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Full Length Research Paper

Effect of shared kangaroo care on preterm infant twins' cardiorespiratory, oxygenation and thermal responses

Amel M. Abouelfettoh[1]* and Susan M. Ludington-Hoe[2]

[1]King Saud bin Abdulaziz University for Health Sciences, College of Nursing, Saudi Arabia.
[2]Pediatric Nursing, Frances Payne School of Nursing, Case Western Reserve University, USA.

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Kangaroo Care (KC) is practiced in Neonatal intensive care unit (NICU) rather frequently but predominantly with mothers of single infant. Mothers of twins often expressed a desire to do KC with their twins. Simultaneously holding both twins is called Shared Kangaroo Care (SKC). Two previous case studies of SKC could be found and have encouraged the practice of SKC prior to sufficient evidence of acceptable cardiorespiratory and thermal responses. The current study describes the effects of SKC on preterm twins' cardio-respiratory and thermal responses to SKC and test the correlation between infant's skin temperature and maternal breast temperature. Five triads were recruited. Thus, data from 10 infants and five mothers (5 triads) were collected. Infant Heart rate (HR), Respiratory rate (RR), infant oxygen saturation level (SaO_2), skin temperature and maternal right and left breast temperature were recorded every 30 s during a 5 min baseline (incubator) and during SKC holding period. Majority of infants tolerated SKC well. The Shared KC means for each vital sign did not appear to be clinically different than those obtained during baseline when infants were in separate incubators. The majority of breasts increased their temperature over the course of SKC. Maternal breast temperature means were positively, highly, and significantly correlated to infant skin temperature means during SKC. Further studies with a larger sample and controlled design are merited.

Key words: Twin, kangaroo care, cardio-respiratory, breast temperature.

INTRODUCTION

The number of multiple births continues to increase (Martin et al., 2010; Nygren et al., 2011). Many of the infants of multiple births are born prematurely. Premature infants experience physiologic stressors such as hypothermia, apnea, and separation from the mother. Nursing interventions have been designed to minimize these stressors; one effective intervention is Kangaroo Care (KC), because KC prevents hypothermia (Ludington-Hoe et al., 2004), increases physiologic stability (Beregman et al., 2004; Fohe et al., 2000; Schrod and Walter 2002) and prevents separation from the mother (Roller, 2005; Feldman et al., 2007). As a consequence, Kangaroo Care occurs in the neonatal intensive care unit (NICU) rather frequently (Engler et al., 2002; Feldman et al., 2003a; b; Ludington-Hoe et al., 2008) but predominantly with mothers of a single infant. Because diffusion of treatment frequently occurs in the NICU, mothers of twins often have expressed a desire to do KC with their twins.

Simultaneously holding both twins is called Shared Kangaroo Care (SKC) (Swinth et al., 2000). Two case studies of twins being held simultaneously (Ludington-Hoe et al., 2006; Swinth et al., 2000) have encouraged the practice of shared Kangaroo Care prior to sufficient evidence of acceptable cardiorespiratory, thermal, and behavioral state responses, even though all infants' values remained within clinically acceptable range and maternal breasts thermally regulated infant temperatures. Previous studies of SKC with twins and triplets showed that SKC provided during 32 or 35 week postmenstrual age had significant response to keep the infants warm and vital signs stable (Dombrowski et al., 2000; Swinth et al.,

*Corresponding author. E-mail: amelmoataz@hotmail.com. Tel: +20123640904.

2000). When two sets of twins were given 90 min of SKC, their temperatures remained with neutral thermal zone for each infant, they were warmed by KC, and each breast responded differently than the other, responding to the thermal needs of the individual infant on that particular breast (Ludington-Hoe et al., 2006).

SKC for twins has become routine practice in Africa (Kambarami, 2002) and some U.S. sites (Wallis, 2000) because no clinical cardiorespiratory or thermal problems have occurred. Two other studies of KC that included twins have been reported, but in each the twins were not given SKC and were studied singly (Cleary et al., 1997; Whitelaw et al. 1998). Thus, empirical data on cardio-respiratory, oxygenation, and thermal outcomes of SKC are still needed to provide evidence for an emerging practice. Thus, the purpose of the study is to describe the effects of SKC on preterm infant twins' cardiorespiratory, oxygenation, and thermal responses by comparing physiologic values obtained during Baseline and during Shared KC.

Research questions

The following research questions were answered by this research;

1. What are the heart rate, respiratory rate, oxygen saturation, and skin temperature of each infant during Baseline and Shared KC?
2. What is the relationship between each breast temperature and the infant's temperature while lying on that breast during Shared KC?

MATERIALS AND METHODS

A one group pretest - test design was used in one day of study. Institutional review board (IRB) approval and signed consent from the mothers were obtained. All infants were to receive SKC up to two hours or until the mother or infant's condition merited cessation of SKC, which ever was sooner. Data were collected every 30 s throughout 5 min pretest period while the infant lay in the incubator. The test period was Shared Kangaroo Care. Each infant served as his/her own control and the design permitted comparisons between SKC and incubator periods of care. Two researchers sat adjacent to each other and recorded data for one infant or maternal breast/ infant pair. Data from both twins were simultaneously recorded every 30 s in the following sequence: infant heart rate, infant respiratory rate, infant oxygen saturation level, infant temperature and maternal breast temperature breast temperature. Data collection times were signaled by audible stop-watches each researcher had that were synchronized in time, down to one hundredth of a second. Data collectors were trained to interrater reliability of 0.90 or more according to percent agreement method.

Setting

The study was conducted in a Midwest tertiary level University Neonatal Intensive Care Unit that admits ap-proximately 15 to 45 sets of twins each year. The NICU has six rooms, each one containing up to six infants. The twins were in separate incubators that were adjacent to each other. The Kangaroo Care lounger was placed between the incubators so that the incubator temperatures on the infants could be used. Maternal legs and feet were supported by the lounger to prevent postpartum thrombophlebitis and a privacy screen was provided.

Sampling and subjects

Non-random, convenience sampling was used to recruit 5 mothers of twins. We planned to conduct the study with 10 mothers, but doing so became unfeasible because of infants condition. Thus, reporting the results of these five mother/twin sets is important to guide Shared Kangaroo Care practice and potential future studies. Infant criteria were: no longer requiring oxygen support, being medically stable at the time of testing, more than 30 weeks gestational age determined by Dubowitz score and having no congenital anomalies. Infants who were being weaned from the incubator were not included. Mothers had to be at least 18 years old, English-speaking, and have had no skin rash or infections on the day of study. Kangaroo Care would cease any time mothers requested KC to stop or if any infant's vital sign demonstrated three consecutive readings that approached or exceeded clinically acceptable ranges, or if an infant had three consecutive observations 30 s apart of crying, irritability or restlessness.

Outcome variables

Infant abdominal skin temperature

This is defined as the temperature in Centigrade displayed on the incubator. Infant abdominal temperature was obtained by placing the Ohmeda Care Plus incubator skin probe 1 cm below the right costal margin of each infant and covered by a Mylar temperature shield (Accutemp Plus) to minimize ambient air and light influences. Clinically acceptable lower limit of infant temperature was 36.5°C and no upper limit of tem-perature was set because we wanted to know if warming occurs and to what degree during two hours of SKC.

Maternal breast temperature

This is the temperature in Centigrade recorded by a Fisher Thermistor attached to a skin probe secured three inches above each nipple at the mid-clavicular line and covered by a Mylar temperature shield.

Infant heart rate

This is defined as the cardiac rate displayed on the clinical cardio-respiratory monitor (Space Labs, Model 210), clinically acceptable infant heart rate range was 120 to 160 beats/min.

Infant respiratory rate

This is the breathing rate displayed on the clinical cardio-respiratory monitor. Clinically acceptable infant respiratory rate range was 40 to 60 breaths/min.

Infant oxygen saturation level

This is defined as the percent of oxygen displayed on the cardiorespiratory monitor detected by a probe over the lateral side of the right ball of the foot. Clinically acceptable infant oxygen saturation range was 87 to 100% on room air (Verklan et al., 2004). Demographic and physiologic data were recorded on a Data collection sheet developed for the purpose of the study.

Procedure

The pretest period began immediately after care and feeding of each infant. Infants were positioned prone and nested and at a 30 degree incline. After five minutes, the pretest period ended. The mothers reclined in a LaFuma zero-gravity lounger (LaFuma, Anneyron, France) behind privacy screens. Infants were transferred to the mother's chest after she was seated between the incubators. Baby A was placed on the right breast (called Breast A) and baby B was placed on the left breast (called Breast B). Infants were positioned midline over each breast so that they were facing each other and their heads were above the nipple. Positioning guidelines for co-bedding of twins were followed (DellaPorta et al., 1998). As soon as both infants appeared settled (resting quietly without extremity movements), which usually took about 2 to 3 min, test period data collection began and continued for 1 to 2 h, ceasing at two hours or before either the mother's or infant's condition mandated cessation.

Statistical analysis

Demographic and outcome data was entered and analyzed by an SPSS 17.0 program. Means, standard deviations and ranges were calculated to describe heart rate, respiratory rate, oxygen saturation level, infant tem-perature, and maternal breast temperature of each infant during each period. Each infant's mean for each variable in each period was used to yield a weighted mean (mean of the means) for the group; weighted means were used to describe group outcomes. Pearson product-moment correlation coefficient was used to test the correlation between each maternal breast temperature and infant's abdominal skin temperature of the infant lying on that breast during shared SKC.

RESULTS

Data from 10 infants and five mothers (5 triads) were collected. Demographic characteristics of the mothers and infants show that mothers were predominantly white, single, and had had cesarean sections. Majority of infants were male, mean GA was 31 weeks, and had one minute Activity, Pulse, Grimace, Appearance, Respiration (APGAR) of 6.0 and five minute APGAR of 8.0. Infants' birth weight ranged from 640 to 2345 g and their weight at entry to study ranged from 1470 to 2450 g. All infants were on room air during the study. Shared Kangaroo Care duration for each set of twins varied from 25 to 83 min. Variation in SKC duration was due to physiologic responses of the infants to SKC exceeding clinically acceptable values. The mean duration of KC for all twins on the right breast (Twins A) was 45.8 min (SD = 28.2); for all twins on the left breast (Twins B) mean SKC duration = 47.2 (SD = 29.5) min. Only one triad (Triad No. 4) had more than 75 min of SKC for each twin.

Outcome data

Results are based on data provided by only 4 sets of twins (8 infants) because Twin A in the fifth set was crying constantly and repeatedly kicked and pushed at Twin B from the beginning of SKC. Set 5 Twin A appeared to want Twin B off the chest, and Twin B was moving and irritated in response to Twin A's aggression. Because Twin A would not cease kicking, shoving, and jabbing Twin B, SKC was terminated after 5 min. All of the fifth set of twins' data were due to artifact because of behavioral agitation, thus, data from the fifth set of twins have been excluded from the results. Thus, the group mean is based on only four sets of twins. The baseline data produced 11 data points for each variable for each subject; the number of data points for each physiologic outcome during SKC was 902 (Tables 1 to 4).

Heart rate means in the incubator ranged from 144.09 to 166.91 beat per minute and were relatively similar between the twins in each Triad. Two infants (both twins of Triad No. 2) had heart rate means that were beyond clinically acceptable range while in the incubator. Heart rate means of each subject during SKC ranged from 146.26 to 171.26 and exhibited a wider range during SKC than during the incubator period. The incubator period (group M = 153.80, SD = 7.59), and SKC period (group M = 153.05, SD = 6.84) period means were relatively similar. During SKC, heart rate means changed by 3 to 5 beats/min in all subjects: three experienced an increase of 3 to 5 and five experienced a decrease of 3 to 5 beats/min. All of the three infants who had an incubator HR mean that exceeded clinically acceptable range experienced a subsequent increase during SKC.

Respiratory rate means in the incubator ranged between 30.67 to 62.78 (group M = 47.76, SD = 14.50) breaths per minute. In the incubator, all subjects' respiratory rates were within clinically acceptable range. During SKC, respiratory rate means ranged between 14.54 to 59.77 (group M = 34.46, SD = 7.98). Two sets of twins (Triads No. 1 and 4) experienced a two-to-three fold decrease in respiratory rate (19 to 48 breaths/min) and two sets (Triads No. 2 and 3) experienced small increases (3 to 6 breaths/min) in respiratory rate during SKC (Table 2). Two twins in Triads #1 and 4 had low mean respiratory rates in SKC (RR = 14 to 27) that were lower than clinically acceptable values. Thus, change in respiratory rate due to SKC varied between subjects.

Oxygen saturation means in incubator ranged between 94.73 to 99.30% (group M = 96.18%, SD = 1.57) (Table 3). All subjects' oxygen saturation means during the incubitor period were within clinically acceptable range. During

SKC, oxygen saturation ranged between 90.26 to 97.30% (group M = 95.97%, SD = 4.83). Five infants experienced a decrease in their oxygen saturation during SKC (a drop between 0.44 to 5.10%); the other three infants experienced a small increase in their mean oxygen saturation level (an increase between 0.26 to 1.39). Even though oxygen saturation decreased or increased during SKC, all oxygen saturation means were within clinically acceptable limits.

Infant temperature means in incubators ranged between 36.17 to 37.73°C (group M = 36.66°C, SD = 0.174) (Table 4). All temperature means during the incubator period were within clinically acceptable values even though one infant (Triad No. 4, Twin A) had a high mean temperature during the incubator period. During SKC twins' temperatures ranged between 36.38 to 37.81°C (group M = 36.99°C, SD = 0.173). Mean temperature during SKC increased in six twins (an increase of 0.15 to 1.64°C) but only one twin (Triad No. 1, Twin A) had an increase to the point where his mean temperature (M = 37.81°C, SD = 0.09) exceeded the acceptable limit of 37.5°C. Temperature decreased in two twins (a drop between 0.08°C in one twin and 0.99°C in the other twin). The infant who had a high mean temperature during the incubator period experienced a 0.99°C drop in temperature during SKC. Infants' temperature either increased or decreased during SKC, revealing no consistent pattern in response to SKC.

Maternal breast temperatures were taken every 30 s during SKC. The first temperature of the maternal right breast was between 35.43 and 37.21°C; the left breasts' beginning temperatures ranged between 34.87and 37.73°C. The ending temperatures for the right breast were between 36.36 and 37.02 and for the left breast were between 36.35 and 37.92. Thus, 2 right breasts increased their temperature during SKC, and 2 decreased their temperature during SKC. An increase in temperature was also seen in 3 left breasts, and a decrease was seen in only one left breast. Thus, the majority of breasts increased their temperature over the course of SKC. The Right breast mean temperature during SKC was M = 36.84 SD = 0.47 and the left breast mean temperature was M = 37.13 and SD = 0.56, suggesting dissimilarity between breasts during SKC.

Relationship between maternal breast and infant temperatures

The relationship between each breast's temperature and the infant's temperature while lying on that breast during SKC is presented in Tables 5 and 6. Maternal right breast temperature means were positively, highly, and significantly correlated to infant skin temperature means during SKC ($r = 0.77$ to 0.96; $p \leq 0.006$ for all cor-relations) for all but one subject whose mean temperature during SKC was negatively, weakly, but significantly correlated to maternal right breast temperature ($r = -0.275$; $p = 0.006$), that infant had a high temperature during SKC that exceeded the acceptable clinical ranges. Maternal left breast temperature means for three twins was significantly correlated with skin temperature of the infant lying on that breast during SKC ($p < 0.001$) with moderate-to-high correlations ranging between 0.52 to 0.88. Infant skin temperature was not significantly correlated to maternal breast temperature in one twin.

DISCUSSION

Infants showed vital signs (HR, RR, SaO_2, and T) that generally remained within clinically acceptable range during SKC. Changes in heart rate during SKC were small and inconsistent in direction. Heart rate either increased or decreased during SKC by 3 to 5 beats/min. Kangaroo Care studies have shown that HR may increase (Sontheimer et al., 2004; Bohnhorst et al., 2004; Fohe et al., 2000) or remain stable (Kadam et al., 2005). In the current study increases in mean HR were of greater magnitude than decreases in HR. HR increases have occurred when preterm twins have been co-bedded together, suggesting that closeness with another infant activates HR (Byers et al., 2003). Greater increase in HR may also have been due to warming that occurred during SKC, as has been found in singleton studies (Ludington et al., 2000; 2004; 2008).

Respiratory rate increased in 2 sets of twins and decreased in the other two during SKC. Decreases in mean RR were of greater magnitude than increases in RR as two sets of twins (triad No. 1 and 4) had RRs that were lower (RR = 14.54 to 27 breath per minute) than the common range for preterm infants in incubators. Although RR was lower than expected during SKC in two sets of twins, the two sets of twins' oxygen saturation levels were maintained within the clinically accepted ranges. Lower RR values are similar to those reported elsewhere (McCain et al., 2004) and may be due to the predominance of parasympathetic drive during KC. RR may be fundamentally different between incubator and KC, especially considering that the incubator is not a natural environment for the infant because of its inherent separation of mother and newborn. Additionally, the low RRs may have been due to the predominance of sleep because when in deep sleep RR decreases, suggesting mutual coherence with state, a sign of central nervous system maturation and regulation (Smith, 2007; Feldman and Eidelman, 2003a; b; Feldman et al., 2002, 2007).

Oxygen saturation during the incubator period was within clinically acceptable range. During SKC oxygen saturation ranged between 90.26 to 97.30% (group M = 95.97%, SD = 4.83). Changes in SaO_2 exceeded those anticipated (less than 1% change) suggesting the need

Table 1. Individual and group heart rate means and standard deviations before and during SKC.

Triad No./Twin	Before SKC (Incubator) (n = 11)	During SKC (n)
1/Twin A	149.73±11.35	146.26±8.05 (100)
1/Twin B	144.09±4.18	147.46±5.56 (100)
2/Twin A	166.91±5.01	171.26±11.79 (50)
2/Twin B	165.36±4.06	160.18±3.83 (54)
3/Twin A	154.00±11.97	151.72±6.80 (138)
3/Twin B	148.73±12.46	144.52±8.63 (148)
4/Twin A	150.27±8.16	155.50±8.72 (162)
4Twin B	151.36±8.71	147.51±8.51 (166)
Group (mean±SD)	153.80±7.59	153.05±8.44

Table 2. Individual and group respiratory rate means and standard deviations before and during shared kangaroo care.

Triad No./Twin	Respiratory Rate (mean±SD)	
	Before SKC (Incubator) (n=11)	During SKC (n)
1/Twin A	37.78±14.70	18.02±9.31 (100)
1/Twin B	62.00±12.75	14.54±6.66 (99)
2/Twin A	46.20±16.42	53.75±20.92 (47)
2/Twin B	30.67±9.66	36.1±20.22 (49)
3/Twin A	43.36±17.25	46.54±0.78 (138)
3/Twin B	56.00±16.53	59.77±0.92 (149)
4/Twin A	62.78±12.43	27.22±10.59 (158)
4Twin B	43.25±16.19	19.70±4.41 (162)
Group (mean±SD)	47.76±14.50	34.46±7.98

Table 3. Individual and group oxygen saturation means and standard deviations before and during shared kangaroo care.

Triad No./Twin	Oxygen saturation (mean±SD)	
	Before SKC (Incubator) (n=11)	During SKC (n)
1/TwinA	96.64±1.50	96.90±1.62 (100)
1/TwinB	95.55±1.81	95.11±2.10 (98)
2/TwinA	95.36±1.21	90.26±12.28 (47)
2/TwinB	97.73±1.27	94.12±3.38 (49)
3/TwinA	94.73±1.74	96.1 2±7.94 (139)
3/TwinB	96.09±1.38	96.79±1.37 (149)
4/TwinA	98.27±1.19	97.30±7.40 (158)
4/TwinB	96.18±2.60	93.83±2.56 (161)
Group (mean±SD)	96.18±1.57	95.97±4.83

Table 4. Individual and group temperature means and standard deviations before and during shared kangaroo care.

Subject no./Twin	Temperature (mean±SD)	
	Before SKC (n=11)	During SKC (n)
1/Twin A	36.17±0.76	37.81±0.087 (100)
1/Twin B	37.10±0.00	37.02±0.08 (98)
2/Twin A	36.67±0.06	36.82±0.21 (48)
2/Twin B	36.20±0.12	36.46±0.13 (49)
3/Twin A	36.72±0.04	36.99±0.20 (138)
3/Twin B	36.23±0.37	37.08±0.23 (149)
4/Twin A	37.73±0.02	36.38±0.25 (157)
4/Twin B	36.50±0.02	37.31±0.20 (162)
Group (mean±SD)	36.66±0.174	36.99±0.173

Table 5. Right breast temperature and infant A skin temperature during shared kangaroo care.

Triad no.	Maternal right breast temperature during SKC (mean±SD)	Infant A temperature during SKC (mean±SD)	r	*p**
1	36.78±0.79	37.81±0.087	- 0.275	0.006
2	36.73±0.16	36.82±0.21	0.893	0.000
3	36.77±0.12	36.99±0.20	0.809	0.000
4	37.01±0.28	36.38±0.25	0.774	0.000

*Significant level at 0.05.

Table 6. Left breast temperature and infant B skin temperature during SKC (n = 5).

Triad no.	Maternal left Breast Temperature (Mean ± SD)	Infant B Temperature (Mean ± SD)	r	*p**
1	37.81±0.087	37.02±0.08	0.524	0.000
2	36.82±0.21	36.46±0.13	0.876	0.000
3	36.99±0.20	37.08±0.23	0.124	0.133
4	36.38±0.25	37.31±0.20	0.552	0.000

*Significant level at 0.05.

for further study with a larger sample size to determine if such decreases are really common or not. The changes in SaO_2, evident with these SKC infants, are similar to those reported in the previous SKC case studies (Jarell et al., 2009). During transfer, oxygen saturation has been found to drop in ventilated infant (Neu et al., 2000) and also with head tilting, changes in oxygen saturation can occur (Schrod and Walter, 2000). Thus, the drop is SaO_2 may be due to warming. .Interestingly, the lower SaO_2 values were not present in infants whose RR decreased during SKC. SKC effects on SaO_2 are paradoxical and recommend further investigation.

Infant abdominal temperature

Infant temperature either increased or decreased during SKC, with no consistent pattern in response to SKC. However, infants temperatures remained with the clinically acceptable ranges during SKC, only one twin (Triad No. 1, Twin A) had an increase to the point where his mean temperature (M = 37.81°C, SD = 0.09) exceeded the acceptable limit of 37.5°C. In preterm twins, infant temperature remained warm or increased while held simultaneously in KC (Ludington-Hoe et al., 2006). In the current study, Infant temperature either increased

or decreased during SKC, revealing no consis-tent pattern in response to SKC. Thermal regulation did not occur because temperature went up to 37.81°C and all maternal breast temperatures were high as the breast that the infant who experiences high temperature was laid on, thus lowering its temperature during SKC as there is a negative correlation between the infant's abdo-minal temperature and the breast temperature. Previous studies showed that KC in single preterm infants provides adequate warmth (Ludington-Hoe et al., 2006). Twins and triplets are also placed in KC. Swinth and associates (2000) measured triplet infant temperatures when all three infants were simultaneously held by their mother at the end of the first KC session which lasted three hours, infant axillary temperatures ranged between 36.8 and 37.1°C, at the end of the second session (45 min long) that evening, infant temperatures ranged between 37.0 and 37.3°C.

Physiologic events may explain why maternal breasts are able to respond differentially to each infant. First, skin-to-skin contact is a form of touch that stimulates the slow conducting unmyelinated (C) afferents in the human hairy skin. Activation of C tactile afferents produces the sensation of pleasant touch as determined by the activation of the insular cortex (Limbic system) rather than the somatosensory areas of S1 and S2 by the tactile afferents (Olausson et al., 2002). Maternal and infant skin responds to pleasant touch by releasing neuropeptides including cholescytokinin and opioids (Weller et al., 2003). Kangaroo Care produces an opiod mediated relaxation (Modi et al., 1998; Mooncey et al., 1997) which can cause skin vasodilation and its concomitant warming.

Second, KC increases pituitary thyroid axis activity (Weller et al., 2002) which can in turn increase metabolic rate and skin temperature in each mother and infant. Third, placement of the warm infant upon the mother's breast produces a warm sensation in the mother that is dependent on each infant's body temperature. Warm touch increases skin blood flow (Yosipovitch et al., 2003), helping each breast respond individually to the infant.

Fourth, the warm touch perceived when an infant is placed on the breast also causes a release in calcitonin generated peptides that elevate local skin temperature (Noguchi et al., 2003). Fifth, each infant has his own weight, posture, and movement pattern as he/she lies on the breast. As each infant lies on the breast, skin hair follicles in the stratum corneum of the mother are aroused, stimulating release of cutaneous corticotrophin releasing hormone, which in turn, locally vasodilates skin vessels (Crompton et al., 2003) and finally, the amount of corticotrophin releasing hormone that is activated in the infant by being skin-to-skin against the breast affects his/her movements (Slominski et al., 2004), each of which further stimulates cutaneous corticotrophin releasing hormone in the mother and ultimately breast skin temperature.

Conclusion

Majority of the infants tolerated SKC well. The Shared KC means for each vital sign did not appear to be clinically different than those obtained during Baseline when infants were in separate incubators. The majority of breasts increased their temperature over the course of SKC. Maternal breast temperature means were positively, highly, and significantly correlated to infant skin temperature means during SKC. Further studies with a larger sample and controlled design are merited. The study provide data that have moved the evidence base from a case study level to evaluative study level and have provided data that merit further descriptive and comparative study with a much larger sample size. Behavioral state needs to be measured at the same time as physiologic variables to provide reasons for unusual values other than infants' illness. The findings of the current study should be interpreted with caution because little is still known when only four sets of infants constitute the sample size.

REFERENCES

Bohnhorst B, Gill D, Dordelmann M, Peters CS, Poets CF (2004). Bradycardia and desaturation during skin-to-skin care: No relationship to hyperthermia. J. Pediatr. 145:499-502.

Byers JF, Yovaish W, Lowman LB, Francis JD (2003). Co-bedding versus single bedding premature multiple-gestation infants in incubators. J. Obstet. Gynecol. Neonatal. Nurs. 32:340-347.

Crompton R, Clifton VL, Bisits AT, Read MA, Smith R, Wright IM (2003). Corticotropin-releasing hormone causes vasodilation in human skin via mast cell-dependent pathways. J. Clin. Endocrinol. Metab. 88:5427-5432.

DellaPorta, K, Aforismo, D, Butler-O'Hara, M (1998). Co-bedding of twins in the neonatal intensive care unit. Pediatr. Nurs. 24:529-531.

Engler, AE, Ludington-Hoe SM, Cusson, RM, Adams R, Bahnsen, MA, Brumbaugh EJ, Coates P, Grieb JK, McHargue LK, Ryan D, Settle M, Williams, DM (2002). Kangaroo care: National survey of practice, knowledge, barriers, and perceptions. MCN Am. J. Matern. Child. Nurs. 27:146-153.

Feldman R, Eidelmanm AI (2003a). Skin-to-skin contact (Kangaroo Care) accelerates autonomic and neurobehavioural maturation in preterm infants. Dev. Med. Child. Neurol. 45:274-281.

Feldman R, Weller A, Sirota L, Eidelman AI (2002). Skin-to-Skin contact (Kangaroo care) promotes self-regulation in premature infants: sleep-wake cyclicity, arousal modulation, and sustained exploration. Dev. Psychol. 38:194-207.

Feldman R, Weller A, Sirota L, Eidelman AI (2003b). Testing a family intervention hypothesis: the contribution of mother-infant skin-to-skin contact (kangaroo care) to family interaction, proximity, and touch. J. Fam. Psychol. 17:94-107.

Fohe K, Kropf S, Avenarius S (2000). Skin-to-skin contact improves gas exchange in premature infants. J. Perinatol. 53:311-315.

Kadam S, Binoy S, Kanbur W, Mondkar JA, Fernandez A (2005). Feasibility of Kangaroo mother care in Mumbai. Indian J. Pediatr. 72: 35-38.

Kambarami R (2002). Kangaroo care and multiple births. Ann. Trop. Paediatr. 22: 107-108

Ludington-Hoe SM, Anderson GC, Swinth JY, Thompson C, Hadeed A J (2004). Randomized controlled trial of kangaroo care: Cardiorespiratory and thermal effects on healthy preterm infants. Neonatal Netw. 23:39-48.

Ludington-Hoe SM, Lewis T, Morgan K, Cong X, Anderson L, Reese S

(2006). Breast-infant temperature synchrony with twins during Shared Kangaroo Care. J. Obstet. Gynecol. Neonatal Nurs. 35:1-9.
Ludington-Hoe SM, Morgan K, Abouelfettoh A (2008). Clinical guidelines for implementation of kangaroo care with premature infants ≥ 30 weeks postmenstrual age. Adv. Neonatal Care. 3S:S3-S23.
Martin JA, Hamilton BE, Sutton PD, Ventura S, Mathews TJ, Kirmeyer S, Osterman MJ (2010). Births: final data for 2007. Nat. Vital Stat. Rep. 58(24): 1-85.
Modi N, Glover V (1998). Non-pharmacological reduction of hypercortisolaemia in preterm infants. Infant Behav. Dev. 21:86.
Mooncey S, Giannakoulopoulos X, Glover V, Acolet D, Modi N (1997). The effect of mother-infant skin-to-skin contact on plasma cortisol and Beta-endorphin concentrations in preterm infants. Infant Behav. Dev. 20: 553-557.
Noguchi M, Ikarashi Y, Yuzurihara M, Kase Y, Takeda S, Aburada M (2003). Significance of measured elevation of skin temperature induced by calcitonin gene-related peptide in anesthetized rats. J. Pharmacol. 55:1547-1552.
Nygren KG, Sullivan E, Zegers-Hochschild F, Mansour R, Ishihara O, Adamson GD, de Mouzon, J (2011). International Committee for Monitoring Assisted Reproductive Technology (ICMART) world report: Assisted reproductive technology 2003. Fertil. Steril. 95:2209-2222.
Olausson H, Lamarre Y, Backlund H, Morin C, Wallin BG, Starck G, Elholm S, Strigo I, Worsley K, Vallbo AB, Bushnell MC (2002). Unmyelinated tactile afferents signal touch and project to insular cortex. Nat Neurosc. 9:900-904.
Roller CG (2005). Getting to know you: Mothers' experiences of kangaroo care. J. Obstet. Gynecol. Neonatal Nurs. 34:210-217.
Schrod L, Walter J (2002). Effect of head-up tilt position on autonomic function and cerebral oxygenation in preterm infants. Biol. Neonate. 81:255-259.
Slominski A, Pisarchik A, Tobin DJ, Mazzurkiewicz JE, Wortsman J (2004). Differential expression of a cutaneous corticotropin-releasing hormone system. Endocrinol. 145:941-950.
Swinth JY, Nelson LE, Hadeed A, Anderson GC (2000). kangaroo care for triplets. MCN Am. J. Matern. Child Nurs. 25:214-216.
Verklan MT, Walden M (2004). Core Curriculum for Neonatal Intensive Care Nursing. Elsevier Saunders, St. Louis.
Wallis CL (200). Kangaroo Care. Neonatal Netw. 19:68.
Weller A, Feldman R (2003). Emotion regulation and touch in infants: the role of cholecystokinin and opioids. Peptides 24:779-788.
Weller A, Rozin A, Goldstein A, Charpak N, Ruiz-Pelaez JG, Figueroa de Calume Z, Charpak Y, Sack J (2002). Longitudinal assessment of pituitary-thyroid axis and adrenal function in preterm infants raised by Kangaroo mother care. Horm. Res. 57:22-26.
Yosipovitch G, Chan YH, Tay YK, Goh CL (2003). Thermosensory abnormalities and blood flow dysfunction in psoriatic skin. Br. J. Dermatol. 149:492-497.