

Effects of Kangaroo Mother Care on Physiological Parameters of Low-Birth-Weight Neonates

AMNA MATEEN¹, NAGHAM NAWAZ AWAN², SYEDA SHIREEN GUL³, BUSHRA ADEEL⁴, SANA RAZZAK⁵, SAIRA MUSHTAQ⁶

^{1,2,4,5}MBBS, FCPS (Pediatrics), Fellow Neonatology, Children Hospital PIMS, Islamabad

³MBBS, FCPS (Neonatology), FCPS (Pediatrics), MCPS, DCH, Assistant Professor Neonatology, Children Hospital PIMS, Islamabad

⁶MBBS, FCPS (Pediatrics), Medical Officer, Children Hospital PIMS, Islamabad

Correspondence to: Amna Mateen, Email: dramnamateen@yahoo.com, Cell: +92 349 5290104

ABSTRACT

Background: Maternal skin contact has impact on physiological parameters in newborns, some studies showed positive effects but as we live in under developing country and the data on impact of kangaroo mother care (KMC) on physiological parameters is very limited. We hypothesized that KMC is effective in stabilizing the heart rate, respiratory rate and maintaining the oxygen saturation and body temperature of low birth weight (LBW) newborns.

Objective: The aim of the study was to determine effects of 3 hours KMC on physiological parameters such as body temperature, heart rate, respiratory rate and oxygen saturation in LBW neonates.

Study Design: Observational Quasi-experimental study

Study Setting: This study was conducted in Department of Neonatology, Children Hospital, PIMS, Islamabad, Pakistan from 1st June 2022 to 1st December 2022.

Methodology: The neonates were hemodynamically stable admitted in NICU and Nursery of Children Hospital, PIMS with LBW with the bodyweight <2 kg was enrolled in the study after taking the consents from mother or other female attendant. Data were collected by structured questionnaire and observational checklist after taking consent from each participant. After inclusion neonates was received KMC for 03 hours. Participants physiological parameters were monitored closely before and after KMC. The statistical analysis was done by using SPSS version 20.

Results: Out of the 60 mother-child couples enrolled in the study. There was high frequency of neonates between 1-1.5 kgs with 36.7%. Out of 60, 33 were baby boys and 27 were baby girls. After three hours of KMC, temperatures showed significant increase ($p < 0.001$). Most infants' temperatures were maintained during KMC, and no cases of hypothermia were reported. Also, statistically significant increases in heart rate were seen throughout KMC ($p < 0.001$), with mean increases of exhibited bradycardia before starting KMC, but at the end of the session, all of their heart rates were normal (100-170 beats per minute) and stable.

Practical implications Though KMC has been proven to be an efficient and feasible approach of caring for LBW infants in a hospital setting, there is a lack of evidence on its outcomes in Pakistan. In light of this, we set out to examine the impact of 3 hours of KMC on vital signs in LBW infants, namely their core temperature, heart rate, respiratory rate, and oxygen saturation. The ultimate goal is to collect enough evidence to advocate for the strategy's widespread adoption.

Conclusion: Better quality and more humanized care for preterm and low birth weight babies and their mothers may be achieved by encouraging the use of the Kangaroo Mother Care approach in neonatal intensive care units in Pakistan.

Keyword: KMC, temperature, oxygen saturation, respiratory rate, heart rate. Low birth weight

INTRODUCTION

World Health Organization (WHO) defined low birth weight (LBW) as a condition in which body weight of an infant is less than 2500 grams. Prevalence of LBW in developing countries is 96.5%.¹ LBW is a major factor that contributes in mortality of newborns.² In 2019, UNICEF and WHO published a report according to which about 20.5 million births suffered from LBW globally.³ Low birth weight is a major death factor specially in early life period and LBW newborns in Under developed countries are at higher risk of death.⁴ Out of four births one baby is of low birth weight in Pakistan.⁵ A study was conducted in Azad Jammu and Kashmir in 2017, which concluded that underweight female was more common than male babies and LBW is an important factor for mortality and morbidity.⁶ Globally, despite area or climate, newborns having low birth weight presents with low body temperature and that hypothermia leads to serious complications and even death.⁷ Approximately 74% infants faces hypothermia after birth and in LBW neonates it is associated with several morbidities and high mortality rate.⁸

The care of such babies is crucial and also a burden on the health care system. Common method of care used in hospitals is incubator method that is not available in all care systems while there is another method called as Kangaroo Mother Care (KMC). In KMC infants are placed with direct skin to skin contact with mother chest and abdominal area in upright direction making frog like position in which infants' arms and hips are flexed while head is slightly extended and turned to one side. Infants' abdomen should have enough space for breathing. In this position mothers breathing will stimulates the baby.⁹ A research conducted in Myo Hospital Lahore showed that there is significant statistical

improvement in physiological parameters in low birthweight neonates after KMC.¹⁰ KMC has shown beneficial effects in term of weight gain of LBW infants and also shortened the stay of babies in NICU.¹¹ According to a study conducted in 2017, Mortality rate of neonates having LBW reduces after getting KMC.¹² A study conducted in PIMS Islamabad showed that KMC is effective therapy for weight gain in low birthweight neonates.¹³ Recently, a research has showed that KMC is significantly better for weight gain than other care options and it reduces the duration of stay in the hospital so, it should be included in routine care for all the neonates having low body weight.¹⁴ KMC is a cost-effective method to decrease neonatal mortality rate. With minimum incentives it will eliminate time strain, financial burden of patient by reducing their hospital stay duration and patients burden on hospital so in Pakistan KMC interventions should be tested in hospitals.¹⁵

Maternal skin contact has impact on physiological parameters in newborns, some studies showed positive effects but as we live in under developing country and the data on impact of KMC on physiological parameters is very limited. So, the objective of the study is to determine the effects of Kangaroo Mother Care on physiological parameters like body temperature, heart rate, respiratory rate and oxygen saturation of newborns having LBW. We hypothesized that KMC is effective in stabilizing the heart rate, respiratory rate and maintaining the oxygen saturation and body temperature of LBW newborns. The aim of the study was to determine the effects of 3 hours KMC on physiological parameters such as body temperature, heart rate, respiratory rate, and oxygen saturation in LBW neonates.

MATERIAL AND METHODS

Study Setting and Design: This was an observational Quasi-experimental study conducted in the Department of Neonatology, Children Hospital, PIMS, Islamabad, Pakistan from 1st June 2022 to 1st December 2022.

Sample Size: By using WHO calculator sample size of 60 samples were taken for study with level of significance 5%.

Inclusion and Exclusion Criteria: The neonates were hemodynamically stable admitted in NICU and Nursery of Children Hospital, PIMS with LBW with the bodyweight <2 kg was enrolled in the study after taking the consents from mother or other female attendant. However, the hemodynamically unstable neonates, neonates on any type of respiratory support (oxygen, CPAP, Ventilator etc.), neonates with pre- or post-surgery, neonates with gross congenital anomalies and neonates whose parents did not give consent were not included in the study.

Data Collection Procedure: Data were collected by structured questionnaire and observational checklist after taking consent from each participant. After inclusion neonates was received KMC for 03 hours. Participants physiological parameters were monitored closely before and after KMC. Immediately before and after KMC for 3 hours, the baby's temperature, respiration rate, heart rate, and oxygen saturation were all measured. The digital thermometer was used to take the temperature of the axilla in degrees Celsius. One minute of monitoring chest motion was used to calculate the respiration rate. A pulse-oximeter was used to measure the subject's heart rate and oxygen saturation.

Statistical Analysis: Data was analyzed by using descriptive and inferential statistics through SPSS version 20. Demographic data was also analyzed in terms of frequency and percentage. Physiological parameters analyzed in terms of mean and standard deviation. The Independent t-test was used as a test of significance. P-value <0.05 kept as significant. Data were interpreted in terms of tables and graphs.

RESULTS

Out of the 60 mother-child couples enrolled in the study. There was high frequency of neonates between 1-1.5 kgs with 36.7%. Out of 60, 33 were baby boys and 27 were baby girls as shown in Table I. Table II summarizes the physiological variables during the course of the three hours. There were no infant fatalities. On all three hours of KMC, temperatures increased, and the increase was statistically significant. Some infants experienced minor hypothermia as the KMC session began. Most infants' temperatures were maintained during KMC, and no cases of hypothermia were reported. The minimum and maximum range of temperature before and after KMC was 35.2-37.8 and 36.10-37.4, heart rate 95-170 and 110-160, and oxygen saturation were statistically significantly improved from 70 to 90 respectively. However, the respiratory rate was also improved but not statistically significant.

Table 1: Demographic Details of Neonates.

Groups	Frequency	Valid Percent
Birth Weight in Kgs		
<1	18	30.0
1-1.5	22	36.7
1.6-2	20	33.3
Gender		
Male	30	50.0
Female	30	50.0
Age in days		
1-7	11	18.3
8-14	11	18.3
15-21	16	26.7
22-28	21	35.0

During the study no infant displayed symptoms of respiratory distress. Babies' breathing was rhythmic, and they often fell asleep during KMC sessions. No cases of apnea were seen during KMC.

Figure 1-4 shows that KMC also reduced the temperature potentially in male, heart rate and respiratory rate in female. And no difference was found in oxygen saturation based on gender differences. Increases in heart rate were seen throughout KMC, with mean increases of exhibited bradycardia (heart rates of less than 100 beats per minute) before starting KMC, but at the end of the session, all of their heart rates were normal (100-170 beats per minute) and stable. There was no statistically significant decrease of the mean oxygen saturation between baby girl and boy. But there was an overall difference of before and after KMC, oxygen saturation levels below 90% at the beginning of the KMC session, but all of them improved at the end of the three hours. Within 15 minutes of beginning KMC, infants on oxygen had a markedly decreased need for oxygen.

Table 2: Comparison of before and after KMC

Physiological Parameters	Mean	Std. Deviation	P Value	
Temperature (Celsius)	Before	35.9	0.6	<0.001
	After	37.0	0.3	
Respiratory Rate (per minute)	Before	35.1	12.2	0.17
	After	51.9	9.4	
Heart Rate (per minutes)	Before	135.7	25.2	<0.001
	After	142.8	16.8	
Oxygen Saturation (%)	Before	87.1	8.5	<0.001
	After	95.4	3.2	

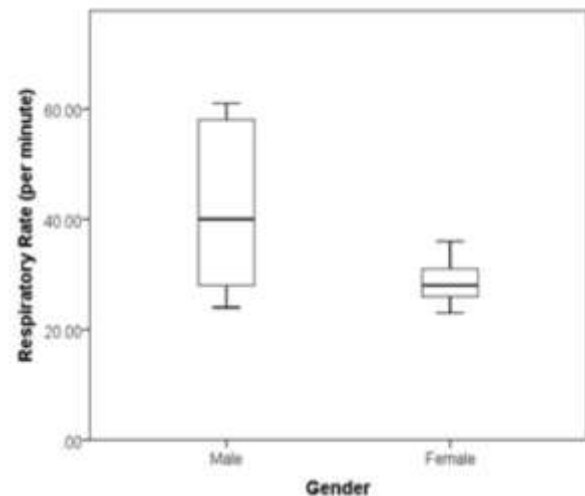


Figure 1: Gender Based Comparison of Temperature.

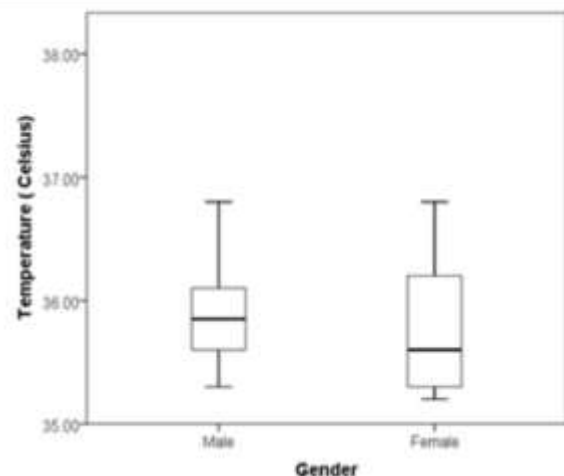


Figure 2: Gender Based Comparison of Heart Rate

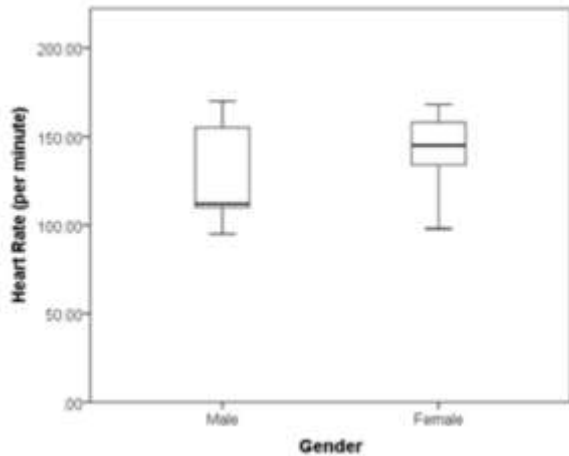


Figure 3: Gender Based Comparison of Respiratory Rate

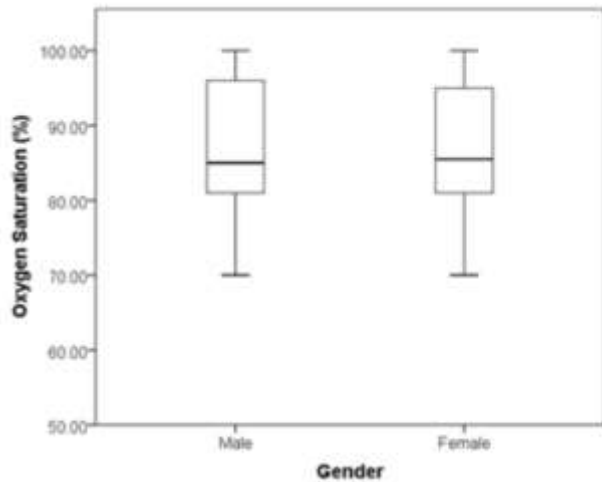


Figure 4: Gender Based Comparison of Oxygen Saturation

DISCUSSION

KMC is a straightforward and inexpensive treatment for LBW newborns. It's beneficial for moms and babies, and it doesn't require any unique setup (like heated bassinets or incubators) to be put into practice.¹⁶ The natural concept has now spread around the globe as educators, parents, and policymakers learn more about the many physiological, psychological, and financial benefits it offers.² The findings of our study based on the effects of 3 hours KMC on physiological parameters such as body temperature, heart rate, respiratory rate, and oxygen saturation in LBW neonates. KMC treatments raise core body temperature gradually, which should help insulate the infant from temperature swings and cold stress. According to a study conducted by Jothi Priya J, the average axillary temperature and heart rate were both greater in the KMC group compared to the control group. One of the most cost-effective strategies to safeguard infants throughout the vulnerable newborn period, KMC accomplishes its primary aim of "keeping baby warm."¹⁷ Kangaroo care has been shown to improve physiological stability, as documented by Ludington-Hoe et al. They found that throughout KMC, subjects' heart rates were steady (mean 143.9), their respiration rates varied from 20 to 72, and they did not have any apnea episodes. Babies' temperatures stayed at a steady 37.1 degrees Celsius after being placed in the KMC posture, never dipping below 36.8 degrees Celsius. During the KMC sessions, oxygen saturation levels rose noticeably. This is significant for premature or ill infants, especially those who need

supplemental oxygen. Babies on mechanical ventilation who are able to tolerate transfers and changes in posture have shown decreases in apnea and increases in oxygen saturation in previous trials.^{18, 19} There was an increase in core body temperature of 0.22°C, but not in heart rate and oxygen saturation of 0.60% during skin-to-skin contact, according to a meta-analysis of many studies involving both full-term and preterm infants with the gestational age twenty six to thirty six week. A comparable increase in body temperature, a little but statistically significant increase in heart rate, and an undisputable enhancement in oxygen saturation were discovered in our investigation. Similar research were found on all 3 days, with as little as 1 hour of kangaroo care on the first day, making it unlikely that they were attributable to chance alone.²⁰ Mother-infant skin-to-skin contact during the first few months of life, along with frequent suckling for both nutrition and comfort, may also trigger cognitive reactions that set the stage for lifelong behavioral and physiological programming. Additionally, during KMC, the infant is exposed to the mother's heart sounds, rhythmic breathing, warmth, and prone positioning, which provide mild stimulation to the baby's auditory, tactile, vestibular, and thermal sensory systems and may have a calming effect, allowing physiological parameters to stabilize.^{9, 20, 21}

Several women, despite their motivation, were unable to appropriately deliver KMC despite repeated demonstrations. This focuses on the significance of moms and nursing staff persevering in their pursuit of correct KMC practice. The research was carried out in a postnatal ward and NICU environment, both of which had highly motivated and well supervised medical staff. In a general ward it was feasible to provide the same level of careful supervision. As a result, the enhanced physiological metrics and their associated therapeutic benefits was observed after KMC.^{13, 15} This skin to skin contact suggests that newborns should be left in the posture for at least an hour to enable them to relax and settle into a deep slumber, which is crucial for their recovery and brain development. Applying the kangaroo position to premature infants for only one hour resulted in positive physiological changes, according to research by Boju et al.²² Maintaining the kangaroo position for as long as feasible (at least one or two hours) is recommended by Thukral et al., taking into account the infant's tolerance.²³ In a study of 22 preemies and babies with low birth weight, Almeida et al. found that the infants' respiratory rates decreased after thirty minutes in a cot and thirty minutes in the kangaroo position for 3 days in a row.²⁴ Van Zanten et al., who monitored thirty four preterm infants on ventilator support before, during, and after use of KMC, found the same results. The kangaroo and prone positions increase the volume available for ventilation and enhance respiratory performance.²⁵ This is because the ribs are more stable in these positions, allowing for better synchronization between the diaphragm and stomach muscles. In this study there was gender-based difference found in physiological parameters. Boy showed wide range heart and respiratory rate as compared to the baby girls and vice versa in temperature. However, there is no difference found in oxygen saturation. Results from this study, in which the average respiratory rate of the newborns dropped from 46 to 42 breaths per minute, were corroborated by a meta-analysis of 29 randomized controlled trials involving the kangaroo position conducted by Moore et al.²⁶ They also noted a steady level of 95% or so for the peripheral oxygen saturation. Olmedo et al. found similar outcomes when they compared peripheral oxygen saturation levels in premature neonates (10 in each of the kangaroo position and prone position groups) over the course of three days of treatment.²⁷ On the other hand, Milstersteiner et al. describe an improvement in this variable after applying the kangaroo position to a group of 23 preterm infants; they detected an increase in peripheral oxygen saturation after applying the posture.²⁸ The results showed that the kangaroo posture reduced the risk of hypothermia by 90% compared to standard treatment.

The limitation of the study is the small sample size, but the results in a small but statistically significant, this may reduce the

likelihood of problems and the necessity for invasive procedures. The KMC should be the default treatment for LBW infants at our facility. However, sufficient resources are required to encourage and teach mothers to do KMC and to ensure that their efforts are being monitored to ensure success. The health and well-being of preterm infants and their families depends on the widespread adoption of the kangaroo mother care practice. This research set out to evaluate the physiological benefits of the kangaroo position on infants in critical care. KMC also maintained peripheral oxygen saturation, axillary temperature, and heart rate stability, suggesting that it has the potential to keep preterm and low birth weight infants clinically stable.

CONCLUSION

The purpose of this research was to increase awareness of the kangaroo position and its advantages in the selected neonatal intensive care unit, with the hope that its usage would be maintained. Breastfeeding and skin-to-skin contact, which were promoted as a consequence of these findings, are thought to be beneficial to the health of mothers and dads and their babies and ultimately form the basis of a crucial part of the emotional relationship: the mother-baby connection. In this research all physiological parameters were significantly improved after 3 hours of KMC except respiratory rate. The large sample size will more clear the theory. Better quality and more humanized care for preterm and low birth weight babies and their mothers may be achieved by encouraging the use of the Kangaroo Mother Care approach in neonatal intensive care unit in Pakistan.

REFERENCES

1. Organization WH. Guidelines on optimal feeding of low birth-weight infants in low-and middle-income countries: World Health Organization; 2011.
2. Vilanova CS, Hirakata VN, de Souza Buriol VC, Nunes M, Goldani MZ, da Silva CH. The relationship between the different low birth weight strata of newborns with infant mortality and the influence of the main health determinants in the extreme south of Brazil. *Population health metrics*. 2019;17(1):1-12.
3. Organization WH. UNICEF-WHO low birthweight estimates: levels and trends 2000-2015. World Health Organization; 2019.
4. Eshete A, Alemu A, Zerfu TA. Magnitude and risk of dying among low birth weight neonates in Rural Ethiopia: a community-based cross-sectional study. *International journal of pediatrics*. 2019;2019.
5. Abbas F, Kumar R, Mahmood T, Somrongthong R. Impact of children born with low birth weight on stunting and wasting in Sindh province of Pakistan: a propensity score matching approach. *Scientific Reports*. 2021;11(1):19932.
6. Iltaf G, Shahid B, Khan MI. Incidence and associated risk factors of low birth weight babies born in Shaikh Khalifa Bin Zayad Al-Nayan Hospital Muzaffarabad, Azad Jammu and Kashmir. *Pakistan journal of medical sciences*. 2017;33(3):626.
7. McCall EM, Alderdice F, Halliday HL, Vohra S, Johnston L. Interventions to prevent hypothermia at birth in preterm and/or low birth weight infants. *Cochrane Database of Systematic Reviews*. 2018(2).
8. Lee NH, Nam SK, Lee J, Jun YH. Clinical impact of admission hypothermia in very low birth weight infants: results from Korean neonatal network. *Korean Journal of Pediatrics*. 2019;62(10):386.
9. Parsa P, Karimi S, Basiri B, Roshanaei G. The effect of kangaroo mother care on physiological parameters of premature infants in Hamadan City, Iran. *The Pan African Medical Journal*. 2018;30.
10. Shabir S, Hamid MH, Chishti AL. Effect of Daily Intermittent Kangaroo Mother Care on Vital Physiological Parameters of Low Birth Weight Newborns. *Annals of King Edward Medical University*. 2021;27(Special Issue (Jul-Sep)):417-22.
11. Rehman MOU, Hayat S, Gul R, Waheed KAI, Victor G, Khan MQ. Impact of intermittent kangaroo mother care on weight gain of neonate in nicu: Randomized control trial. *J Pak Med Assoc*. 2020;70(6):973-7.
12. Choudhary TS, Mazumder S, Haaland ØA, Taneja S, Bahl R, Martines J, et al. Health equity impact of community-initiated kangaroo mother care: a randomized controlled trial. *International Journal for Equity in Health*. 2021;20(1):1-8.
13. Ahmad N, Gul SS, Khan MH, Hashmi F, Batool A, Fatima A. Outcome of Kangaroo Mother Care in Preterm, Low Birth Weight Neonates; A Randomized Control Trial. *Annals of PIMS-Shaheed Zulfiqar Ali Bhutto Medical University*. 2022;18(3):196-200.
14. Siddiqui MA, Butt TK, Farooq MA, Omer MT, Zahoor F, Hussain KK. Difference in mean weight gain and hospital stay in preterm babies receiving complete or partial kangaroo mother care compared to no kangaroo mother care: Experience from a tertiary care hospital. *Journal of Fatima Jinnah Medical University*. 2020;14(4):152-5.
15. Tahir HN, Fatmi Z. Kangaroo mother care: opportunities and implications for rural Pakistan. *JPMA The Journal of the Pakistan Medical Association*. 2019;69(11):1725.
16. Suman Rao P, Udani R, Nanavati R. Kangaroo mother care for low birth weight infants: a randomized controlled trial. *Indian pediatrics*. 2008;45(1):17.
17. Singh A, Yadav A, Singh A. Utilization of postnatal care for newborns and its association with neonatal mortality in India: an analytical appraisal. *BMC pregnancy and childbirth*. 2012;12:1-6.
18. Ludington-Hoe SM, Cranston Anderson G, Simpson S, Hollingsead A, Argote LA, Rey H. Birth-related fatigue in 34–36-week preterm neonates: Rapid recovery with very early kangaroo (skin-to-skin) care. *Journal of Obstetric, Gynecologic, & Neonatal Nursing*. 1999;28(1):94-103.
19. Hunt F. The importance of kangaroo care on infant oxygen saturation levels and bonding. *Journal of Neonatal Nursing*. 2008;14(2):47-51.
20. Mori R, Khanna R, Pledge D, Nakayama T. Meta-analysis of physiological effects of skin-to-skin contact for newborns and mothers. *Pediatrics International*. 2010;52(2):161-70.
21. Jefferies AL, Society CP, Fetus, Committee N. Kangaroo care for the preterm infant and family. *Paediatrics & child health*. 2012;17(3):141-3.
22. Bruno F, Piva JP, Garcia P, Einloft P, Fiori R, Barreto SM. Short-term effects of prone positioning on the oxygenation of pediatric patients submitted to mechanical ventilation. *J Pediatr (Rio J)*. 2001;77(5):361-8.
23. Thukral A, Chawla D, Agarwal R, Deorari AK, Paul VK. Kangaroo mother care-an alternative to conventional care. *The Indian Journal of Pediatrics*. 2008;75:497-503.
24. Almeida C, Almeida A, Forti E. Effects of kangaroo mother care on the vital signs of low-weight preterm newborns. *Brazilian journal of physical therapy*. 2007;11:1-5.
25. van Zanten HA, Havenaar AJ, Stigt HJ, Ligthart PA, Walther FJ. The kangaroo method is safe for premature infants under 30 weeks of gestation during ventilatory support. *Journal of Neonatal Nursing*. 2007;13(5):186-90.
26. Maria A, Shukla A, Wadhwa R, Kaur B, Sarkar B, Kaur M. Achieving early mother-baby skin-to-skin contact in caesarean section: A quality improvement initiative. *Indian Pediatrics*. 2018;55:765-7.
27. Olmedo MD, Gabas GdS, Merrey LSF, Souza LSd, Muller KdTC, Santos MLdMd, et al. Physical responses of pre-term newborn babies submitted to the Kangaroo-Mother Care Method in Prone position. *Fisioterapia e Pesquisa*. 2012;19:115-21.
28. Boju SL, Gopi Krishna M, Uppala R, Chodavarapu P, Chodavarapu R. Short spell kangaroo mother care and its differential physiological influence in subgroups of preterm babies. *Journal of tropical pediatrics*. 2012;58(3):189-93.