Jurnal Mitra Kesehatan (JMK)
DOI: 10.47522/jmk.v1iIAHSC.112
ISSN: 2580-3379 (print); 2716-0874 (online)

PRONATION POSITION OF OXYGEN SATURATION, RESPIRATORY AND PULSE FREQUENCY IN LOW BIRTH WEIGHT BABIES

Desi Sarli[1*], Syalfia Oresti[2], Faridah Moh. Said[3], Cici Nova Runia[4]

1. Department of Midwifery, STIKes Alifah Padang, Padang-Indonesia
2. Department of Nursing, STIKes Alifah Padang, Padang-Indonesia
3. Department of Nursing, Lincoln University College Malaysia, Malaysia
4. Department of Nursing, STIKes Alifah Padang, Padang-Indonesia

*Correspondence: Desi Sarli | STIKes Alifah Padang | desi_sarli@yahoo.com

Abstract

Introduction: Data from WHO 2018 shows the prevalence of LBW is estimated at 21% globally with a limit of 4.5%-40%. LBW babies often have complications in the form of Respiratory Distress Syndrome and an increase in pulse rate. One way to prevent complications is to place the baby in a prone position. Based on scientific article searches, this literature review aims to determine the effect of pronation position on oxygen saturation, pulse rate, and respiratory rate in LBW infants.
Method: The type of research was a Literature Review with meta-analysis. Journal searches are carried out on the electronic basis of Google Scholar, Garuda Portal, One Search, and Pubmed, totaling 30 articles. The literature used is literature published from 2016 - 2021.
Results: The study results of 30 articles found that the average oxygen saturation before and after being given a pronation position was in the range of 90.27% - 98.1%. The average pulse frequency before and after being given a pronation position was in the range of 144.87 x/minute -140.90 x/minute. The average breathing frequency before and after being given a pronation position was in the range of 69.50 x/minute – 44.18 x/minute. All articles have the effect of pronation position on oxygen saturation in infants (LBW). There is an effect of pronation position on oxygen saturation, respiratory, and pulse with p-value <0,05.
Conclusion: It was concluded that the pronation position affected the oxygen saturation, pulse rate, and respiratory frequency in LBW infants. It is expected for nursing services to make the provision of a pronation position as one of the nursing interventions and become a standard operating procedure in the management of LBW infants.
Keywords: Pronation position, Oxygen Saturation, Pulse Frequency, Respiratory Frequency, LBW

Received November 5, 2021; Accepted December 30, 2021

INTRODUCTION

Babies with low birth weight often have respiratory distress syndrome (RDS) complications and increased pulse rate. RDS is due to the incomplete formation of the hyaline membrane of pulmonary surfactant, a substance that can reduce the tension of the walls of the pulmonary alveoli. Alveoli, which act as a place for the exchange of oxygen and carbon dioxide, are not sufficient in number to meet the needs of oxygen in the blood. In this case, the heart compensates to increase blood flow to meet the oxygen needs of the tissues. This is one of the causes of mortality in infants born with LBW (Mukhlis and Marini, 2020).

The condition and clinical appearance of infants, such as monitoring oxygen saturation, respiratory rate, and pulse rate, are routine actions that should be carried out in LBW infants and neonates (Anggraeni, Indiyah, and Daryati, 2019). The development of nursing interventions in reducing RDS continues to be developed, including the use of mechanical ventilation and mobilization as an effort to accelerate healing to avoid complications due to treatment or static or static body position just on your back. Immobilized infants are at risk for developing respiratory complications. The most common respiratory complications are atelectasis (collapse of the alveoli) and hypostatic pneumonia (inflammation of the lungs due to static or accumulation of secretions). In practice, not all babies are mobilized to prevent complications. One way to prevent complications is to place the baby in a pronation position (Apriliawati, 2016).

The pronation position is a sleeping position for the baby, namely the prone position with the head tilted to one side (right or left), the arm bent on the baby's chest, and the legs (knees) attached to the baby's chest (Cristina and Mattos, 2019). The pronation position is perfect and has advantages such as reducing apnea (stopping breathing), increasing lung volume, and making the baby sleep more peacefully. The

DOI: 10.47522/jmk.v1iIAHSC.112
ISSN: 2580-3379 (print); 2716-0874 (online)

pronation position will give the chest wall more freedom. There will be no pressure to increase compliance so that there is more ventilation in non-dependent areas of the lung and an increase in oxygenation status. An increase in oxygenation status can lead to an increase in oxygen saturation. A trigger can also cause increased respiratory rate in infants for breathing from babies who try to breathe spontaneously without relying on a ventilator (Apriliawati, 2016).

Giving a pronation position can also affect the heart rate of LBW babies. This can be seen from the research results (Anggraeni, Indiyah, and Daryati, 2019), which found that the average baby heart rate tends to decrease gradually from 156.62 x/minute before giving the pronation position and to 141.10 x/minute after the first 2 hours pronation. Measurement of the baby's heart rate is needed to assess the presence of bradycardia, which can cause apnea, especially in infants due to immature CNS function or the respiratory central nervous system (T *et al.*, 2006).

Another study conducted by (Oktariani, Sari, and Sari, 2020) on the effect of pronation position in premature infants with CPAP installed on hemodynamic status (Breathing Frequency, Heart Rate, and Oxygen Saturation/SpO2) in the NICU Room An-Nisa Hospital Tangerang. The results showed that before giving the pronation position, the average respiratory rate was 73.97 x/minute, and after being given the pronation position, it was 69.50 x/minute. Before being given a pronation position, the average pulse frequency was 162.60 x/minute and decreased after being given a pronation position, namely 144.87 x/minute. The results of the study the average oxygen saturation before being given a pronation position was 94.00% and increased after being given a pronation position, which was 96.87%. The results prove that there is an effect of giving a pronation position to premature infants who have CPAP installed on hemodynamic status (Breathing Frequency, Heart Rate, and Oxygen Saturation/SpO2) (p=0.000) (Oktariani, Sari and Sari, 2020).

Research conducted by (Cristina and Mattos, 2019) in the neonatal ICU of Do Mandaqui Hospital found that the prone position in premature newborns increased parasympathetic activity and the complexity of autonomic adjustment compared to the supine position (p=0.001). A study was also conducted by Aprilliawati and Rosalina (2016) about the effect of pronation position on oxygen saturation and respiratory frequency in infants who were mechanically ventilated in the NICU room of Koja Hospital. The results of the study found that there was an effect of the pronation position on the oxygen saturation value (p=0.002) and the respiratory rate (p=0.026) in neonates using mechanical ventilation (Apriliawati, 2016). Comparison of the pronation position with other positions or if the baby is left in the same position for a long time. There will be an emphasis on one part of the body so that growth and development are not symmetrical. The baby tends to lose energy if left in the supine position for too long because the position is suitable in LBW infants is a flexion position as in the mother's intrauterine, and this flexion position can be obtained by giving the LBW baby a pronation position (Dyah, Rustina and Waluyanti, 2017). The purpose of this study was to determine the effect of the pronation position on oxygen saturation, pulse rate, and respiratory frequency in low birth weight (LBW) infants through a literature review study approach.

METHOD

This research is literate about the effect of pronation position on oxygen saturation, pulse rate, and respiratory rate in low birth weight (LBW) infants. The method used in this research is Literature Review, which describes the theory, findings, and research articles obtained from several library sources. The article search method was analyzed using the electronic database Google Scholar, Garuda Portal, One Search, and Pubmed. The number of articles used for the literature review is 20 articles from 2016 to 2021. The stages of data collection in conducting a literature review study are looking for sources, looking for similarities (compare), looking for dissimilarities (contrast), providing views (criticizing), comparing (synthesize).) summarize The keywords used in this literature review search include "pronation position," AND oxygen saturation, AND pulse frequency, AND respiratory rate, AND low birth weight infants." Processing the literature review data is by using meta-analysis.

RESULTS

Tabel 1. Pronation position on oxygen saturation, respiratory rate, and pulse rate in infants with low birth weight

Variable	Average±SD	Different	P-value

DOI: 10.47522/jmk.v1iIAHSC.112
ISSN: 2580-3379 (print); 2716-0874 (online)

		Average±SD	
Oxygen Saturation Frequency		7,830±4,524	0,001
Pre-test	90,27		
Post-test	98,10		
Respiratory Frequency		25,320±6,782	0,002
Pre-test	69,50		
Post-test	44,18		
Pulse Frequency		3,970±4,312	0,000
Pre-test	144,87		
Post Test	140,90		

Based on table 1 on the effect of the pronation position on oxygen saturation, respiratory rate, and pulse frequency in infants with low birth weight, data processing from 30 articles that were processed using meta-analysis showed the results: the average frequency of oxygen saturation before the pronation position was 90.27% and the frequency of oxygen saturation after the pronation position is 98.10% with a p-value of 0.001 which means that there is an effect of the pronation position on oxygen saturation in infants with low birth weight. The average respiratory frequency before the pronation position was 69.50 x/minute. After the pronation position, the average respiratory frequency in infants was 44.18 x/minute with a p-value of 0.002, which means an effect of the pronation position on the respiratory frequency. The average pulse frequency before the pronation position was 144.87 x/minute. After the pronation position, the average pulse frequency was 140.90 x/minute with a p-value of 0.000 which means that there is an effect of the pronation position on the pulse frequency in infants with low birth weight.

DISCUSSION

Average Oxygen Saturation in Low Birth Weight (LBW) Babies Before and After Being Given a Pronation Position

Based on the results of a review of the articles that have been carried out, it was found that the average oxygen saturation of low birth weight (LBW) infants before being given the pronation position was still high and low after being given the pronation position. This can be seen from each article, namely in the Anggraeni study (2019), finding the average oxygen saturation in infants before being given a pronation position was 92.87%, gradually increasing to 96.46 in the first 1 hour and 97.25 in the first 2 hours. Anggraeni's research (2019) found a significant effect of pronation position in infants on increasing oxygen saturation pre-post intervention in the first 1 and 2 hours (p = 0.000). There was a significant effect of giving a pronation position for 1 hour and 2 hours on saturation conditions. Monitoring oxygen saturation is necessary to prevent retinopathy in premature infants. Oxygen should be given if the oxygen saturation is below 90%. The results of the study were infants who had saturation below 90%. The observations of infants with 700 grams of weight, 86% oxygen saturation conditions before pronation, and becoming 96% and 98% means that the saturation conditions are getting better with the pronation position (Anggraeni, Indiyah, and Daryati, 2019).

The study of (Apriliawati 2016) found that the average oxygen saturation in the intervention group before being given the pronation position was 91.13%. The average oxygen saturation in the intervention group after being given the pronation position was 95.25%. The Independent T-test statistical test results obtained p-value = 0.032, with a significance level of = 0.05. It can be concluded that there is a significant difference in the average oxygen saturation between respondents who were given a change of position and respondents who were not given a change of position. The pronation position is an inverted position from supination. The head is placed in a lateral position facing the ventilator; the hands are flexed, the knees and feet are supported using a soft roll device. Emphasis on the abdominal area is an important consideration for the effectiveness of the pronation position (Apriliawati, 2016).

Oktariani's study (2020) also found the average oxygen saturation in premature infants before being given a pronation position was 94%, and the average oxygen saturation in premature infants after being given a pronation position was 96.87%, with a p-value of 0.000 (Oktariani, Sari and Sari, 2020). Lestari's research (2018) also found that the average oxygen saturation in premature infants before being given a pronation position was 93.25%. After being given a pronation position, the average oxygen saturation in premature infants was 96.55%, with a p-value of 0.000. The results of the study were two infants with 89%

DOI: 10.47522/jmk.v1iIAHSC.112
ISSN: 2580-3379 (print); 2716-0874 (online)

oxygen saturation. The first baby was born at 35 weeks of gestation with a birth weight of 1,900 grams and had a moderate RDS. The other baby was born at 36 weeks gestation with a birth weight of 1600 grams and had a moderate RDS. In Torabian's research, et al. (2019) found the average oxygen saturation before being given a pronation position was 90.27%, and the average oxygen saturation after being given a pronation position was 98.81%. In addition, the oxygen saturation position of the baby can also be increased with the prone position. Still, these results show that the average oxygen saturation in the pronated position is significantly higher than in the supine position (Lucchini *et al*., 2018).

Oxygen saturation is the percentage of hemoglobin bound to oxygen in the arteries; normal oxygen saturation is between 95-100%. In medicine, oxygen saturation (SO2), often called "SATS," measures the percentage of oxygen bound by hemoglobin in the bloodstream. At low oxygen partial pressures, most of the hemoglobin is deoxygenated, meaning the process of distributing oxygenated blood from arteries to body tissues. Monitoring of oxygen saturation is carried out using an oximeter. The measurement is carried out to determine the percentage of oxygen saturation of hemoglobin in arterial blood. An oximeter is a tool that is often used to observe oxygenation status in children, which is portable, does not require specific preparation, does not require calibration, and is non-invasive (Cristina and Mattos, 2019). An oximeter measures the color of blood flowing through the skin's capillaries and compares it to different colors of blood with known oxygen levels. Oxygen is transported by hemoglobin in red blood cells. Hemoglobin that does not contain oxygen is blue, and hemoglobin is oxygen saturated in red. The oximeter has a probe consisting of a small light source and a light detector. The probe is placed on the skin; the light penetrates the skin, is reflected by the skin capillaries' red blood cells, and is received by the detector. The device on the oximeter converts a signal from the detector into a number that appears on the monitor and shows the percentage of oxygen saturation in hemoglobin. Because the blood in the capillaries is pulsating, the oximeter can also show the heart rate quickly (Kattwinkel, 2016).

Pronation position dramatically affects the improvement of oxygen saturation, lung expansion, chest wall expansion, and decreased incidence of apnea in premature infants (Noor, 2016). According to Efendi (2019), the pronation position improves oxygenation in premature infants with Continuous Positive Airway Pressure (CPAP). This condition is supported by increased ventilation and respiratory stability when the preterm infant is positioned prone. The use of the oximeter begins with placing the probe in a thin area of skin, blood vessels close to the surface so that the light source can penetrate the skin and be received by the detector. It is expected that the oxygen saturation detected on the oximeter is the same as the saturation of blood flowing through vital organs such as the heart muscle and brain. The probe is placed on the right arm in newborns, which receives blood from the aorta before reaching the ductus arteriosus. Aortic blood that has passed through the ductus arteriosus may have been mixed with low-oxygen blood from the pulmonary artery that passed through the ductus because the ductus may still be open several hours after birth (Sirait, 2020).

Pronation position can improve oxygenation, longer sleep time, and improve digestion. When the baby is positioned correctly, the dystonic phase is shortened. This facilitates the hand towards middle movement, helps control the head, helps improve balance in flexion and extension to improve posture, reduces stress, promotes normal movement, prevents abnormal movement, and improves posture—motor skills in infants (Mirshahi et al. 2021). Based on the results of a review of the articles that have been carried out, from several articles, the researchers concluded that before giving the pronation position to LBW infants, oxygen saturation was still low. This is because LBW babies have difficulty adapting and defending the environment outside the uterus after birth due to the immaturity of the baby's organ systems, such as lungs and surfactants that have not been fully formed, which function as lubricants for lung development by lowering lung tension. And the immaturity of the neurological system that regulates breathing. There is an increase in oxygen saturation after being given a pronation position because the pronation position can improve lung tidal and help lung development increase the oxygen that enters the baby's lungs. Increased oxygen consumption will cause the risk of respiratory problems.

Average Pulse Frequency in Low Birth Weight (LBW) Babies Before and After Being Given a Pronation Position

Based on the results of a review of the articles that have been carried out, it was found that the pulse frequency in LBW infants before being given a pronation position was still high and decreased after being

DOI: 10.47522/jmk.v1iIAHSC.112
ISSN: 2580-3379 (print); 2716-0874 (online)

given a pronation position. This can be seen from several articles, namely the Anggraeni research (2019), which found the average pulse frequency in infants before being given a pronation position was 156.62 x/minute, and the average pulse frequency in infants after being given a pronation position was 141.10 x /minute with a p-value of 0.008. Measurement of the baby's heart rate is needed to assess the presence of bradycardia, which can cause apnea, especially in infants due to the immaturity of respiratory CNS function. There was no observation that the baby had bradycardia. The results of observations in this study on infants with a birth weight of 700 grams, HR was originally 171 x/minutes then changed to 142 x/minutes and 168/minutes, meaning that they were within normal limits. Mukhlis' research (2020) found the average pulse frequency before being given a pronation position was 161.50 x/minute, and the average pulse frequency after being given therapy was 151.60 x/minute. Babies born with low birth weight often have complications, such as respiratory distress syndrome and increased pulse rate. This happens because the formation of the hyaline membrane of the lung surfactant is not yet perfect, which is a substance that can reduce the tension of the walls of the pulmonary alveoli.

Oktariani's study (2020) found that the average pulse frequency in premature babies before being given a pronation position was 162.60 x/minute. After being given a pronation position, the average pulse frequency in premature babies was 144.87 x/minute with a p value of 0.026. Torabian Research et al. (2019) also found the same thing. The average pulse frequency in premature babies before being given a pronation position was 140.9 x/minute. After being given a pronation position, the average pulse frequency in premature babies was 133.27 x/minute with a p-value of 0.000. In addition, giving the pronation position, the pulse rate can also decrease with the supine position, but the pronation position is significantly lower than in the supine position. The provision of pronation and prone positions were not found to have an impact on cardiac output. However, blood volume and cardiac output show a significant decrease in the pronated position. Pulse is a palpable pulsating sensation in the peripheral arteries due to friction or blood flow when the heart contracts.

When the left ventricle contracts, blood is pumped into the aorta and forwarded to the arteries throughout the body, creating a pressure wave that rushes in the arteries and can be felt. The pulse rate can be counted in one minute and is the same as the heart rate. Examination of the pulse by palpation can be done, among others: the radial artery, dorsal pedis artery, posterior tibial artery, popliteal artery, femoral artery (Sirait, 2020). The pulse rate is an indicator to assess the cardiovascular system. The pulse can be checked easily using the fingers (palpation), or it can also be done with simple or sophisticated electronic devices. Pulse examination can be performed on the radial artery at the wrist, a brachial artery on the inside of the elbow, carotid artery in the neck, temporal artery, femoral artery, dorsal pedis artery, and on the frontal artery in infants. This examination aims to determine the pulse (rhythm, frequency, and strength) and assess the ability of cardiovascular function (Sarli, 2017).

The pulse rate in newborns should be above 100 beats/minute. The easiest way to determine the pulse rate is to feel the pulse at the base of the umbilical cord. If no pulse is palpable, the pulse is heard with a stethoscope. If the frequency cannot be assessed both ways, measure it using an oximeter or an electronic heart monitor because these two devices can display the heart rate (Sirait, 2020). Pronation position can lower pulse rate, longer sleep time, and improve digestion. When the baby is appropriately positioned, the dystonic phase is shortened; this facilitates the hand towards middle movement, helps control the head, helps improve balance in flexion and extension to improve posture, reduces stress, promotes normal movement, prevents abnormal movement, and improves posture—motor skills in infants (Sarli *et al.*, 2021).

Based on the results of a review of the articles that have been carried out, from several articles, the researchers concluded that the pulse frequency in premature babies is still high. This is because LBW or premature babies have a higher heart rate than normal-born babies, influenced by the baby's body temperature. In addition, low birth weight babies tend to experience bradycardia which can cause apnea in infants. However, after being given a pronation position, there was a decrease in the baby's pulse rate. After being given a pronation position, the baby's breathing becomes calmer, thus making the baby's heart rate stabilize and become calmer.

Average Breathing Frequency in Low Birth Weight (LBW) Babies Before and After Being Given a Pronation Position

DOI: 10.47522/jmk.v1iIAHSC.112
ISSN: 2580-3379 (print); 2716-0874 (online)

Based on the results of a review of the articles that have been carried out, it was found that the frequency of breathing in LBW infants before being given a pronation position was still high and decreased after being given a pronation position. This can be seen from several articles, namely the Anggraeni research (2019), which found the average respiratory frequency in infants before being given a pronation position was 48.65 x/minute, and the average breathing frequency in infants after being given a pronation position was 47.68 x /minute with p-value < 0.05. When referring to the usual standard, the respiratory frequency of premature babies (40-70/minute) and the respiratory rate of 35-60/minutes, the average respiratory rate before and after the pronation position is within normal limits. Based on the data on the min-max frequency of the baby's breath, there was a fluctuation in the baby's respiratory rate during the observation process, outside normal limits. Asphyxia in prematurity can occur due to surfactant deficiency. The results of the observations from the study showed that the majority of 74% were premature/LBW infants who were studied using a mechanical ventilator due to respiratory problems. Pronation position is performed to reduce abdominal compression and improve respiratory function. The observations from this study of infants weighing at least 700 grams showed that the respiratory rate before being given a pronation position was 31 x/minute and then increased to 38 x/minute and 40 x/minute. The study of Apriliawati and Rosalina (2016) found the average respiratory frequency of infants before being given a pronation position was 55 x/minute, and the average respiratory frequency of infants after being given a pronation position was 65 x/minute with a p-value <0.05. An increase in the respiratory rate in infants can be due to a trigger for breathing from the baby trying to breathe spontaneously without relying on a ventilator. The indicates a reasonable breathing effort in the baby to be a reference in collaborating with doctors to carry out the weaning process.

Mukhlis's study (2020) found the average respiratory frequency before being given a pronation position was 67 x/minute, and the average breath frequency after being given treatment was 58.5 x/minute with a p-value < 0.05. Giving treatment makes the baby's breathing frequency more stable, which affects better blood circulation to become calmer. Oktariani's study (2020) found that the average respiratory frequency in premature infants before being given a pronation position was 76.97 x/minute. After being given a pronation position, the average breathing frequency in premature infants was 69.5 x/minute, with a p-value < 0.05. Torabian research et al. (2019) also found the same thing. Before being given a pronation position, the average respiratory frequency in premature babies was 44.18 x/minute, and the average breathing frequency in premature babies after being given a pronation position was 36.09 x/minute. In addition, giving a pronation position to the baby's breathing frequency, the prone position can also reduce the baby's breathing frequency. However, in this study, it was observed that the mean respiratory rate of infants was significantly lower in the pronation position than in the supine position. The respiratory examination is one indicator to determine the function of the respiratory system, which consists of maintaining the exchange of oxygen and carbon dioxide in the lungs and regulating acid-base balance. The purpose of the respiratory examination is to determine the frequency, rhythm, and depth of breathing and assess respiratory function ability (Sarli, 2017).

Initial respiratory assessment in newborns by observing adequate chest movement, the frequency, and depth of breathing increases after getting tactile stimulation within a few seconds. The respiratory rate is done by observing for one full minute. For stable infants, respiratory rate is measured by performing periodic counts every 3-4 hours. If unstable, count the respiratory rate every hour. Normal respiratory rate in neonates 40-60 x/minute, 1 month – 1 year 30-60 x/minute, 1-2 years 25-50 x/minute, 3-4 years, 3-4 years 20-30 x/ minutes, 5-9 years and over 10 years 15-30 x/minute (Sirait, 2020). Based on the results of a review of the articles that have been carried out, several articles have found that the pronation position has many benefits; by placing the baby in a pronation position, gravity can pull the tongue anteriorly so that the airway is better. Thus air can enter the lungs, alveoli, and all tissues body.

CONCLUSION

The study results of 30 articles found that the average oxygen saturation before and after being given a pronation position was in the range of 90.27% - 98.1%. The average pulse frequency before and after being given a pronation position was in the range of 144.87 x/minute - 140.9 x/minute. The average respiratory frequency before and after being given a pronation position was in the range of 69.50 x/minute – 44.18 x/minute. All articles have the effect of pronation position on oxygen saturation in infants (LBW). There is

DOI: 10.47522/jmk.v1iIAHSC.112
ISSN: 2580-3379 (print); 2716-0874 (online)

an effect of pronation position on oxygen saturation, pulse rate, and respiratory with p value <0,05.

ACKNOWLEDGEMENT

The authors are thankful to STIKes Alifah Padang, Indonesia, for supporting a scholarship to the author to carry out this research work and management of Lincoln University College for research support.

REFERENCE

Anggraeni, L. D., Indiyah, E. S. and Daryati, S. (2019) 'Pengaruh Posisi Pronasi Pada Bayi Prematur Terhadap Perubahan Hemodinamik', *Journal of Holistic Nursing Science*, 6(2), pp. 52–57.

Apriliawati, A. (2016) 'The Effect Of Prone Position To Oxygen Aturations'level And Respiratory Rate Among Infants Who Being Installed Mechanical Ventilation In Nicu Koja Hospital,' in *The 2nd International Multidisciplinary Conference 2016 November 15th*, pp. 541–546.

Cristina, M. and Mattos, V. De (2019) 'Autonomic responses of premature newborns to body position and environmental noise in the neonatal intensive care unit,' *Rev Bras Ter Intensiva*, 31(1), pp. 296–302. DOI: 10.5935/0103-507X.20190054.

Dyah, D. A., Rustina, Y. and Waluyanti, F. (2017) 'Sleep Positioning By Levine's Conservation Theory Approach Can Optimize Enteral Nutrition In Low Birth Weight Infants,' *Jurnal Ilmu Kesehatan UMC*, pp. 33–34.

Efendi, D. (2019). Pemberian Posisi (Positioning) dan Nesting pada Bayi Prematur: Evaluasi Implementasi Perawatan di Neonatal Intensive Care Unit (NICU). Jurnal Keperawatan Indonesia, 22(3),169–181. https://doi.org/10.7454/jki.v22i3.619

Kattwinkel. (2016). Neonatal Resuscitation: American Heart Association Guidelines for Cardiopulmonary Resuscitation and Cardiovascular Care. *Official Journal of The American Academy of Pediatrics*, 126(5),1400-1413. https://doi.org/10.1542/peds.2010-2972E

Lestari, P. (2018). Quarter Turn From Prone Position Increases Oxygen Saturation in Premature Babies With Respiratory Distress Syndrome. *Jurnal Keperawatan Soedirman*, 13(1).38-44. http://download.garuda.ristekdikti.go.id/article.php?article

Lucchini, A. *et al.* (2018) 'Intensive & Critical Care Nursing Application of prone position in hypoxemic patients supported by venovenous ECMO q's, *Intensive & Critical Care Nursing*. Elsevier Ltd. doi: 10.1016/j.iccn.2018.04.002.

Mirshahi et al. (2021). The Effect of Position on Oxygen Saturation and Heart Rate in Very Low Birth Weight Neonates. *Caspian Journal of Pediatrics*, 2(2),153-157. https://doi.org/10.22088/acadpub.BUMS.2.2.153

Mukhlis, H. and Marini, M. (2020) 'Pengaruh terapi murottal terhadap denyut nadi dan pernafasan pada bayi dengan berat badan lahir rendah', *Indonesia Berdaya*, 1(1), pp. 29–37.

Noor, M, dkk. (2016). Penggunaan Nesting dengan Fiksasi Mampu Menjaga Stabilitas Saturasi Oksigen, Frekuensi Pernafasan, Nadi dan Suhu Pada Bayi Prematur dengan Gawat Napas: Studi Kasus. *Jurnal Ners Indonesia*, 6(1),65-76. http://download.garuda.ristekdikti.go.id/article.php?article

Oktariani, L., Sari, R. S. and Sari, F. R. (2020) 'Pengaruh Posisi Pronasi Pada Bayi Prematur Yang Terpasang Cpap Terhadap Status Hemodinamik Di Ruang Nicu Rs An-Nisa Tangerang'.

Sarli, D. (2017) *Buku Ajar Asuhan Kebidanan pada Masa Persalinan*. cetakan 1. Edited by Rio Firmansyah. Padang: Sinar Ultima Indah.

Sarli, D. *et al.* (2021) 'Developing Birth Preparedness and Complication Readiness (BPCR) Screening Based on Android Applications,' 11(1), pp. 92–98.

Sirait, R, H. (2020). *Pemantauan Hemodinamik Pasien*. Jakarta: FKUI

Torabian et al. (2019). Comparison of the Effects of Supine and Prone Positions on Oxygen Saturation and Vital Signs in Premature Infants: a Crossover Clinical Trial. *Iranian Journal of Neonatology*, 10(2),30-36.https://doi.org/10.22038/ijn.2019.32928.1465

T, H. S. *et al.* (2006) 'Effects of postural change on oxygen saturation and respiration in patients after the Fontan operation : Platypnea and orthodeoxia,' *International Journal of Cardiology*, 106, pp. 211–217. DOI: 10.1016/j.ijcard.2005.01.044.