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Effects of Facilitated Tucking On Duration and Frequency of Crying During Rest among Hospitalized Premature Infants: A Randomized Clinical Trial

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Abstract

Background: Infants born prematurely experience more self-regulation problems in comparison to term infants. Increasing crying in premature infants can disrupt sleep and awaking pattern and it can increase stress. This study aimed to determine the effects of facilitated fetal tucking on duration and frequency of crying among premature infants.

Materials and Methods: This randomized, clinical trial was carried out in the Al-Zahra Hospital of Tabriz, Iran. Thirty-two premature infants (33-36 weeks) were selected for the study. The initial selection of the participants was based on the simple random sampling. Then the participants were allocated to groups using randomized block procedure. Every infant was studied for 4 days and in 12h period every day (8 A.M to 8 P.M) in this sequential study infants were randomly assigned 2 days in free-body posture and 2 days in facilitated fetal tucking posture. Films recorded in the 12 – h periods.

Results: The mean of crying time for facilitated fetal tucking group was 17.50 minutes and at the free-body posture was 23.35 minutes. The frequencies of crying in facilitated fetal tucking group were lower than free-body posture group. Also statistically significant difference was observed between durations of crying (p=0.009) and frequencies of crying (p=0.01).

Conclusion: It is concluded that the fetal tucking posture reduces duration and frequency of crying during rest times among infants born prematurely which leads to an improvement in sleep and waking cycles and reduces stress in premature infant. It provides to premature infant's self- regulation and adaptation to the surrounding environment.

Key Words: Crying, Facilitated fetal tucking, Infants, Neonatal ward.

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1- INTRODUCTION

Every year, about fifteen million premature infants are born (1). Infants born premature are deprived of the physiological flexion that helps position the fetus ideally for the experience of birth. During the third trimester, positioning of the fetus' body on the "midline" and in the position of "physiological containment" is encouraged (2). These positions prepare the infant for a broader range of functions, support neurodevelopment, and promote self-soothing (3). Premature infants not only are deprived of this vital experience, but also are neurologically immature and lack adequate muscular tone and strength at birth. These factors require them to maintain their bodies in extended postures, potentially disrupting development and self-regulation. The adverse effects on neonatal development prevent infants from acquiring vital skills (such as the ability to obtain nourishment and proper interact with care providers) (4). The philosophy of developmental care provided to premature infants is to support the self-regulation and adaptation of each infant to the surrounding environment (5).

Moreover, facilitated fetal tucking is recommended to improve neonatal self-regulation during the provision of developmental care to premature infants (6). The facilitated fetal tucking is a posture that supports the infant and causes the infant to control his/her body until the body is able to automatically self-regulate. In this posture, the infant's hands and feet are flexed at the midline while the infant is lying on his/her side, back, or belly (6, 7). In addition to being placed in appropriate postures, premature infants hospitalized in neonatal intensive care units (NICUs) are usually exposed to invasive procedures, high levels of noise and light, painful therapeutic methods, and so forth, all of which cause stress and excitation in infants (8). Infants' responses to stress manifest through various behaviors in their autonomic, motor, and state systems (5). In this regard, crying and fussing are among the symptoms of self-regulation disorders in premature infants (9). Fussing is a state that involves scattered waking periods along with severe anxiety, in which the infant displays a crying face but the crying sound is poor or is not heard at all. Crying also involves severe turmoil along with rhythmic, strong, and loud crying sounds (10). Crying is considered an auditory feature of infants and is a non-invasive means of assessing neural and physiological characteristics (11, 12).

Crying patterns in infants have physiological bases. However, environmental factors (such as care models and physical holding) also influence crying patterns (13, 14). The incidence and duration of crying in premature infants are higher than in term infants (9). Therefore high incidence of crying and fussing in premature and sick infants influences the relationship between parent (s) and infant (15, 16). Perhaps this is why researchers have resorted to different care methods in working with infants; these methods correct self-regulation and reduce stress and crying in infants. For example, in the research by Croff et al., (1995) it was found that post-heel-stick facilitated fetal tucking reduces the average crying duration, average sleep disorder duration, and frequency of sleep state changes (6).

In the research by Liaw et al., (2013) the concurrent effects on neonatal behavior states were studied for a routine of non-nutritive sucking, oral sucrose, and facilitated fetal tucking as well as routine care provision during a heel-stick procedure. It was found that frequencies of crying and fussing in the non-nutritive sucking, oral sucrose, and facilitated fetal tucking group were lower than in other infants (17). In the other study conducted by Larson et al. (2004), it was shown that facilitated fetal tucking is a developmentally sensitive,

nonpharmacological comfort measure that can relieve procedural pain in VLBW infants (7). Numerous studies have been conducted on neonatal stress and crying as well as methods of reducing them in infants (5-7, 17). In previous studies, facilitated fetal tucking was examined as a nursing intervention for relieving infants' pain throughout painful procedures. However, no study has examined the independent effect of facilitated fetal tucking on behavioral states and crying of infants. Since crying could be a result of stress in premature infants, the stress needs to be identified. This is because failure to identify this stress may have permanent effects, such as a higher probability of learning, functional, and psychological disorders as well as impulsive behaviors. These destructive effects could be reduced and prevented in premature infants through developmental and personal care and stress reduction techniques in the NICU environment (5).

Therefore, action is required (including adjusting fetal tucking) to mitigate neonatal stress levels and reduce the frequency and duration of crying in infants. The reason is that facilitated fetal tucking calms down the infant and reduces crying. Therefore, if this posture is implemented after each period of relaxation, medical action, or painful procedure, the mean duration and frequency of crying will decline overall. With respect to the present research, the important consideration is that infants are placed in the facilitated fetal tucking posture as part of a broader model of care for premature infants during 12-hour relaxation periods, and the effects of this intervention on duration and frequency of crying are explored. The aim of study was comparing the effect of facilitated fetal tucking and free body posture on duration and frequency of crying and fussing in premature infants during rest.

2- MATERIALS AND METHODS

2-1. study design and population

The present research was a randomized clinical trial (201407088315N9. Premature infants (33-36 weeks' post-conceptual age [PCA]) were recruited in 2015 (6 December 2014 – 6 March 2015) at the neonatal ward of the Alzahra Teaching Hospital affiliated to Tabriz University of Medical Sciences, Iran. The sample size 0f 32 infants in each group assigned to intervention.

2- 2. Methods

The sample size was estimated based on the pilot research and G*Power version 3.1.2 (public domain, Universität Dusseldorf, Germany) was used to determine the sample size. Pilot information was obtained using a preliminary sample of 10 infants. Using the means and standard deviations of three variables (namely sleep, wake, and crying), and ANOVA test, the overall sample size was calculated to be 76 at the confidence interval of 95% with a statistical power of 0.8. As a result, 19 participants were estimated for each group. Considering the possible loss, a total of 32 participants were selected for each group to increase credibility. A total of 38 infants were assessed. Of the 38 infants, 6 were excluded from the research due to the incidence of hyper bilirubinemia and the use of eye shield, leaving a study population of 32 infants who participated. Data over 4 days (128 observations) comprised the final analysis. Initially, the convenience sampling method was used for this research. Afterwards, infants were put in different groups using size 4 random blocks. The required random numbers were generated in RAS v1.0 by the study's statistics advisor. The principal researcher oversaw the selection of criteria for assessment, enrollment, and random assignment of participants; intervention and data collection were managed by a co-researcher and one of the main researchers. All of the infants were under the same

environmental conditions, and all of them were out of incubators and inside their cots. The ambient temperature varied between 23℃ and 25℃, and ambient light was between 97 and 112 lx. Sound intensity was 46-66 db. All infants received family-centered care, and mothers participated in taking care of the infants during the course of this research. Supportive care, which involved the Kangaroo Mother Care (KMC) method, massaging, the cluster-caring method, non-nutritive sucking, and the singing of lullabies on the part of the mother, was provided equally to all of the infants in accordance with the ward's routine.

2-3. Measuring tools: validity and reliability

To record the sleeping, waking, nutrition-sucking, and crying-fussing states of infants, the "Baby's Day Diary" developed by Barr et al. was used (18). An inventory was also used to record the demographic information of infants. The reliability of the sleeping, waking and crying-fussing diagnoses of observers by intraclass correlation coefficient (ICC) was 0.96, 0.97, and 0.82, respectively. The sleeping, waking, nutrition-sucking, and crying-fussing states of infants were recorded every 5 minutes while watching the recorded films. To recognize the sleeping, waking and crying – fussing states, the state portion of the Assessment of Premature Infant Behavior (APIB) scale was used (10).

2-4. Intervention

Two types of postures used by the infants in rest included facilitated fetal tucking and the free-body posture:

2-4-1. Facilitated fetal tucking *(with Tucking*)

In this state, the infant's hands and feet were flexed and the body was on the midline. This position was maintained by creating borders using soft rolled clothes.

- *Facilitated fetal tucking in supine position:* infant lying in a position faced up, back to the bed and body in flat state on bed. The feet and hands were in flexion state and at the middle line. U-formed rolled soft cloth was put around the infant for protection.
- *Facilitated fetal tucking in lateral position:* infant lying on the right or left side of the body. The feet and hands were in flexion state and at the middle line. The back of the infant was protected by C-formed rolled soft cloth.

2-4-2. Free body posture *(without Tucking)*

In this state, the infant's hands and feet were in the spontaneous state next to the body, and placement and movement of the body were spontaneous and controlled by muscular tone.

- *Free body posture in supine position:* infant lying in a position faced up, back to the bed and head in middle line. Infant's feet and hands were free (spontaneous) and at the sides of body.
- *Free body posture in lateral position:* infant lying on the right or left side of his body and his feet and hands were in free (spontaneous) and at the sides of body. Infant's back and belly were protected by rolled soft cloth.

In both states, the supine and lateral positions were used. The prone position was omitted from both states in this research, because it was difficult to obtain the image of the infant's face in the prone position. Following safety standards, four SCS 900 tvl closed-circuit video cameras (CCVCS) were installed in the neonatal ward of Alzahra Teaching Hospital.

The cameras were affixed to the walls with metal stands such that they were at a

distance of about 40 cm from the infants' faces, and observers were able to recognize the facial expressions, crying, and fussing of infants in the recorded films. For this purpose, the infants were placed for 2 days in the fetal tucking state (n=32), and two days in the free-body posture (n=32). The effect of physical holding on duration and frequency of crying and fussing during rest times was also studied in all cases. The daily observation period lasted for 12 hours, with filming starting at 8 A.M. each day (after the start of the physical holding/positioning), and ending at 8 P.M.

Two trained researcher nurses were in charge of maintaining body posture and positions when infants were in their cots for rest. The nurses directly supervised the maintenance (through holding) of infants in the desired postures during rest; if an infant changed the fetal tucking posture, the researcher nurse would gently place the infant in the fetal tucking posture using warm hands. The 12-hour observation periods were divided into two parts: the morning working shift (from 8 A.M. to 2 P.M.), and the afternoon working shift (from 2 P.M. to 8 P.M.). One nurse served as the co-researcher in the neonatal ward during each period. The washout periods were between the hours of 8 P.M. and 8 A.M., and the ward's routines were followed with respect to holding and positioning of infants during these periods. After completing the interventions, the recorded films were reviewed by two persons unfamiliar with the study hypothesis.

2-5. Ethical consideration

The informed consent of all parents was obtained, and the ethics committee of Tabriz University of Medical Sciences approved the research protocol (Research No. 9358). Moreover, the present research is registered with the 201407088315N9 code on the IRCT website.

2-6. Inclusion and exclusion criteria

The inclusion criteria were birth weight > 1,500 gr, a one-day history of hospitalization in the neonatal ward, no limitations for posture changes, disease condition acceptable for observation (illness severity indicated by the Neonatal Therapeutic Intervention Scoring System [NTISS] score being < 21, with no substance abuse on the part of the mother. Exclusion criteria included congenital anomalies, the outbreak of hyper bilirubinemia during phototherapy due to the use of an eye shield, septicemia, intra ventricular hemorrhage, small for gestational age (SGA), hospitalization of <4 days, and use of tranquilizers, muscle relaxants, analgesics, aminophylline, and caffeine in infants.

2-7. Data Analyses

In this single-blind study the mean and standard deviation values were used to present the demographic variables. To compare the effects of posture on duration of sleeping, waking, and crying-fussing, as well as on frequency of crying-fussing, the mixed-model analysis method was used. SPSS v13 (SAS; Chicago, Illinois, USA) was used to analyze the data at the significance level of $p<0.05$.

3- RESULTS

The aim of this study was to determine the effects facilitated of fetal tucking on duration and frequency of crying among premature infants. Characteristics of the 32 studied infants are shown in **Table.1**. No significant statistical difference was observed in the mentioned variables ($p>0.05$). Variables including gestational age (GA), birth weight, Apgar score, Post Conceptual Age at beginning of exposure, weight at beginning of exposure, length of hospital stay and gender. The confounding variables included the infant's weight on the day of investigation, number of procedures carried out in the infant, the

infant's feeding times, duration of feeding the infant within 12 hours, volume of milk received, and NTISS score; these are presented in **Table.2**. No statistically significant difference were observed in these variables (p>0.05). The means and standard deviations of duration of sleeping, waking, and crying-fussing are shown in **Table.3**. Following the statistical investigations, a statistically significant difference was observed between durations of crying-fussing in the fetal tucking (Mean ± standard deviation [SD]: 17.50±15.23) and free-body posture (23.35 ±19.08) groups (p=0.009). Infants in the fetal tucking posture group cried and fussed 5.8 minutes less than did infants in the free-body posture group in each 12-hour period. In addition, there was a statistically significant difference between values of sleeping and waking of the fetal tucking posture and free-body posture groups. That is to say, the mean duration of sleep in the fetal tucking group was 41.9 minutes more than in the free-body posture group (p=0.00). Furthermore, the mean duration of wakefulness in the fetal tucking group was 17.83 minutes less than in the free-body posture group (p=0.005),). Moreover, the duration of provision of care methods, either nursing or otherwise (such as Kangaroo Mother Care and massaging), as well as the times the infants were out of camera range and it was not possible to directly observe their behavioral status, were considered as missed data. Durations of missed data for the fetal tucking and free-body posture groups were 42.69 min/12 h (5.92%) and 60.94 min/12 h (8.46%), respectively. **Table.4** presents results from the examination of concurrent effects of physical holding on frequency of crying-fussing in infant participated in the study Based on the results, the highest frequency (15 ≥) of crying-fussing belonged to the free-body posture group (32%). A statistically significant difference was observed between frequencies of crying-fussing in the fetal tucking and free-body posture groups following statistical analyses using the mixed-model analysis method (p=0.01). Therefore, frequencies of crying and fussing in infants in the fetal tucking posture were lower than those for infants in the free-body posture.

Table-1: Demographic and clinical characteristics of the sample (n = 32)

Variables	Mean ± SD
GA, week	31.4 ± 2.8
Birth weight, gr	1721.8 ± 595.15
Apgar Score 1th minute after birth*	8
Apgar Score 5th minute after birth*	9
PCA at beginning of exposure, wk	34.34 ± 1.12
Weight at beginning of exposure, g	2018.75 ± 415.78
Length of hospital stay, d	9 ± 8.67
Gender(female:male ratio)**	15:17

Data is presented as *Median or **ratio; PCA: postconceptional age; SD: standard deviation.

Table-2: Comparison of confounding variables among study groups

Variables	Free body posture	Facilitated fetal tucking	P-value
Weight on the study day (gr)	2062.03± 393.78	2059.37 ± 413.85	0.99
The number of procedures, (N/12h)	3.81 ± 1.33	3.68 ± 1.15	0.07
The number of Feeding, (N/12h)	6.40 ± 1.68	6.18 ± 1.54	0.12
The duration of nutrition,(Min/12h)	71.79 ± 26.67	71.82 ± 22.71	0.95
The intake milk at every turn, (ml)	24.17 ± 10.73	24.59 ± 9.82	0.97
Mixed model analysis	3.84 ± 2.34	3.81 ± 2.41	0.56

Table-3: Descriptive statistics and mixed model analysis for sleeping, waking and crying - fussing at free body posture and facilitated fetal tucking posture.

Variables	Free body posture	Facilitated fetal tucking	Mean Difference	95% Confidence interval		P-value* Differences Groups
				Lower	Upper	
Sleep, min/12ha	481.39 ± 83.14	523.29 ± 82.71	-41.90	-62.54	-21.26	0.00
Wake, min/12h a	82.53 ± 54.03	64.70 ± 40.24	17.82	5.66	29.99	0.005
Crying-fussing, min/12h **	23.35 ± 19.08	17.50 ± 15.23	5.85	1.48	10.23	0.009

Dependent variables: Sleep, Wake, Crying – fussing; * Mixed model analysis; **Reported as mean ± SD, in minutes (decimal) of bouts.

Table-4: Frequency of crying-fussing in infants participated in the study

Frequency of Crying-fussing, N/12h	Free body posture		Facilitated fetal tucking	
	Total	Percent	Total	Percent
3 ≤	16	25	22	34.4
8-4	11	17.2	16	25
15-9	16	25	15	23.4
15≥	21	32.8	11	17.2

4- DISCUSSION

Research findings showed that the facilitated fetal tucking posture led to significant decreases in duration and frequency of crying-fussing, increases in sleep duration, and decrease in duration of waking among infants who born premature. In the present study, the facilitated fetal tucking posture reduced duration of crying and fussing (p=0.009) and frequency of crying and fussing (p=0.01) within 12 hours as a care model and as a process of physical holding when infants were relaxing. In the study by Croff et al. (1995), it was found that in infants with a gestational age of 25-35 weeks, the facilitated fetal tucking posture caused shorter mean crying time and shorter mean sleep disruption time during procedures causing minor pain (6) which was consist with the present study. However, in this study only duration of crying-fussing has been calculated and the frequency of crying-fussing has not been studied.

In an investigation by Liaw et al. (2013), the effects of non-nutritive sucking, oral sucrose, and the facilitated fetal tucking posture on behavioral states of infants were studied during a heel-stick procedure. Results of their investigation revealed that the facilitated fetal tucking posture reduces occurrences of crying and fussing if accompanied by non-nutritive sucking and oral sucrose during painful procedures (17). The results of our study are similar; (17). Also Reyhani and et al. (2014), calculated that the effects of facilitated tucking during venipuncture on duration of crying in premature infants and have been shown to facilitated tucking is effective in reducing the duration of crying infant (19).

Proper positioning and supporting flexed postures are one of the NIDCAP (The Neonatal Individualized Developmental Care and Assessment Program) subset. These intervention support the infants and increasing stability and reducing the stress and agitation (20). Reducing crying and increasing sleep is one of the symptoms of stress relief. So the results of our study are similar, however in previous studies, facilitated fetal tucking was intervention for relieving infant's pain thought painful procedures and these studies haven't

examined the independent effect of facilitated fetal tucking on behavioral states and crying on infants. The innovation of this research was its concentration on the effect of facilitated fetal tucking during rest time on duration and frequency of crying and fussing in hospitalized premature infants. In the present study, the development of behavioral states (e.g. increased sleep duration, decreased waking duration, and decreased duration/frequency of crying and fussing) occurs more rapidly in the facilitated fetal tucking posture. Neonatal stress decreases with a decrease in duration and frequency of crying and fussing, and this outcome leads to improvement of self-regulation and peaceful behavioral states in premature infants. Improvement of self-regulation leads to enhancement of quietness and sleep duration in premature infants through reduction of the frequency of crying episodes.

Seven components of the state system include: deep sleep, light sleep, drowsy, awake/alert, awake/fussy, awake/aroused and crying, or unavailable. The role of the state system in infant developmental assessment reflects the infant's ability to respond to the environment (21). Some of the benefits of increasing sleep duration in preterm infants include improved physical growth (22, 23), sensory-nervous system development, hippocampus and pons development (24), body temperature adjustment, storage of energy, and removal of toxins from neurons (25). Since the self-regulation system is reflective of the efforts and successes of infants in restoring integration and peace (26).

4-1. Limitations of the study

This study was conducted on infants aged between 33 and 36 weeks and weighing 1,500 gr or higher. Hence, its results could not be generalized to all premature infants. In addition, infants with medical and congenital problems or infants receiving advancement treatments (with high NTISS scores) were excluded from this research. Therefore, the findings of this study could not be applied to such infants. Due to ethical considerations, mothers were allowed to retrieve their babies from their cots for caregiving when they desired.

5- CONCLUSION

Results of this research revealed that the effect of facilitated fetal tucking posture on the decrease in crying of infants is significantly better in reducing crying-fussing and other adverse behaviors than the effect of the free-body posture. That is to say, the facilitated fetal tucking posture (as with the Newborn Individualized Development and Care Assessment Program care model) reduces duration of crying at the time of relaxation and reduces neonatal crying during 12-hour periods. Moreover, the facilitated fetal tucking posture increases duration of sleep and reduces duration of waking in 12-hour periods. This posture could be used as an essential care method to accelerate the neonatal development process and improve self-regulation of infants. It is also recommended to set policies for implementation of this method as a necessity for nursing cares. Some of the suggestions for future research include the following: conducting studies with larger age and weight ranges; conducting studies on infants with more complicated problems; and investigating the effect of developmental care and the maternal health states and the intra – uterine environmental on crying in premature infants.

6- CONFLICT OF INTEREST: None.

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8- REFERENCES

1. World Health Organization. Born too soon: the global action report on preterm birth. 2012. Avalaible at: http://www. who. int/maternal_child_adolescent/documents/born_too_soon/en. 2014.

2. Waitzman KA. The Importance of Positioning the Near-term Infant for Sleep, Play, and Development. Newborn and Infant Nursing Reviews. 2007;7(2):76-81.

3. Aucott S, Donohue PK, Atkins E, Allen MC. Neurodevelopmental care in the NICU. Mental Retardation and Developmental Disabilities Research Reviews. 2002;8(4):298-308.

4. Zarem C, Crapnell T, Tiltges L, Madlinger L, Reynolds L, Lukas K, et al. Neonatal Nurses' and Therapists' Perceptions of Positioning for Preterm Infants in the Neonatal Intensive Care Unit. Neonatal Netw. 2013;32(2):110-16.

5. Hill S, Engle S, Jorgensen J, Kralik A, Whitman K. Effects of facilitated tucking during routine care of infants born preterm. Pediatric Physical Therapy. 2005;17(2):158-63.

6. Corff KE, Seideman R, Venkataraman PS, Lutes L, Yates B. Facilitated tucking: a nonpharmacologic comfort measure for pain in preterm neonates. Journal of Obstetric, Gynecologic, Neonatal Nursing. 1995;24(2):143-7.

7. Ward-Larson C, Horn RA, Gosnell F. The efficacy of facilitated tucking for relieving procedural pain of endotracheal suctioning in very low birthweight infants. MCN. The American Journal of Maternal Child Nursing. 2004;29(3):151-6.

8. Beck S, Wojdyla D, Say L, Betran AP, Merialdi M, Requejo JH, et al. The worldwide incidence of preterm birth: a systematic review of maternal mortality and morbidity. Bulletin of the World Health Organization. 2010;88(1):31-8.

9. Korja R, Huhtala M, Maunu J, Rautava P, Haataja L, Lapinleimu H, et al. Preterm Infant's Early Crying Associated With Child's Behavioral Problems and Parents' Stress. Pediatrics. 2014;133(2):e339-45.

10. Goldson E. Nurturing the Premature Infant: Developmental Intervention in the Neonatal Intensive Care Nursery. 1st ed.NewYork: Oxford University Press; 1999.

11. Soltis J. The signal functions of early infant crying. The Behavioral and Brain Sciences. 2004;27(4):443-58.

12. Porter FL, Porges SW, Marshall RE. Newborn Pain Cries and Vagal Tone: Parallel Changes In Response to Circumcision. Child Development. 1988;59(2):495-505.

13. Brazelton TB. Crying in infancy. Pediatrics. 1962;29(4):579-88.

14. Rautava P, Lehtonen L, Helenius H, Sillanpää M. Effect of Newborn Hospitalization on Family and Child Behavior: A 12-Year Follow-up Study. Pediatrics. 2003;111(2):277-83.

15. Kusaka R, Ohgi S, Shigemori K, Fujimoto T. Crying and Behavioral Characteristics in Premature Infants. Journal of the Japanese Physical Therapy Association. 2008;11(1):15.

16. Keith DR, Russell K, Weaver BS. The Effects of Music Listening on Inconsolable Crying in Premature Infants. Journal of Music Therapy. 2009;46(3):191-203.

17. Liaw J-J, Yang L, Lee C-M, Fan H-C, Chang Y-C, Cheng L-P. Effects of combined use of non-nutritive sucking, oral sucrose, and facilitated tucking on infant behavioural states across heel-stick procedures: a prospective, randomised controlled trial. International Journal of Nursing Studies. 2013;50(7):883-94.

18. Barr R, Kramer M, Boisjoly C, McVey-White L, Pless I. Parental diary of infant cry and fuss behaviour. Archives of Disease in Childhood. 1988;63(4):380-7.

19. Reyhani T, Aemmi SZ, Mohebbi T, Boskabadi H. The Effect of Facilitated Tucking (FT) During Venipuncture on Duration of Crying in Preterm Infants. International Journal of Pediatrics. 2014;2(4.3):431-5.

20. Fleisher BE, VandenBerg K, Constantinou J, Heller C, Benitz WE, Johnson A, et al. Individualized Developmental Care

for Very-Low-Birth-Weight Premature Infants. Clinical Pediatrics. 1995;34(10):523-9.

21. Als H. A Synactive Model of Neonatal Behavioral Organization: Framework for the Assessment of Neurobehavioral Development in the Premature Infant and for Support of Infants and Parents in the Neonatal Intensive Care Environment. Physical & Occupational Therapy In Pediatrics. 1986;6(3-4):3-53.

22. Tikotzky L, DE Marcas G, Har-Toov J, Dollberg S, Bar-Haim Y, Sadeh A. Sleep and physical growth in infants during the first 6 months. Journal of Sleep Research. 2010;19(1-Part-I):103-10.

23. Reyhani T, Aemmi SZ, Sannadgol V, Boskabadi H. The effect of creating an artificial night on physiological changes in preterm infants. International Journal of Pediatrics. 2014;2(4.3):407-12.

24. Graven SN, Browne JV. Sleep and Brain Development: The Critical Role of Sleep in Fetal and Early Neonatal Brain Development. Newborn and Infant Nursing Reviews. 2008;8(4):173-9.

25. Dang-Vu TT, Desseilles M, Peigneux P, Maquet P. A role for sleep in brain plasticity. Pediatric rehabilitation. 2006;9(2):98-118.

26. Als H. NIDCAP: Testing the Effectiveness of a Relationship-Based Comprehensive Intervention. Pediatrics. 2009;124(4):1208-10.