



Original article

Effects of bathing interval on skin condition and axillary bacterial colonization in preterm infants[☆]Jong Cheul Lee, PhD, RN^a, Yaelim Lee, PhD, MSN, RN^b, Ho Ran Park, PhD, RN^{c,*}^a Yanbian University of Science & Technology, 3458 Chaoyang St., Yanji City, Jilin Province 133000, China^b Red Cross College of Nursing, Chung-Ang University, 84 Heukseok-ro, Dongjak-gu, Seoul 06974, Republic of Korea^c The Catholic University of Korea, 222 Banpo-daero, Seocho-gu, Seoul 06591, Republic of Korea

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ABSTRACT

Aim: The objective of this study was to evaluate the effects of preterm infant bathing periods on skin condition and axillary skin colonization.

Background: Reducing the frequency of bathing in preterm infants is beneficial in reducing the risk of hypothermia and exposure to stress from frequent nursing contacts.

Methods: The subjects of this study were observed at The V hospital at the C University in South Korea between December 2012 and August 2013. A total of 32 preterm infants were included and were randomly assigned to two different bathing intervals; every four days ($n = 16$) and the other every two days ($n = 16$) bathing groups. A neonatal skin conditions were assessed on a daily basis, whereas, axillary skin colonization was measured every eight days before bathing. Data was analyzed via the SPSS program with a non-inferiority test, t -test, chi-square test, Fisher's exact test, and paired t -test.

Results: Mean differences of skin condition between the four-day bathing and two-day bathing groups were 0.065 and the 97.5% one-sided confidence limit was 0.196 (less than the non-inferiority margin, 0.3). There were no statistically significant differences in skin condition and axillary skin colonization between the two groups ($p > 0.05$).

Conclusion: The interval of bathing for preterm infants can be changed from every two days to every four days without increasing the incidence of skin condition problems or axillary skin colonization. Less-frequent bathing may decrease the chance of physiological instability caused by the caring process, while providing them with a better environment for growth and development.

1. Introduction

The skin plays a major role in preventing physical damage, maintaining body temperature, preventing body fluid loss, and protecting against harmful substances or microorganisms (Afsar, 2009). The skin of a newborn is different from adults' in form and function; in particular, the skin of a preterm infant has a thinner skin structure layer, which makes them have weaker protective functions and skin integrity due to anatomical and physiological immaturity (Blume-Peytavi, Hauser, Stamatas, Pathirana, & Bartels, 2012). The skin is where microbial colonization takes place after birth, and since some of the microorganism can cause skin infection, skin care nursing is critical for maintaining optimal skin condition in preterm infants (Rutter, 2003). Skin condition is one of the criteria for evaluating the condition of preterm infants, and skin assessment can predict infection (Lund &

Osborne, 2004) and decrease morbidity due to infectious diseases in preterm infants with reduced immunity (Afsar, 2009).

The preterm infant accounts for about 50% of newborns admitted to the neonatal intensive care unit (NICU) in South Korea (Bae et al., 2009), and, due to the improvement in neonatal intensive care and nursing, the survival rate of preterm infants in early pregnancy has increased. However, due to invasive treatment processes and various skin attachments accompanied by intensive care and various nursing interventions, the preterm infant's skin is at risk of more damage than before (Körner, Dinten-Schmid, Stoffel, Hirter, & Käppeli, 2009; Munson, Bare, Hoath, & Visscher, 1999; Peters, 1998).

Bathing is one of the routinely performed nursing duties to keep newborns' skin clean, along with monitoring, intravenous injections, feeding, and phototherapy (Peters, 1998). However, for preterm infants, any handling during the nursing process can cause physiological

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and behavioral instability, which can negatively affect their condition (Liaw, Yang, Yuh, & Yin, 2006; Zahr, 1998). Therefore, reducing daily care performance, such as bathing, may be desirable in the growth and development of preterm infants (Liaw et al., 2006; Zahr, 1998). It is common for most of the NICUs in Korea to perform a routine daily or every-other-day bathing of preterm infants for their skin care (Lund et al., 2001; Munson et al., 1999). However, as frequent bathing can cause stress and fatigue in preterm infants, lengthening the bath cycle has been recommended ((Bryanton, Walsh, Barrett, & Gaudet, 2004; Chollopetz da Cunha & Procionoy, 2005; H. K. Lee, 2002; Liaw et al., 2006; Lund et al., 2001; Sweeney & Blackburn, 2013; Tapia-Rombo et al., 2012). A study conducted in a different country extended the bath cycle to four days and examined skin colonization, and reported that the risk of infection did not increase (Franck, Quinn, & Zahr, 2000). However, there are only a limited number of studies in South Korea, which requires more studies and evidence to determine the adequate bathing cycle in Korean NICU settings. The purpose of this study was to explore the difference in skin condition and underarm skin bacteria colonization between groups on a two-day bathing cycle—which is the current nursing routine—and on a four-day bathing cycle among preterm infants admitted to the NICU of a university hospital.

2. Methods

2.1. Study participants

The participants of the study were 32 preterm infants who were admitted immediately after the birth to C University V hospital between December 2012 and August 2013. The NICU (level III) of this hospital has 10 beds, and the number of preterm infants born and admitted to this NICU during the data collection period was 104. The inclusion criteria of the study were preterm infants (a) with a gestational age below 37 weeks (b) that were approved for bathing by the medical staff after 24 h after birth due to good general condition and vital signs being stable, and (c) having received written consent from their parents, who understood the purpose of the present study. The exclusion criteria of the study were preterm infants (a) on mechanical ventilation, (b) with stage 3–4 intraventricular hemorrhage, (c) with skin damage, or (d) whose bathing was impossible due to a worsening of their medical condition.

The sample size of the study was calculated based on the difference in skin condition between before and after the bathing intervention (i.e., the primary outcome variable). Skin condition after the bathing intervention was defined as a mean of skin condition evaluated from the second time after bathing. The standard deviation of the skin difference between before and after the intervention was 0.26, adopted from a pilot study on current two-day bathing cycles. Based on these values and a non-inferiority margin of 0.3, with the one-sided significance level being 2.5% and 80% of power, the sample size of the study was calculated to be 12 participants in each group. Considering the drop-out rate of 20%, the study oversampled the participants to be 16 participants in each group (i.e., 32 participants in total). The approvable non-inferiority limit was 0.3, which is 0.1 (i.e., 10% of the minimum difference in skin evaluation score, 1 point) each for three items in total. The participants were randomly assigned to two-day and four-day cycle bathing groups using the coin toss method. The study was reviewed and approved by C University's Institutional Review Board (approval number: VC12OASI0168).

2.2. Study design

The study used a randomized experimental design to compare the skin condition and underarm skin bacterial colonization of preterm infants in the NICU between who received two-day cycle bathing (two-day bathing group) and four-day cycle bathing (four-day bathing group).

2.3. Study intervention

The two-day bathing group received bathing every 48 h, while the four-day bathing group received it every 96 h throughout their stay in the NICU. The room temperature before the bathing intervention was kept at 26 °C, while the water temperature was kept at 40 °C using the Thermofinder FS300 (HubDIC Co., Anyang, Korea). Bathing was performed from 4 to 5 p.m. by NICU nurses with more than two years of working experience. The duration of the bathing was 7 min, based on the mean bathing time of the NICU. For the intervention, one sterilized pus pan, twenty five 10 cm × 10 cm sterilized gauze (HP-K-95, Dasom, China), 0.5 L sterile distilled water at 40 °C (Daehan Pharm Co. Ltd., Ansan, Korea), two disposable sterile gloves, two cotton swabs, a hat, a diaper, and a towel were needed.

Prior to initiating the study, the bathing methods were communicated to all participating NICU nurses. Compliance with infection control and correct usage of the instruments were individually monitored by the researcher and five nurses with more than five years of working experience in the NICU. The bathing process was as follows: the performer (1) did hand washing before preparing for the bathing items, (2) removed the infant's hat and diaper, (3) did hand washing, (4) wore disposable sterile gloves, (5) checked the temperature of sterile distilled water, and (6) washed each of the infants' body parts in the cephalocaudal direction using sterile gauze. First, the infant's face and eyes were cleaned, and then the neck, chest, back, armpits, and limbs were cleaned using moistened gauze. The infant's genitals and buttocks were wiped, and then his/her scalp was cleaned using gauze moistened with water. The performer (7) dried the infant's scalp and armpits using a dry gauze; (8) covered the body with a towel; (9) changed the mattress linen, hat, and diaper; (10) attached monitoring electrodes; (11) maintained the previous body position; and (12) cleaned the infant's nostrils using cotton swabs moistened with saline.

2.4. Instruments

2.4.1. Skin condition

The participants' skin conditions were evaluated using the neonatal skin condition score (NSCS). The NSCS was used by Lund et al. (2001) to evaluate skin condition when exploring evidence-based clinical guidelines related to bathing, while the reliability was tested by Lund and Osborne (2004). The NSCS evaluates the dryness of skin, erythema, and skin damage/scratches using a three–nine-point scale. Lower scores mean better skin conditions. Skin condition was evaluated right before bathing, as well as around 4 to 5 p.m. on other days when bathing was not scheduled, so as to observe the skin condition continuously. The room temperature and humidity were kept at 26 °C and 50%–60%, while the temperature of the incubator was kept at the level of a neutral thermal environment, based on NICU regulations.

2.4.2. Underarm skin bacteria colonization

Underarm skin bacteria cultures were performed through the following steps: the performer (1) did hand washing and wore sterile gloves; (2) soaked the cotton swab in sterile saline and swabbed the infant's right underarm area (2 cm²) 10 times (five times each in the vertical and horizontal directions); (3) placed the cotton swab in the transfer medium (COPAN Italia S.P.A, Brescia, Italy); (4) sent to swab to the Laboratory Medicine, Department of Microbial; (5) inoculated the sample on a blood agar plate, MacConkey agar plate, and chocolate agar plate; (6) incubated the sample for 24–48 h at 37 °C; and (7) performed bacteria identification and antimicrobial susceptibility testing using Microscan system (VITEK2, BioMeriux, Marcy l'Etoile, France) on a gram-stained bacteria.

Based on a previous study (Franck et al., 2000), culturing was performed right before bathing. The skin area for the culture, the underarm area, was selected as the first areas where infants' microbial colonization occurs within the 24 h of birth, followed by the groin, and

abdomen (Quinn, Newton, & Piecuch, 2005), as well as based on a previous study describing the usefulness of culturing from the underarm area (Lee et al., 2011).

2.5. Data analysis

The collected data were analyzed using the SPSS (18.0, IBM Co., Armonk, NY, USA) program. The differences between the two groups were analyzed using a *t*-test, chi-square test, and Fisher's exact test. The primary outcome variable, difference in skin conditions between before and after bathing, was considered to prove non-inferiority, as long as the upper limit on the 97.5% one-sided confidence interval did not exceed the non-inferiority margin of 0.3. The homogeneity of the skin condition between the two groups was analyzed using the *t*-test, while the culture result was analyzed using Fisher's exact test. The background factors of the infants (e.g., gender, gestational age, and body weight), as well as, the overall significance level for multiple tests were not adjusted in this study, which pose limitations of the study.

3. Findings

3.1. General characteristics, baseline skin condition, and skin cultures

There were no significant differences between the two-day and four-day bathing group in sex, gestational age, postconceptional age, birth weight, body weight, age at participation in the study, length of hospital stay, delivery type, one-minute and five-minute APGAR scores, diagnosis, or general characteristics during the study period (Table 1). Moreover, the baseline skin condition and skin culture result showed no significant differences between groups at the baseline assessment.

3.2. Skin conditions

The non-inferiority of the skin condition proven as the upper limit on the 97.5% one-sided confidence interval was 0.196, which was below 0.3. Therefore, the four-day bathing group did not show a

Table 2

Comparison of neonatal skin condition score in subjects.

Group	2-day bathing (n = 16)	4-day bathing (n = 16)	Difference (~95% one-sided confidence interval)
	Mean ± SD		
Baseline	3.063 ± 0.250	3.000 ± 0.000	
After intervention	3.010 ± 0.038	3.012 ± 0.037	
Difference	−0.053 ± 0.255	0.012 ± 0.037	0.065 (~0.196)
<i>p</i>	0.421	0.223	

Note. *p* values were obtained by paired *t*-test. Non-inferiority margin was set at 0.3.

worsening in skin condition compared to the two-day bathing group (Table 2). The NSCS was assessed daily throughout the study period – 273 times in the two-day bathing group and 271 times in the four-day bathing group. The NSCS score indicating poor skin condition, four points, were scored three times in the two-day bathing group and two times in the four-day bathing group. The other assessment scores were three points, a normal score, showing no significant differences between the two groups (*p* = 0.333–1.000).

3.3. Skin bacteria colonization

Skin cultures were performed 30 times in the two-day bathing group and 27 times in the four-day bathing group (57 times in total). The number of times when bacteria was detected was seven times in each bathing group. There were no differences in skin culture results between the two groups at the baseline assessment and each assessment before bathing (Table 3).

In the two-day bathing group, the most frequently observed strain was *Staphylococcus aureus* (*S. aureus*) (four times), followed by coagulase negative *Staphylococcus* (CoNS) (three times) and *Enterobacter aerogenes* (one time). In the four-day bathing group, the most frequently observed strain was CoNS (six times), *S. aureus* (two times), and *Serratia marcescens* (one time) (Fig. 1).

Table 1

General characteristics of 2-day and 4-day bathing group.

Characteristics	Every 2-day bathing (n = 16)	Every 4-day bathing (n = 16)	Total (n = 32)	<i>p</i>
	Mean ± SD or number (%)			
Gender				1.000
Male	8 (50.0)	8 (50.0)	16 (50.0)	
Female	8 (50.0)	8 (50.0)	16 (50.0)	
GA (weeks)	32.4 ± 2.5	31.5 ± 3.1	32.0 ± 2.8	0.348
PCA at study (weeks)	33.4 ± 2.0	32.7 ± 2.5	33.1 ± 2.1	0.408
BW (g)	1582.5 ± 107.1	1524.4 ± 491.8	1553.4 ± 445.1	0.718
Weight at study (g)	1578.8 ± 386.3	1533.8 ± 465.2	1556.3 ± 421.2	0.768
Age at study (days)	7.3 ± 5.6	9.8 ± 10.6	8.5 ± 8.4	0.412
LOS (days)	16.8 ± 12.4	15.6 ± 10.2	16.2 ± 11.2	0.769
Delivery type				0.433 ^a
NSD	3 (18.8)	6 (37.5)	9 (28.1)	
C/SD	13 (81.3)	10 (62.5)	23 (71.9)	
Apgar score (1 min)	5.8 ± 1.3	5.8 ± 1.5	5.8 ± 1.4	1.000
Apgar score (5 min)	7.6 ± 1.0	7.4 ± 1.5	7.5 ± 1.3	0.689
Diagnosis				0.654 ^a
Prematurity	12 (75.0)	14 (87.5)	26 (81.3)	
RDS	3 (18.8)	2 (12.5)	5 (15.6)	
PPHN	1 (6.3)	0 (0.0)	1 (3.1)	
Duration of study (days)	17.8 ± 12.4	17.9 ± 11.1	17.8 ± 11.5	0.988
Skin scale	3.1 ± 0.3	3.0 ± 0.0	3.0 ± 0.2	0.333 ^a
Skin culture				1.000 ^a
Growth	1(6.3)	2(12.5)	3(9.4)	
No growth	15(93.8)	14(87.5)	29(90.6)	

Note. BW = birth weight; C/SD = Cesarean section delivery; GA = gestational age; LOS = length of stay; min = minutes; NSD = normal spontaneous delivery; PCA = postconceptional age; PPHN = persistent pulmonary hypertension of newborn; RDS = respiratory distress syndrome.

p value were obtained by *t*-test for continuous variables and chi-square test or Fisher's exact test for categorical variables.

^a Fisher's exact test.

Table 3
Bacterial culture results through each period.

Period	2-day bathing		4-day bathing		p
	n	Number of growth (%)	n	Number of growth (%)	
Baseline	16	1 (6.3)	16	2 (12.5)	1.000
Culture 1	14	4 (28.6)	12	2 (16.7)	0.652
Culture 2	8	0 (0.0)	9	3 (33.3)	0.206
Culture 3	3	0 (0.0)	4	2 (50.0)	0.429
Culture 4	3	1 (33.3)	2	0 (0.0)	1.000
Culture 5	2	2 (100)	–	–	–
Total (after intervention)	30	7 (23.3)	27	7 (25.9)	

Note. Culture 1 = culture at day 8; Culture 2 = culture at day 16; Culture 3 = culture at day 24; Culture 4 = culture at day 32; Culture 5 = culture at day 40.

p values were obtained by Fisher's exact test.

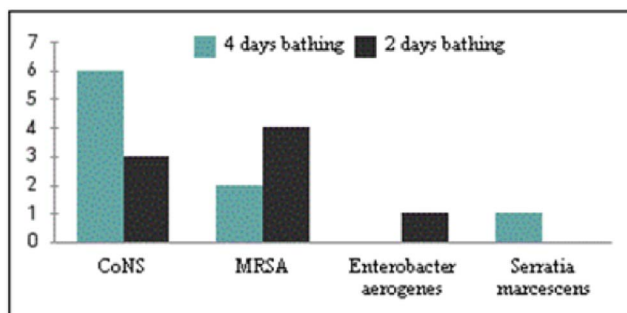


Fig. 1. A comparison of organism in subjects.

4. Discussion

Bathing is performed to prevent infection through removing waste products of the skin and reducing the colonization of microorganisms. However, bathing can cause stress in preterm infants in the NICU and adversely affect their physiology and behaviors through increasing their heart rate and the oxygen needs of their hearts (Peters, 1998; Tapia-Rombo, Morales-Mora, & Álvarez-Vázquez, 2003). In addition, bathing can be a hazard, causing irritation to preterm infants who have vulnerable skin integrity, and sometimes can be the path of microorganism spread through contact with the bathing nurse (Al Reyami, Al Zoabi, Rahmani, Tamim, & Chedid, 2009; Chollopetz da Cunha & Procianoy, 2005; Cohen, Saiman, Cimiotti, & Larson, 2003; Quinn et al., 2005; Visscher et al., 2009).

Most NICUs tend to prefer to keep the bathing cycles they have always used. Therefore, in order to reduce number of baths, observing the skin condition using the instrument which is well proved for its reliability and validity is crucial. Moreover, skin's protection function, water loss, risk of injury from the outside and infection, and other possible skin problems should be evaluated daily by nurses (Lund et al., 2001). In this sense, for clear determination of skin condition in accordance with bathing cycle, skin condition was assessed daily using the NSCS.

The findings of the study showed that the skin condition of the infants in the four-day bathing group was not worse than that of the infants in the two-day bathing group. Therefore, the researcher suggests performing a four-day bathing cycle with preterm infants in the NICU to reduce the risk of physiological instability caused by frequent bathing, thus providing a better growth and development environment. However, more studies are needed, as there is only a limited number of studies exploring the relationship between the bathing cycle and skin condition.

The findings on the skin culture showed no increase in the colonization of pathological bacteria in the four-day bathing group comparing

to the two-day bathing group, supporting the findings from previous studies (Franck et al., 2000; Quinn et al., 2005). In both groups, the most frequently observed strain was CoNS, which is mainly observed on the skin and frequently detected during blood cultures contaminated by patients' or medical staffs' skin (Maraqa et al., 2011). Considering preterm infants with relatively weak immunity, who often require a central venous line and are exposed to frequent contact with medical staffs, it can be a severe source of infection that requires strict hand washing before and after contact them (Kilbride et al., 2003; Rastogi et al., 2012). In addition, *S. aureus* was detected six times in this study; it was all methicillin-resistant *Staphylococcus aureus* (MRSA). MRSA is a major healthcare-related pathogen, increasing the morbidity and mortality of infants. Because of this severity, thorough isolation of patients and strict contact precautions are crucial (Cohen et al., 2003). Moreover, monitoring and managing MRSA is beneficial for isolating patients with MRSA, reducing the potential risk of severe infection in the NICU (Maraqa et al., 2011).

In conclusion, a four-day cycle of bathing is a safe nursing intervention, as suggested by the study findings. Skin condition and skin colonization were not affected by changing the two-day cycle to the four-day cycle of bathing in preterm infants in the NICU. The researchers suggest that reducing the frequency of bathing in preterm infants is beneficial in reducing the chance of physiological instability caused by the caring process. In the nursing field, attempts to renovate traditional and routine nursing interventions to evidence-based reasonable nursing interventions is important for patients' safety, as well as time and cost efficiency. The researchers conclude the paper by emphasizing the need for more studies addressing this important point and conducting repeated test including NICU from multi-hospitals.

References

- Afsar, F. S. (2009). Skin care for preterm and term neonates. *Clinical and Experimental Dermatology*, 34(8), 855–858. <http://dx.doi.org/10.1111/j.1365-2230.2009.03424.x>.
- Al Reyami, E., Al Zoabi, K., Rahmani, A., Tamim, M., & Chedid, F. (2009). Is isolation of outborn infants required at admission to the neonatal intensive care unit? *American Journal of Infection Control*, 37(4), 335–337. <http://dx.doi.org/10.1016/j.ajic.2008.09.023>.
- Bae, C. W., Kim, K. S., Kim, B. I., Shin, S. M., Lee, S. L., Lim, B. K., & Choi, Y. Y. (2009). Patient distribution and hospital admission costs in neonatal intensive care units: Collective study of 7 hospitals in Korea during 2006. *Journal of the Korean Society Neonatology*, 16, 25–35.
- Blume-Peytavi, U., Hauser, M., Stamatas, G. N., Pathirana, D., & Bartels, N. G. (2012). Skin care practices for newborns and infants: Review of the clinical evidence for best practices. *Pediatric Dermatology*, 29(1), 1–14. <http://dx.doi.org/10.1111/j.1525-1470.2011.01594.x>.
- Bryanton, J., Walsh, D., Barrett, M., & Gaudet, D. (2004). Tub bathing versus traditional sponge bathing for the newborn. *JOGNN - Journal of Obstetric, Gynecologic, and Neonatal Nursing*, 33(6), 704–712. <http://dx.doi.org/10.1177/0884217504270651>.
- Chollopetz da Cunha, M. L., & Procianoy, R. S. (2005). Effect of bathing on skin flora of preterm newborns. *Journal of Perinatology*, 25(6), 375–379. <http://dx.doi.org/10.1038/sj.jp.7211332>.
- Cohen, B., Saiman, L., Cimiotti, J., & Larson, E. (2003). Factors associated with hand hygiene practices in two neonatal intensive care units. *Pediatric Infectious Disease Journal*, 22(6), 494–498. <http://dx.doi.org/10.1097/00006454-200306000-00003>.
- Franck, L. S., Quinn, D., & Zahr, L. (2000). Effect of less frequent bathing of preterm infants on skin flora and pathogen colonization. *Journal of Obstetric, Gynecologic, and Neonatal Nursing*, 29(6), 584–589.
- Kilbride, H. W., Powers, R., Wirtschafter, D. D., Sheehan, M. B., Charsha, D. S., LaCorte, M., ... Goldmann, D. A. (2003). Evaluation and development of potentially better practices to prevent neonatal nosocomial bacteremia. *Pediatrics*, 111(4 Pt 2), e504–518.
- Körner, A., Dinten-Schmid, B., Stoffel, L., Hirter, K., & Käppeli, S. (2009). Skin care and skin protection in preterm babies. *Pflege*, 22(4), 266–276.
- Lee, H. K. (2002). Effects of sponge bathing on vagal tone and behavioural responses in premature infants. *Journal of Clinical Nursing*, 11(4), 510–519. <http://dx.doi.org/10.1046/j.1365-2702.2002.00594.x>.
- Lee, J., Kim, E. K., Lee, J. A., Choi, C. W., Kim, H. S., Kim, B. I., & Choi, J. H. (2011). Effective ways of performing surveillance surface cultures in extremely low birth weight infants. *Journal Korean Society Neonatology*, 18, 240–247.
- Liaw, J. J., Yang, L., Yuh, Y. S., & Yin, T. (2006). Effects of tub bathing procedures on preterm infants' behavior. *The Journal of Nursing Research*, 14(4), 297–305.
- Lund, C. H., Kuller, J., Lane, A. T., Lott, J. W., Raines, D. A., & Thomas, K. K. (2001). Neonatal skin care: Evaluation of the AWHONN/NANN research-based practice project on knowledge and skin care practices. Association of Women's Health, Obstetric and Neonatal Nurses/National Association of Neonatal Nurses. *Journal of*

- Obstetric, Gynecologic, and Neonatal Nursing*, 30(1), 30–40.
- Lund, C. H., & Osborne, J. W. (2004). Validity and reliability of the neonatal skin condition score. *Journal of Obstetric, Gynecologic, and Neonatal Nursing*, 33(3), 320–327. <http://dx.doi.org/10.1177/0884217504265174>.
- Maraq, N. F., Aigbivbalu, L., Masnita-Iusan, C., Wludyka, P., Shareef, Z., Bailey, C., & Rathore, M. H. (2011). Prevalence of and risk factors for methicillin-resistant *Staphylococcus aureus* colonization and infection among infants at a level III neonatal intensive care unit. *American Journal of Infection Control*, 39(1), 35–41. <http://dx.doi.org/10.1016/j.ajic.2010.07.013>.
- Munson, K. A., Bare, D. E., Hoath, S. B., & Visscher, M. O. (1999). A survey of skin care practices for premature low birth weight infants. *Neonatal Network*, 18(3), 25–31.
- Peters, K. L. (1998). Bathing premature infants: Physiological and behavioral consequences. *American Journal of Critical Care*, 7(2), 90–100.
- Quinn, D., Newton, N., & Piecuch, R. (2005). Effect of less frequent bathing on premature infant skin. *Journal of Obstetric, Gynecologic, and Neonatal Nursing*, 34(6), 741–746. <http://dx.doi.org/10.1177/0884217505282021>.
- Rastogi, S., Shah, R., Perlman, J., Bhutada, A., Grossman, S., Pagala, M., & Lazzaro, M. (2012). Pattern of bacterial colonization in a new neonatal intensive care unit and its association with infections in infants. *American Journal of Infection Control*, 40(6), 512–515. <http://dx.doi.org/10.1016/j.ajic.2012.02.016>.
- Rutter, N. (2003). Applied physiology: The newborn skin. *Current Paediatrics*, 13(3), 226–230. [http://dx.doi.org/10.1016/S0957-5839\(03\)00008-3](http://dx.doi.org/10.1016/S0957-5839(03)00008-3).
- Sweeney, J. K., & Blackburn, S. (2013). Neonatal physiological and behavioral stress during neurological assessment. *The Journal of Perinatal & Neonatal Nursing*, 27(3), 242–252. <http://dx.doi.org/10.1097/JPN.0b013e31829dc329>.
- Tapia-Rombo, C. A., Mendoza-Cortés, U., Uscanga-Carrasco, H., Sánchez-García, L., Tena-Reyes, D., & López-Casillas, E. C. (2012). Variations of vital signs and peripheral oxygen saturation in critically ill preterm newborn, after sponge bathing. *Revista de Investigación Clínica*, 64(4), 344–353.
- Tapia-Rombo, C. A., Morales-Mora, M., & Álvarez-Vázquez, E. (2003). Variations of vital signs, skin color, behavior and oxygen saturation in premature neonates after sponge bathing. Possible complications. *Revista de Investigación Clínica*, 55(4), 438–443.
- Visscher, M., Odio, M., Taylor, T., White, T., Sargent, S., Sluder, L., ... Bondurant, P. (2009). Skin care in the NICU patient: Effects of wipes versus cloth and water on stratum corneum integrity. *Neonatology*, 96(4), 226–234. <http://dx.doi.org/10.1159/000215593>.
- Zahr, L. K. (1998). Two contrasting NICU environments. *MCN: American Journal of Maternal Child Nursing*, 23(1), 28–36.