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Effects of the prone position and kangaroo care on gastric residual volume, vital signs and comfort in preterm infants

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Abstract

Aim: Prone and kangaroo care positioning of preterm infants during intragastric tube feeding were compared with regard to post prandial gastric residual volume, vital signs and infant comfort.

Methods: The study sample included 30 28-36-birth-week old preterm infants who were hospitalized at the neonatal intensive care unit. Infants were fed in two positions: prone and kangaroo care. All the infants were placed in the prone position after feeding. Vital signs and comfort scores were recorded 30 min after feeding, and the gastric residual volume was measured 3 h after feeding.

Results: After 3 h of feeding, the heart rate was lower in the kangaroo care position than in the prone position. After 30 min and 3 h of feeding, the mean comfort scores and the mean distress scores were lower in the kangaroo care position than in the prone position. It was also determined that there was no significant difference between the kangaroo care position and prone position regarding their effects on the residual volume measured 3 h after feeding.

Conclusions: The infants fed in the kangaroo care position have a lower heart rate, better comfort levels and less distress after feeding. These positive effects ensure that preterm infants experience less stress and consume less energy. What is currently known? It has been determined that kangaroo care reduces the pain response and heart rate of the newborn, increases the duration of sleep, reduces the length of stay in the hospital, facilitates breastfeeding, reduces the risk of hypothermia, decreases the mother's anxiety level by initiating the relationship between the mother and infant, and improves the infant's growth and development. What does this article add? While there were no differences between prone and kangaroo positions during feeding with regard to gastric residual volumes, we found that the heart rate, comfort scores and distress scores were lower in the kangaroo care position than in the prone position.

KEYWORDS
comfort score, kangaroo care, prone position, residual volume, vital signs

1 | INTRODUCTION

The fetus is expected to be born between the 38th and 42nd weeks of fetal life in normal development. However, infants called preterm babies are born before the 37th week of the postmenstrual age (PMA) (Görak, 2008). These preterm infants' exposure to stressors in the neonatal intensive care unit causes regional changes in brain structure and function (Smith *et al.,* 2011).

What is important in the process of growth and development of a preterm infant is to survive the process in a comfortable way. In the comfort theory developed by Kolcaba, comfort is defined as "an expected complex outcome providing help and comfort (tranquility) regarding individual needs, and overcoming problems within a physical, psychospiritual, psychological, social and environmental integrity" (Kolcaba, 2001). Many factors such as the type of enteral feeding (orogastric or nasogastric), the size of the tube, the amount and temperature of the milk to be given, and the patient's position are important for the safety of feeding and the comfort of the infant (Premji, 2005).

Nutrition is of great importance for preterm infants when they receive intensive care (Premji, 2005). Enteral feeding soon after birth is essential and milk is the only food which has regulatory influence on the development of the gastrointestinal system. Enteral nutrition stimulates secretion of many gastrointestinal hormones and bile flow, improves gastrointestinal blood flow and reduces risk of nosocomial infection (Premji, 2005). Due to prematurity and the various health problems accompanying it, it may be necessary to feed the preterm infant through an orogastric tube for a certain period of time. Feeding intolerance, a common problem for preterm infants, is characterized by signs of delayed gastric emptying such as large gastric aspirates, abdominal distension, and vomiting (Perrella, Hepworth, Simmer, & Geddes, 2013). Various studies have been carried out on the effect of positioning of the infant on the residual volume in preterm infants, but the results vary from one study to another. There are different studies indicating that the prone position or the supine position or left lateral position reduces gastric residual volume (Chen, Tzeng, Gau, Kuo, & Chen, 2013; Cohen, Mandel, Mimouni, Solovkin, & Dollberg, 2004; Hwang, Ju, Kim, Lee, & Kim, 2003; Jebreili, Syeedrasooli, Headarzadeh, & Morteza, 2011; Sangers *et al.,* 2013; Yu, 1995). For preterm infants, the best lying position is the prone position. The American Academy of Pediatrics recommends that preterm infants should be laid in the prone position as long as they stay in intensive care units (AAP, 2000), in part because of well documented physiologic effects on ill newborns, especially those with lung disease (Kemp, 2007).

In addition to therapeutic positions, kangaroo care (KC) is another practice that improves the comfort of the newborn and affects its feeding (Tharashree, Shravani, & Srinivasa, 2018). In a study investigating the effect of KC on the feeding of low birth weight preterm newborns, weight gain was higher in those who received KC than in those who did not (Yıldırım, 2009). In the literature, although a considerable number of studies have been conducted on mortality, nutrition, infection, heart rate, respiration and oxygenation, body temperature, hypoglycemia and cortisol levels, length of hospitalization, growth and pain (Beiranvand, Valizadeh, Hossseinabadi, & Yadollah, 2014; Boundy *et al.,* 2016; Gray, Miller, Philipp, & Blass, 2002; Gray, Watt, & Blass, 2000; Ludington-Hoe, 2015; Ludington-Hoe *et al.,* 2006; Moore *et al.,* 2013), rather less attention has been paid to the effect of KC on gastric residual. In a study in which the KC and supine positions were compared, the gastric residual volume was lower in those fed in KC than in those fed in supine position (Valizadeh, Hosseini, Jafarabadi, & Mohebbi, 2015). Gastric residual volumes are frequently measured to guide the advancement of enteral feeding; however; there is no clear evidence to justify their usefulness in either improving feeding intolerance or preventing necrotizing enterocolitis (Linthavong *et al.,* 2018). Although there are no studies on the effect of gastric residual volume on comfort, increased gastric residual volume induced abdominal distension is predicted to adversely affect comfort.

2 | AIM

The purpose of this study is to determine the effects of the KC and prone positions in preterm infants during feeding on the residual volume, vital signs and comfort.

2.1 | Hypotheses

H1. There is a difference between the vital signs of preterm infants fed in KC and prone positions.

H2. There is a difference between the comfort scores of preterm infants fed in KC and prone positions.

H3. There is a difference between the amount of residuals of preterm infants fed in KC and prone positions.

3 | METHODS

Study design: This study is a quasi-experimental study in which two different methods are successively implemented in a single group.

Process: All infants who met the inclusion criteria and who were admitted to the nursery during the study were included in the study. All the interventions were performed on these infants. After the mothers of the participating infants were informed about the study, their written informed consent was obtained. The appropriate day was planned and the mother was informed about KC. The Personal Information Form for Preterm İnfants was obtained from the patient file.

First Day: KC was performed at 1:00 p.m. on Tuesdays or Thursdays. Before the process, the preterm infant's mother's breast milk to which eoprotein was added (one dose drug a cup of eoprotein to 25 mL breast milk) was heated (37 C) in a standard formula heater. Feed volumes were the same for each infant. After the placement of the orogastric tube was checked, KC was started. Once the mother was seated, diaper-clad infants were carefully placed onto their mothers' bare chest, to ensure an open airway and facilitate direct mother-infant eye contact. A soft blanket was gently wrapped around the infant and mother for warmth. KC and feeding were started simultaneously. The infant was fed with perfusion for 30 min during KC. At the end of the 30th minute, vital signs and comfort were assessed. Immediately after the assessments, KC was terminated, and then the infant was placed in the prone position while the incubator was in the upright position. Vital signs, comfort and the residual volume were assessed at 4.00 p.m.

Second Day: On the second day at 1:00 p.m. (within 48 h, Wednesday or Friday), the orogastric tube was positioned. The newborn was placed in the prone position while the incubator was in the upright position. The infant was fed with perfusion for 30 min in the prone position. At the end of the 30th minute, vital signs and comfort were assessed. The infant was kept in the prone position. Vital signs, comfort and the residual volume were assessed at 4.00 p.m.

In our study, six French catheters were used for orogastric feeding. In our study, preterm infants were fed with intermittent feeding methods every 3 h; the duration of feeding was 30 min via a pump.

Measurements: First, oxygen saturation, followed by respiration rate, comfort evaluation, heart rate, body temperature and finally residual amount were measured. The pulse oximetry probe is attached to the right foot when looking at the vital signs. Body temperature was measured by axillary digital thermometer. The number of breaths was counted for 1 min, heart rate was counted with a stethoscope for 1 min from the apex. Gastric residual volume was controlled using a manually aspirated 5 mL syringe.

3.1 | Setting

The study was carried out at the Neonatal Intensive Care Unit of Dokuz Eylül University Hospital between January 2017 and June 2017.

3.2 | Sampling

All preterm infants staying in the neonatal intensive care unit between the aforementioned dates comprised the study population. Of the preterm infants, those who met the inclusion criteria were included in the study sample. In the study, 30 preterm infants selected in accordance with the sampling criteria underwent two successive applications. Based on the sample calculation performed with the openEpi program, 29 infants were included in the experiment and control groups.

Inclusion criteria: Of the preterm infants, those who were 28–36 PMA, weighed over 1000 g during the study, had stabile vital signs and received 75% of the total amount of protein and energy to be consumed with the orogastric tube, were fed with breast milk and eoprotein, did not take analgesics, muscle relaxants, sedative drugs or inotropic drug agents, did not have any serious neurological disease and had spontaneous respiration, were selected. KC was given by non-smoker mothers who volunteered to participate in the study.

Exclusion criteria: Of the preterm infants, those who were intubated, underwent cardiorespiratory monitoring, and had necrotizing enterocolitis, a pneumothorax, a skull fracture, atelectasis, a surgery that may affect the residual and comfort, a chest tube or a condition that would block the position of the parent or the infant were excluded from the study. Mothers who did not speak Turkish were not included.

3.3 | Data collection tools

To collect the study data, Personal Information Form for Preterm Infants (age, weight, birth mode, sex, diagnose), KC Monitoring Form, Prone Position Monitoring Form and Newborn Comfort Behavior Scale were used. The Newborn Comfort Behavior Scale is a Likert-type scale developed to assess sedation and comfort needs of newborns monitored in the intensive care unit and to assess their pain and distress levels. The Comfort Scale (CS) was developed by Ambuel, Hamlett, Markx, and Blumer (1992) to assess the distress levels of patients receiving mechanical ventilator support in the pediatric intensive care unit (Ambuel *et al.,* 1992). Van Dıjk *et al.* (2009) conducted the validity and reliability study of the COMFORTneo scale in order to measure only behaviors in neonates without physiological parameters. The Cronbach's alpha value of the scale was 0.84 before the invasive procedure and 0.88 after the invasive procedure (Van Dıjk *et al.,* 2009). The scale in which its Turkish validity and reliability was conducted by Kahraman, Başbakkal, and Yalaz (2014) consists of six parameters: alertness, calmness / agitation, respiratory response, crying, body movement, facial tension and muscle tone. The lowest and highest possible scores to be obtained from the scale were 0 and 30 respectively. Higher scores indicate that the infant is not comfortable and that he/she needs interventions to provide comfort. While a score between 4 and 6 indicates a moderate level of pain and distress, a score between 7 and 10 indicates a severe level of pain and distress. The Cronbach's alpha coefficient of the scale was 0.85 in the primary researcher's study and 0.82 in the co-researcher's study before the care, and 0.92 in the primary researcher's study and 0.85 in the co-researcher's study after the care (Kahraman *et al.,* 2014). The study data were loaded on the computer using the SPSS (Statistical Package for Social Science for Windows) 22.0.

Data Analysis: To analyze the data, numbers, percentages, arithmetic means, the *t*-test in dependent groups, and Wilcoxon test were used. *P*-values <0.05 were considered statistically significant. Power analysis revealed that the alpha value was 0.957. Data analysis was performed using the SPSS 22.0.

3.4 | Ethical approval

The ethics committee approval of the study was granted by the decision of the Board of Directors of the Non-Interventional Clinical Researches Ethics Committee of İzmir Kâtip Çelebi University (numbered 295, dated November 16, 2016).

4 | RESULTS

The mean PMA and postnatal age of the preterm infants were 30.20 ± 2.63 weeks and 33.10 ± 1.53 weeks respectively. While the highest birth weight was 3080 g, the lowest birth weight was 593 g. (Table 1).

TABLE 1 Infant characteristics ($N = 30$)

Characteristics	*n*	χ^2 ± SD (min-max)
Postmenstrual age, weeks	30	30.20 ± 2.63 (24–34)
Postnatal age, weeks	30	33.10 ± 1.53 (30–35)
Birth weight, g	30	1,455.43 ± 607.85 (593–3,080)
Characteristics	*n*	%
Mode of birth		
C-section	25	83,3
Normal spontaneous delivery	5	16,7
Sex		
Female	9	30,0
Male	21	70,0
Diagnosis of hospitalization		
Preterm	26	86,7
Preterm, SGA	4	13,3
Multiple pregnancies		
Yes	8	26,7
No	22	73,3
Total	30	100

SGA, small for gestational age

Of the infants, 83.3% ($n = 25$) were born by cesarean section, 70% ($n = 21$) were male, 86.7% were hospitalized with a diagnosis of prematurity. The rate of multiple pregnancies was 26.7%.

After 3 h of feeding, the heart rate was lower in the KC position than in the prone position. There was a significant difference between KC and prone positions in terms of the mean cardiac apex beat rates measured 3 h after feeding ($P < 0.05$) (Table 2). There was a significant difference between KC and prone positions in terms of the preterm infants' mean breathing rates measured 30 min and 3 h after feeding ($P < 0.05$), breathing rate was lower in KC than in the prone position. As for the mean oxygen saturation by pulse oximeter (SpO_2) values, there was a significant difference 30 min after feeding ($P < 0.05$) but there was no significant difference 3 h after feeding (Table 2).

After 30 min and 3 h of feeding, the mean comfort scores and the mean distress scores were lower in the KC position than in the prone position. There was a significant difference between KC and prone positions in terms of the mean comfort scores and estimated mean distress scores determined 30 min and 3 h after feeding ($P < 0.05$) (Table 3). There was no significant difference between KC and prone positions in terms of the estimated mean pain scores determined 30 min and 3 h after feeding (Table 3).

In the preterm infants, the mean residual volume measured 3 h after feeding was 0.04 ± 0.19 in KC, and 0.10 ± 0.25 mL in the prone position. There was no significant difference between the prone position and in KC in terms of the mean gastric residual volumes measured 3 h after feeding (Table 4).

5 | DISCUSSION

While heart rates in prone and KC positions at 30 min after feeding were similar, we observed a lower heart rate at 3 h after feeding in the KC position. Infants can experience stress at the next feeding hour 3 h later, but because KC application calms down the infant, the cardiac apex beat rates may have been lower in the infants in the KC group. Bastani, Rajai, Farsi, and Als (2017) found that the KC significantly enhanced the deep sleep state and quiet awake / alert state, and significantly decreased light sleep state, drowsy state, and actively awake state. Low heart rate may be associated with deep sleep. In studies, it was found that heart rate decreased in infants fed in the KC position (Gray *et al.,* 2000; Koç, 2015; Kommer *et al.,* 2017). In several studies, it has been found that the prone position also has positive effects on the oxygenation and vital signs of infants (Elder, Campbell, & Galletly, 2011; Ghorbani, Asadollahi, &

TABLE 2 Preterm infants' heart rates, respiratory rates, oxygen saturation level (SaO_2) and body temperature at 30 min and 3 h after intragastric tube feeding in the prone and kangaroo care positions

	Kangaroo care	Prone position	Analysis	*P*
Mean heart rates	$\chi^2 \pm$ SD	$\chi^2 \pm$ SD	*T*	
30 min after feeding	149.43 ± 11.00	147.93 ± 9.94	0.706	0.486
3 h after feeding	147.60 ± 10.48	156.60 ± 10.56	3.702	**0.001**
Mean respiratory rates	$\chi \pm$ SD	$\chi \pm$ SD	*Z*	*P*
30 min after feeding	55.03 ± 5.86	58.56 ± 6.73	2.687	**0.007**
3 h after feeding	55.56 ± 5.17	58.76 ± 6.68	2.534	**0.011**
Mean SpO_2 values				
30 min after feeding	95.96 ± 2.47	97.43 ± 2.59	2.354	**0.019**
3 h after feeding	97.00 ± 2.55	96.43 ± 2.62	0.731	0.465
Mean body temperatures	$\chi \pm$ SD	$\chi \pm$ SD	T	P
30 min after feeding	36.66 ± 0.33	36.63 ± 0.24	0.523	0.605
3 h after feeding	36.80 ± 0.30	36.77 ± 0.26	0.433	0.668

TABLE 3 Comparison of mean comfort scores of the preterm infants after kangaroo care and prone position feeding

	Kangaroo care	Prone position	Analysis	*P*
Mean comfort scores	$\chi^2 \pm$ SD	$\chi^2 \pm$ SD	*Z*	
30 min after feeding	6.70 ± 1.68	9.50 ± 3.73	3.291	**0.001**
3 h after feeding	9.83 ± 4.05	18.00 ± 5.76	4.076	**0.000**
Estimated mean distress scores				
30 min after feeding	0.10 ± 0.30	1.06 ± 1.11	3.572	**0.000**
3 h after feeding	1.10 ± 1.15	4.20 ± 1.86	4.336	**0.000**
Estimated mean pain scores				
30 min after feeding	0.00 ± 0.00	0.13 ± 0.34	2.000	0.460
3 h after feeding	0.06 ± 0.25	0.20 ± 0.48	1.410	0.157

TABLE 4 Comparison of the amounts of residuals in the preterm infants after feeding in kangaroo care and prone positions

	Kangaroo care	**Prone position**	**Analysis**	
Mean residual volume, mL	$\chi^2 \pm$ **SD**	$\chi^2 \pm$ **SD**	***Z***	***P***
3 h after feeding	0.04 ± 0.19	0.10 ± 0.25	1.050	0.292

Sousan, 2013). In her study (2016) conducted to compare the prone position with the supine position, Çağlayan found that the cardiac apex beat rate was high in the prone position (Çağlayan, 2016). KC in the clinic for optimal heart rate may be helpful. In the clinical setting, provision of KC may contribute to the achievement of optimal heart rate.

In the present study, a significant difference was determined between the mean breathing rates measured 30 min and 3 h after feeding in the KC and prone positions. In preterm infants, esophagus peristalsis is immature and thus esophageal reflux frequently occurs. In KC, because the infant is fed in the upright position, the risk of reflux may have been eliminated, which, in turn, may have caused the number of breaths not to increase. In their (2016) study conducted on KC given to preterm infants, Cho *et al*. found a significant difference in the respiratory rates in the group undergoing KC (Cho *et al.,* 2016). In the study by Bera *et al*. (2014), it was stated that the application of KC had positive effects on physiological parameters in newborns. The preterm infants' mean SpO_2 values measured in KC 30 min after feeding were significantly different from those measured in the prone position, which might be due to the fact that the preterm infants were calm and sleepy and were fed in the upright position during KC. Similarly, the study by Cho *et al*. (2016) on KC given to preterm infants did not find a significant difference in SpO_2 values. In a study on the effect of the lying position on oxygen saturation in preterm infants, it was noted that there was no difference between the supine and prone positions in terms of oxygen saturation values (Cho *et al.,* 2016). In a study conducted on the effect of lying position of infants on their spontaneous pulmonary compliance after mechanical ventilation, it was determined that the position did not affect SpO_2 values (Çağlayan, 2016). Although this change in oxygen saturation and respiration rate is numerically low, this result is considered significant given the negative effects of oxygen deficiency.

There was no significant difference between the preterm infants' body temperatures measured 30 min and 3 h after feeding in KC and in the prone position. Since the stratum corneum, the outermost layer of the epidermis, does not completely develop before the 32nd-34th weeks of gestational age, temperature irregularities in preterm infants are more common. Beiranvand *et al*. (2014) reported that KC did not increase the risk of hypothermia. Moore *et al*. (2013) also found that the body temperature of infants who had skin-to-skin contact was balanced. In their study on KC given to preterm infants, Cho *et al*. (2016) found there was no significant difference in the body temperature of the infants receiving KC. No changes in body temperature were observed in the present study because the temperature of the neutral environment was ensured.

The mean comfort and estimated distress scores of preterm infants measured 30 min and 3 h after feeding varied significantly both in the KC group and in the prone position group. Stress causes hormonal, metabolic changes, can result in a prolonged period of ventilation, changing in vital signs, more chronic lung damage, lower increase of bodyweight and a prolonged period of admittance to the hospital and a less appropriate motor and behavioral development (Wielenga, de Vos, de Leeuw, & de Haan, 2004). However, slower heart and breathing rates may reflect greater infant comfort. The advantage of lower metabolic demand is beneficial for the growing preterm infant. Because no needle interventions were performed during feeding in the present study, no significant difference was determined between KC and prone positions in terms of the estimated mean pain scores measured 30 min and 3 h after feeding (Table 3).

In the current study, no significant difference was determined between the prone position and KC in terms of the mean gastric residual volumes measured 3 h after feeding. That there was no difference in the gastric residual volumes was probably due to the fact that in the KC and prone positions, the infant is laid face down (the front side of the infant's body is in contact with mother's chest or bed) and is fed only with breast milk. According to Imai *et al*. (2013) in the upright, prone, and right lateral positions, most of the antrum is filled with content, and the content is well mixed by antral recirculation. In this study, no difference was found between the two groups because of the comparison of two positions facilitating gastric emptying. In the literature, there are a limited number of studies conducted on gastric residual volumes in preterm infants. In a study conducted to compare the KC and supine position, it was determined that the gastric residual volume was lower in those fed via KC than in those fed in the supine position (Valizadeh *et al.,* 2015).

Limitations: The limitation of the study design is that infants were not randomized for feeding position. The limitation of the study method is that gastric residuals were measured by aspiration of the orogastric tube. According to Perrella *et al*. (2013), direct ultrasound stomach measurement (spheroid) is useful for assessing gastric emptying and feeding intolerance in preterm infants. However, in the present study, gastric residual volume was manually assessed by syringe.

6 | CONCLUSION AND RECOMMENDATIONS

In the present study, it was concluded that feeding both in the prone and KC positions were equally physiologically safe, with KC offering the added benefit of increased infant comfort, lower heart rate (possibly due to more restful sleep) and maternal bonding. Therefore, this practice could be extended to beyond the 30 min of feed duration. All these results suggest that more studies in which KC and different positions are compared should be carried out. The present study included only the preterm infants with spontaneous respiration fed with breast milk and eoprotein supplements. New studies can also be performed on preterm infants receiving continuous positive airway pressure support. It is recommended that future studies investigating the long-term effects of different positions after feeding should be conducted also with preterm infants fed with the formula food.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

DO: contributed to the conception and design of this study, collected the data, performed the statistical analysis and drafted the manuscript,
HYS: contributed to the conception and design of this study, critically reviewed the manuscript and supervised the whole study process.

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REFERENCES

Ambuel, B., Hamlett, K. W., Markx, C. M., & Blumer, J. L. (1992). Assessing distress in pediatric intensive care environments: The comfort scale. *Journal of Pediatric Psychology*, 17, 95–109 https://www.ncbi.nlm.nih.gov/pubmed/1545324

American Academy of Pediatrics (AAP). (2000). Changing concepts of sudden infant death syndrome: Implications for infant sleeping environment and sleep position. Task force on infant sleep position and sudden infant death syndrome. *Pediatrics*, 105(3), 650–656. https://doi.org/10.1542/peds.105.3.650

Bastani, F., Rajai, N., Farsi, Z., & Als, H. (2017). The effects of kangaroo care on the sleep and wake states of preterm infants. *The Journal of Nursing Research*, 25(3), 231–239.

Beiranvand, S., Valizadeh, F., Hossseinabadi, R., & Yadollah, P. (2014). The effect of skin to skin contact on temperature and breastfeeding succesfulnes in full term newborn after cesarean delivery. *Hindawi Publishing Corporationİnternational Journal of Pediatrics*, 2014, 1–7. https://doi.org/10.1155/2014/846486

Bera, A., Ghosh, J., Singh, A., Hazra, A., Som, T., & Munian, D. (2014). Effect of kangaroo mother care on vital physiological parameters of the low birth weight newborn. *Indian Journal of Community Medicine*, 39(4), 245–249. https://doi.org/10.4103/0970-0218.143030

Boundy, E., Dastjerdi, R., Spiegelman, D., Fawzi, W., Missmer, S., Lieberman, E., … Chan, G. (2016). Kangaroo mother care and neonatal outcomes: A meta-analysis. *Pediatrics*, 137(1), 1–16. https://doi.org/10.1542/peds.2015-2238

Çağlayan, S. (2016). *Effect of lying position in preterm infants on heart rate, oxygen saturation and pain level*. (Master's Thesis). Haliç University, Institute of Health Sciences, İstanbul. fie:///C:/Users/-suser/Downloads/417434.pdf

Chen, S., Tzeng, Y., Gau, B., Kuo, P., & Chen, J. (2013). Effect of prone and supine positioning on gastric residuals in preterm infants: A time series with cross-over study. *International Journal of Nursing Studies*, 50, 1459–1467. https://doi.org/10.1016/j.ijnurstu.2013.02.009

Cho, E., Kim, S., Kwon, M., Cho, H., Kim, E., Jun, E., & Lee, S. (2016). The effects of kangaroo care in the neonatal intensive care unit on the physiological functions of preterm infants, maternal-infant attachment and maternal stress. *Journal of Pediatric Nursing*, 31, 430–438. https://doi.org/10.1016/j.pedn.2016.02.007

Cohen, S., Mandel, D., Mimouni, F. B., Solovkin, L., & Dollberg, S. (2004). Gastric residual in growing preterm infants: Effect of body position. *American Journal of Perinatology*, 21(3), 163–166. https://doi.org/10.1055/s-2004-823778

Elder, D. E., Campbell, A. J., & Galletly, D. (2011). Effect of position on oxygen saturation and requirement in convalescent preterm infants. *Acta Pediatrica Foundation*, 100(5), 661–665. https://doi.org/10.1111/j.1651-2227.2011.02157.x

Ghorbani, F., Asadollahi, M., & Sousan, V. (2013). Comparison the effect of sleep positioning on cardiorespiratory rate in noninvasive ventilated preterm infants. *Nursing and Amaidwifery Studies*, 2(2), 182–187 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4228557/pdf/nms-02-182.pdf

Görak, G. (2008). Yenidoğanın Değerlendirilmesi. In T. Dagoglu & G. Görak (Eds.), *Temel Neonataloji ve Hemşirelik İlkeleri* (pp. 179–193). İstanbul, Turkey: Nobel Tıp Kitabevleri.

Gray, L., Miller, L. W., Philipp, B. L., & Blass, E. M. (2002). Breastfeeding is analgesic in healthy newborns. *Pediatrics*, 109 (4), 590–593 http://pediatrics.aappublications.org/content/109/4/590

Gray, L., Watt, L., & Blass, E. M. (2000). Skin to skin contact is analgesic in healthy newborns. *Pediatrics*, 105(1), 14. https://doi.org/10.1542/peds.105.1.e14

Hwang, S. K., Ju, H. O., Kim, Y. S., Lee, H. Z., & Kim, Y. H. (2003). Effects of body position and time after feeding on gastric residuals in LBW İnfants. *Taehan Kanho Hakhoe Chi*, 33(4), 488–494. https://doi.org/10.4040/jkan.2003.33.4.488

Imai, Y., Kobayashi, I., Ishida, S., Ishikawa, T., Buist, M., & Yamaguchi, T. (2013). Antral recirculation in the stomach during gastric mixing. *American Journal of Physiology-Gastrointestinal and Liver Physiology*, 304(5), G536–G542.

Jebreili, M., Syeedrasooli, A., Headarzadeh, M., & Morteza, G. (2011). Effect of body position on gastric residual in preterm ınfants. *Medical Journal of Tabriz University of Medical Sciences*, 33(2), 13–18. http://majalleh.tbzmed.ac.ir/common/files_pdf/7246_en.pdf

Kahraman, A., Başbakkal, Z., & Yalaz, M. (2014). Turkısh valıdıty and relıabılıty of comfortneo scale. *Uluslararası Hakemli Hemşirelik Araştırmaları Dergisi*, 1(2), 1–11. https://doi.org/10.17371/UHD.2014210143

Kemp, C. (2007). NICU nurses' advice on sleep position differs from AAP guidelines. *AAP News*, 28(3). http://www.aappublications.org/content/28/3/2.1.full-text.pdf

Koç, S. (2015). *Influence of kangaroo care ın bırth to behavıors of newborn infant breastfeedıng and comfort level of mother*. (Master's Thesis). Medipol University, Institute of Health Sciences, İstanbul. file:///C:/Users/suser/Downloads/409465%20(2).pdf

Kolcaba, K. (2001). Evolution of the mid range theory of comfort for outcomes research. *Nursing Outlook*, 49(1), 86–92. https://doi.org/10.1067/mno.2001.110268

Kommer, D., Joshi, R., Pul, C., Atallah, L., Feijs, L., Oei, G., … Andriessen, P. (2017). Features of heart rate variability capture regulatory changes during kangaroo care in preterm infants. *The Journal of Pediatrics*, 182, 92–98. https://doi.org/10.1016/j.jpeds.2016.11.059

Linthavong, O., O'Shea, T. M., Allred, E., Perrin, E., Bauserman, M., Joseph, R. M., … Extremely Low Gestational Age Newborn (ELGAN) Research Study. (2018). Neurocognitive and health correlates of overweight and obesity among ten-year-old children born extremely preterm. *The Journal of Pediatrics*, 200, 84–90.

Ludington-Hoe, S. M. (2015). Skin to skin contact: A comforting place with comfort food. *The American Journal of Maternal/Child Nursing*, 40(6), 359–366. https://doi.org/10.1097/NMC.0000000000000178

Ludington-Hoe, S. M., Lewis, T., Cong, X. O., Anderson, L., Morgan, K., & Reese, S. (2006). Breast-infant temperature with twins during shared kangaroo care. *Journal of Obstetric, Gynecologic & Neonatal Nursing*, 35(2), 223–231. https://doi.org/10.1111/j.1552-6909.2006.00024.x

Moore, E. R., Anderson, G. C., Bergman, N., & Early skin to skin contact for mothers and their healthy newborn infants. cochrane database of systematic reviews.2007, ıssue 3. (2013). Preterm ınfants in various body positions. *Journal of Neonatal Nursing*, 19, 337–341. https://doi.org/10.1002/14651858.CD003519.pub2/epdf

Perrella, S. L., Hepworth, A. R., Simmer, K. N., & Geddes, D. T. (2013). Validation of ultrasound methods to monitor gastric volume changes in preterm infants. *Journal of Pediatric Gastroenterology and Nutrition*, 57, 741–749.

Premji, S. S. (2005). Enteral feeding for high-risk neonates: A digest for nurses into putative risk and benefits to ensure safe and comfortable care. *The Journal of Perinatal & Neonatal Nursing*, 19(1), 59–71.

Sangers, H., Jong, P. M., Mulder, S. E., Stigter, G. D., Van Der Berg, G. D., Pas, A. B., & Walther, F. J. (2013). Outcomes of gastric resıduals whilst feeding preterm ınfants in various body positions. *Journal Neonatal Nursing*, 19, 337–341 10.116/j.jnn.2012.12.003.

Smith, G. C., Gutovich, J., Smyser, C., Pineda, R., Newnham, C., Tjoeng, T. H., … Inder, T. (2011). Neonatal intensive care unit stress is associated with brain development in preterm infants. *Annals of Neurology*, 70, 541–549.

Tharashree, C. D., Shravani, M. R., & Srinivasa, S. (2018). The effect of kangaroo mother care (KMC) on breast feeding at the time of NICU discharge. *International Journal of Contemporary Pediatrics*, 5(3), 1068–1071.

Valizadeh, S., Hosseini, M., Jafarabadi, M., & Mohebbi, L. (2015). Comparison of the effect of nutrition in kangaroo mother care and supine positions on gavage residual volume in preterm ınfants. *Journal of Evidence Based Care*, 5(1), 17–24. https://doi.org/10.22038/EBCJ.2015.3734

Van Dıjk, M., Roofthooft, D. W., Anand, K. J., Guldemond, F., de Graaf, J., Simons, S., … Tibboel, D. (2009). Taking up the challenge of measuring prolonged pain in (preterm) neonates the comfortneo scale seems promising. *The Clinical Journal of Pain*, 25, 607–616. https://doi.org/10.1097/AJP.0b013e3181a5b52a

Wielenga, J. M., de Vos, R., de Leeuw, R., & de Haan, R. J. (2004). COMFORT scale: A reliable and valid method to measure the amount of stress of ventilated preterm infants. *Neonatal Network*, 23, 39–44.

Yıldırım, G. (2009). *The effect of kangaroo care on nutrition and development low birth weigth preterm new borns*. (Master's Thesis). Marmara University, Institute of Health Sciences, İstanbul. file:///C:/Users/suser/Downloads/236758%20(1).pdf

Yu, V. Y. H. (1995). Effect of body position on gastric emptying in the neonate. *Archives of Disease in Childhood*, 50, 500–504 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1544598/

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