

5. CONCLUSION

Normal values of respiratory rate in the study were found to be consistent with what is reported in the literature, also the heart rate measured didn’t exceed the upper limit of normal with significant association with maternal and neonatal factors. The O2 saturation records were within the published normal ranges and most neonates reported O2 saturation between 96-99%. The present study succeeded to establish longitudinal normative limits of oxygen saturation, heart rate and respiratory rate for healthy term neonates in Sudan.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES


