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Assessing Factors Influencing the Quality of Developmental Care in Neonatal Intensive Care Units of Tehran

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Abstract

Background: Neonatal intensive care unit (NICU) developmental care refers to interventions in the infant's environment in neonatal intensive care unit to reduce environmental stresses and provide greater family-infant compatibility.
Objectives: The aim of this study was to assess current developmental care performance and factors influencing implementation of this care at NICUs in Tehran, Iran.
Methods: This cross-sectional study as part of a larger mixed method study assessed the quality of developmental care in Tehran NICUs. The study was performed on 400 nurses working in level III NICUs in 27 hospitals of Tehran during years 2014 and 2015. Data were collected using two scales, "NICU developmental care assessment (NDCA) scale " and "NICU developmental care structural (NDCS) checklist". The scales validity was detected by content, face and construct and reliability by internal consistency and test-retest. The overall and each domain score were calculated in percentages. Data were analyzed using the SPSS-21 software using descriptive statistics tests and regression analysis.
Results: The total score of quality of providing developmental care was 74.84%. Among all domains, "daily routine care" had the highest score (85.67%) and "sleep and pain care" had the lowest score (66.63%). Total score of structure was 43.06%. The number of neonates admitted per day (B -0.328, P = 0.019) and number of infants managed by each nurse (B -2.543, P = 0.019) were significant predictor variables for better quality of total developmental care.
Conclusions: The number of infants cared and admitted were the only significant factors contributing to high quality of developmental care. Therefore, it is reasonable to assume that in case of Tehran, work-load and structure of services should receive greater attention.

Keywords: Neonatal Intensive Care Units, Developmental Care, Quality of Care, NICU Developmental Care Assessment (NDCA) Scale, NICU Developmental Care Structural (NDCS) Checklist

1. Background

Every day, a significant number of neonates are admitted to neonatal intensive care units (NICU). Some of the main reasons behind NICU referrals are preterm birth and low birth weight. Every year, 15 million infants are born prematurely worldwide (that is one per ten infants) (1, 2). At a death rate of 15%, premature birth is the leading cause of infant mortality and also the cause of long- and short-term complications, including cerebral palsy, intellectual disability, hearing and visual disorders (3). Infants born preterm between 32 and 36 weeks are two to three times at greater risk of perceptual motor disorders compared to term infants (4), due to infant's premature organs and thus inability to cope with environmental stresses (5). This problem is addressed through developmental interventions provided around the infant's environment at NICU to reduce environmental stresses and provide greater family-infant compatibility. This care has been able to enhance infant outcomes such as weight gain, onset of oral feeding, self-regulation, and satisfaction of the family and care providers (6, 7). Several theoretical models have explained components of such cares. Built on an earlier theory of neonatal behavior by Brazelton, synactive theory by Als proposed a major reformulation of developmental care in 1979, which provided the basis for the "universe of developmental care" (UDC) in 1989 (8). Based on the UDC, five major aspects have been expressed for developmental care at NICU, including sleep care, pain and stress assessment and management, routine daily cares, appropriate environment, and finally, family-oriented care. Also based on UDC, the "integrated neonatal care" model was proposed in 2013, which emphasized two other aspects ("improved nutrition" and "positioning"), along with environmental improvement, parents participation, sleep care, reduced pain

and stress, and skin care (9).

Developmental care as a new method of neonatal care requires major changes in attitude and practice of professionals. Consequently, after such changes are in effect, the result of quality of care should be evaluated. Previous studies have assessed quality of developmental care, including the study of Zhang from China and Valizadeh from Iran that assessed developmental cares in NICU using tools containing four standard cares including individualized care, parents and family involvement, collaboration of healthcare providers, and environmental control (10, 11). A study in Italy assessed quality of developmental care at the NICU using a checklist of "infant-oriented care" and "management of pain" areas with two separate indices. Previous studies determined that the quality of developmental care provided to preterm infants is affected by certain contributing factors, such as nurses' age, years of work experience, educational level, nurse–patient ratio, etc. (10).

2. Objectives

In Iran, developmental care has gained special attention during the past few years. Since assessment of this care is essential in the healthcare system, this study was conducted to assess quality of developmental care provided in NICUs and factors affecting it in Tehran, Iran. Better understanding of the current situation of this care could be useful for necessary intervention to improve quality of developmental care in the future.

3. Methods

This cross-sectional study assessed the quality of developmental care in Tehran NICUs and related factors.

3.1. Data Collection Tools

Developmental care performance was assessed by NDCA scale and structural component of NICU was assessed by NDCS checklist, designed by the research team (12). The scale and checklist were designed in qualitative and quantitative phases. In the qualitative phase, 30 experts in neurodevelopmental care were asked to identify the criteria needed for assessment of these cares using the Delphi method, taking into account conditions at NICUs of Iran. Thus, the initial tools were developed in five Delphi rounds by implementing views expressed by experts and in accordance with review of the literature. In the quantitative phase, validities and reliability were assessed and confirmed. The NDCA scale contains 76 items scored according to a ten-point Likert scale from one (the worst condition) to ten (the best condition). It contains five domains of sensory (10 items), family-centered (18 items), sleep, pain and stress (18 items), daily routine (20 items), and management (13 items) cares. The overall and each domain score were calculated in percentages. The validity of the questionnaire was assessed by content (qualitative-quantitative), face (qualitative-quantitative), and construct (exploratory factor analysis) methods. The questionnaire was reliable with Cronbach's alpha of 0.93 and intraclass correlation coefficient of 0.9.

The NICU developmental care structural checklist contained 78 items and three domains of space, facility control of environment and human resource management. Items were scored in three point Likert scaling including: "Yes completely"," Yes partially" and "No". Its reliability was confirmed with Cronbach's alpha, equal to 0.92.

A questionnaire on NICU nurses' demographics and specifications asked about factors such as nurse's age, work experience, educational level, knowledge, and familiarity of developmental care, number of neonates admitted per day, and number of infants managed by each nurse.

3.2. Sampling and Sample Size

In this study, 400 NICU nurses participated using the convenient sampling method. For participation a minimum of six months of working at NICU was required.

3.3. Study Setting

This study was conducted at level III NICU in 27 hospitals, including 12 teaching, seven public, and eight private hospitals in Tehran.

3.4. Procedures

The study was approved by the ethics committee of the University of social welfare and rehabilitation science (SWR.REC.1393.151), and conducted between November 2014 and August 2015. The NDCA Scale was completed by eligible NICU nurses. The NDCS checklist was completed by head nurse of each NICU.

3.5. Data Analysis

Descriptive statistics were computed for all participants' characteristics and their units. Multiple linear regressions were performed to determine whether there were any variables that predicted quality of developmental care provided at NICUs. Before using regression analysis, Pearson's correlations were conducted. The score of care was assessed in percentages for each domain and the whole scale. Data were analyzed using the SPSS-21 software.

4. Results

Mean age of participating NICU nurses was 33.79 ± 6.49 years. The majority of the participating nurses had Bachelor's degrees (BSc) (90.4%), while 9.6% of the nurses had Master's and PhD degrees. Table 1 presents NICU turnover and participant information including daily and monthly infant admissions, mean age of participants and work experience. Overall, 58.9% of participants were relatively and 28.9% were fully familiar with developmental care, while 12.2% had no familiarity. The total mean score of quality of providing developmental care was 74.84%. Among all domains, "daily routine care" had the highest (85.67%) and "sleep and pain care" the lowest (66.63%) score. Total score of structure was 43.06%. Table 2 shows the mean score of providing developmental care and structure score in total and for each sub-domain. The results of multiple linear regressions showed that lower number of infants managed by each nurse, lower work experience at NICU and lower number of neonates admitted per day were significant predictors for better quality of developmental care. The significant predictors for better quality of total developmental care included the following: number of neonates admitted per day and number of infants managed by each nurse. These predictors together explained nearly 10% of the variance in better quality of developmental care. Results of multiple linear regression suggested that there was a negative linear relationship between "number of neonates admitted per day" and "daily routine cares", "family-centered care", "sensory cares" and "pain and sleep cares". There was a negative linear relationship between "number of infants managed by each nurse" and "work experience at the NICU" and sensory cares.

We did not find any correlation between structural score and variables such as "work experience in NICU" and "number of neonates admitted per day". Table 3 shows summery of multiple linear regressions predicting factors for quality of developmental care. No correlation was found between structural score and developmental care score at total or each sub-domain.

5. Discussion

Today, quality assessment is routinely used to identify inefficient performance in healthcare systems (13, 14). The present study was conducted to assess quality of developmental care provided in NICUs and factors that affected it in Tehran, Iran.

In this study quality of developmental care score in all five domains was 74.84%; Valizadeh in Tabriz reported this score as 76% (11). In a study by Godarzi, developmental care score at nine teaching hospitals in Tehran was reported as 66.53% (15). In the present study, teaching hospitals score was 67.59%, which agrees with the score found in the study of Godarzi (15). In a study by Zhang on nine hospitals in China, score of developmental care was 87% (10). The poor developmental care scores in the present study may be attributed to the novelty of such cares in Iran. Developmental cares have recently gained particular interest in Iran, and a nationwide program is now being prepared and implemented for training nurses and preparing hospitals (16).

In the present study, daily care (nutrition, position, and skin care) was ranked first among all domains of developmental care (85.67%). Other researchers including Valizadeh et al. (11) and Zhang et al. (10) did not report the domains separately, making a comparison impossible. However, in the study of Godarzi (15) conducted in teaching hospitals, a separate score was found for the daily cares domain (79.02%), which agrees with that found in the present study. The high score in this domain may be justified by the fact that nutrition, position and skin cares are considered among the most elementary of neonatal cares. There is also high emphasis placed on many of Iran's studies on interventions such as kangaroo care and breast-feeding.

As the second domain, family care including family participation in care, interaction with family, training, and respect for the family had a score of 83.31%. This domain was reported 75% in the study of Godarzi (15) and 86% in Zhang's study (10). In every study on developmental care, family has been considered the main component in providing appropriate neonatal care. Family-oriented cares have been able to improve frontal brain activity in sleep, weight gain, discontinuation of incubation, and onset of breast-feeding (17-20).

Hospital management was the third domain including developmental care support, teamwork, training of nurses and assessment of cares by departmental and hospital managers. Despite being an important part of providing the right developmental care (21), management has less often been assessed as a separate variable. In the present study, management was identified as the third domain in developmental care with a score of 69.26%, indicating the need for greater consideration to provide better developmental cares in pediatric hospitals.

As the fourth domain, sensory care including control of noise, light, odor or aroma, and touch scored 69.32%. In studies by Valizadeh (11) and Godarzi (15), this domain scored 75.5% and 65.27%, respectively. Intensity of odor, noise and light at NICU can act as stimulants and cause stress to premature organization. In Iran, studies on lighting and noise have shown that these factors are controlled in only 50% of NICUs (22). In America, NICU noise level was also reported above the permissible level (23, 24).

Table 1. Characteristics of the Participants and Neonatal Intensive Care Unit Admissions

Characteristics	Mean ± SD	Maximum	Minimum
Age of participants, y	33.95 ± 6.049	22	55
Work experience, y	4.77 ± 5.615	1	33
Work experience at the NICU, y	5.89 ± 4.586	1	29
Mean number of neonates admitted per day/NICU	3.59 ± 4.627	20	1
Mean number of neonates admitted per month/NICU	65.89 ± 107.971	500	4
Number of infants managed by each nurse/ day	3.12 ± 1.051	5	1

Table 2. Developmental Care and Structure Scores in Evaluated Neonatal Intensive Care Units

	Mean	SD	Minimum	Maximum
Total Developmental Care score	74.8404	9.69268	52.74	88.51
Daily routine care	85.6728	7.19425	63.29	92.59
Family-centered	83.3184	10.05070	57.69	94.57
Management	69.2600	12.26849	32.29	86.54
Sensory	69.3200	10.93687	43.25	85.51
Pain and sleep	66.6309	14.56428	39.37	90.23
Total Structural Score	43.0617	6.37506	33.33	56.33
Space and Facility	46.4074	7.90939	31.00	61.00
Control of environment	27.1852	5.15929	19.00	38.00
Human resource management	55.5926	8.92386	38.00	75.00

Table 3. Predicting Factors for Quality of Developmental Care in Neonatal Intensive Care Units (Linear Regression Method)

Domain	Model	Coefficients[a]		Coefficients[b]	t	P
		B	SD Error	Beta		
Daily routine care	Constant	91.757	3.931		23.343	< 0.001
	Number of neonates admitted per day	-0.518	0.094	-0.308	-5.486	< 0.001
Family-centered	Constant	84.293	4.492		18.765	< 0.001
	Number of neonates admitted per day	-0.574	0.109	-0.295	-5.274	< 0.000
Sensory	Constant	75.673	4.950		15.289	< 0.001
	Work experience at NICU	-0.505	0.231	-0.106	-2.183	0.030
	Number of infants managed by each nurse	-3.620	0.967	-0.214	-3.743	< 0.001
	Number of neonates admitted per day	-0.492	0.130	-0.215	-3.775	< 0.001
Pain and sleep	Constant	64.714	6.937		9.328	< 0.001
	Number of neonates admitted per day	-0.353	0.168	-0.135	-2.097	0.037
Total Developmental care score	Constant	76.958	5.379		14.308	< 0.001
	Number of infants managed by each nurse	-2.543	1.080	-0.173	-2.354	0.019
	Number of neonates admitted per day	-0.328	0.139	-0.173	-2.358	0.019

[a] Unstandardized.
[b] Standardized.

Sleep and pain as the fifth domain was included in sleep control and positioning; assessment and reduction of pain were scored 66.63%. In various developmental care models, sleep and pain are regarded as two separate domains, but in the present study, according to the designed scale, both were placed in one domain. In the study of Godarzi (15), sleep care scored 65.43%. The right sleep conditions and pain control are the two highly important as-

pects of developmental cares. Sleep and sleep-awake cycle are essential to neural and sensory processing, learning, memory development, brain development, and ability for constant changes against stimuli (25). Impaired sleep leads to physiological instability and reduced brain plasticity, resulting in reduced optimal development of a preterm infant (26).

Based on results of the present study, structural checklist score was 43.0617%, which is not appropriate. Structural factors such as physical location of NICU, space and facilities for family accommodation, facilities to control light and sound, and follow-up facility after discharge as well as number and attitude of nurses, neonatal and pediatric specialists, occupational and physical therapists, and audiologists are necessary for providing an optimal developmental care (21, 27). Therefore, modifications in the setting and physical environment of NICU, changes in professionals' attitude and teamwork training are the most important factors for the implementation of developmental care in Iranian NICU settings.

For evaluating the influencing of nursing characteristics and hospital factors (number of infants admitted per day, number of doctor, etc.) on quality of developmental care, primarily Pearson correlation and then multiple liner regression were used. The results of regression showed that lower number of infants managed by each nurse, lower number of neonates admitted per day and lower work experience in NICU were predictive for better quality of developmental care. Developmental care is very accurate and time-consuming method of care and not easy to implement in any professional field. As a consequence, large number of nurses, who spend more time in contact with the infant and their families, are required for providing developmental care (28). Many studies acknowledge that the large number infants under the supervision of each nurse or inappropriate nurse-to-patient ratios are a very important factor in the quality of developmental care.

According to the obtained results, surprisingly, higher work experience at the NICU had led to lower quality of developmental care in sensory care sub-scale domain. This could be due to the significant benefits of newer developmental care versus the traditional methods used by the more experienced staff. An efficient developmental care initially requires an acceptance of the need for new mentality and practical methods. Once there is a broad understanding of the need, a knowledgeable team of professionals with expertise in such new methods can significantly help boost the quality of developmental care. This process requires a change in attitude and behavior, which in the field of medicine, is translated into improved quality of care.

5.1. Conclusion

The results obtained in this study indicate that while developmental care is beginning to grow in the practical aspect in Iran, more attention to it as a new approach is essential. Developmental care includes multiple domains and status of care in each of the domains can indicate weaknesses in providing these cares, and to improve them, appropriate planning is required. Improvements in quality of care provided by the healthcare system can be identified through reassessment of these cares in the future.

5.2. Strengths and Limitations

Despite the limitations, this study had positive points which include: use of national scales with complete psychometric assessment, assessment of all aspects of developmental care including hospital management, adequacy of sample size and the number and diversity of hospitals. In this research, along with nurse's performance, the structure and facilities of NICU was also evaluated. The main limitation of this study was that while nurses' attitudes and beliefs are important and influential factors on performance of developmental care, these factors were not measured thoroughly.

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References

1. Kinney MV, Lawn JE, Howson CP, Belizan J. 15 Million preterm births annually: what has changed this year?. *Reprod Health.* 2012;**9**:28. [PubMed: 23148557].
2. Liu L, Oza S, Hogan D, Perin J, Rudan I, Lawn JE, et al. Global, regional, and national causes of child mortality in 2000-13, with projections to inform post-2015 priorities: an updated systematic analysis. *Lancet.* 2015;**385**(9966):430–40. [PubMed: 25280870].
3. Soleimani F, Zaheri F, Abdi F. Long-term neurodevelopmental outcomes after preterm birth. *Iran Red Crescent Med J.* 2014;**16**(6):17965. [PubMed: 25068052].
4. Torchin H, Ancel PY, Jarreau PH, Goffinet F. [Epidemiology of preterm birth: Prevalence, recent trends, short- and long-term outcomes]. *J Gynecol Obstet Biol Reprod (Paris).* 2015;**44**(8):723–31. [PubMed: 26143095].
5. Bieleninik L, Gold C. . Early intervention for premature infants in neonatal intensive care unit. *Acta Neuropsychologica.* 2014;**12**:185–213.
6. Phillips RM. Seven core measures of neuroprotective family-centered developmental care: Creating an infrastructure for implementation. *Newborn Infant Nur Rev.* 2015;**15**(3):87–90.
7. 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. *Phys Occup Ther Pediatr.* 1986;**6**(3-4):3–53.

8. Gibbins S, Hoath SB, Coughlin M, Gibbins A, Franck L. The universe of developmental care: a new conceptual model for application in the neonatal intensive care unit. *Adv Neonatal Care.* 2008;**8**(3):141–7. [PubMed: 18535418].
9. Altimier L, Phillips RM. The Neonatal Integrative Developmental Care Model: Seven neuroprotective core measures for family-centered developmental care. *Newborn Infant Nur Rev.* 2013;**13**(1):9–22.
10. Zhang X, Lee SY, Chen J, Liu H. Factors Influencing Implementation of Developmental Care Among NICU Nurses in China. *Clin Nurs Res.* 2016;**25**(3):238–53. [PubMed: 25155801].
11. Valizadeh L, Asadollahi M, Mostafa Gharebaghi M, Gholami F. The congruence of nurses' performance with developmental care standards in neonatal intensive care units. *J Caring Sci.* 2013;**2**(1):61–71. [PubMed: 25276711].
12. Soleimani F, Torkzahrani S, Rafiey H, Salavati M, Nasiri M. Development and psychometric testing of a scale for the assessment of the quality of developmental care in neonatal intensive care units in Iran. *Electron Physician.* 2016;**8**(1):1686–92. [PubMed: 26952183].
13. Chawla D, Suresh GK. Quality improvement in neonatal care - a new paradigm for developing countries. *Indian J Pediatr.* 2014;**81**(12):1367–72. [PubMed: 24705935].
14. Soleimani F, Sharifi N, Rasti Borujeni F, Amiri M, Khazaiyan S, Fathnezhad Kazemi A. Nourodevelopmental follow-up in high-risk infants: Review article. *TUMS.* 2015;**72**(11):733–41.
15. Godarzi Z, Rahimi O, Khalesi N, Soleimani F, Mohammadi N, Shamshiri A. The rate of developmental care delivery in neonatal intensive care unit. *J Critical Care Nur.* 2015;**8**(2):117–24.
16. Developmental care programs (Matin) in the country [press release] Available from: http://health.behdasht.gov.ir/news/tahavolnews/124148/%2015.
17. Raiskila S, Axelin A, Rapeli S, Vasko I, Lehtonen L. Trends in care practices reflecting parental involvement in neonatal care. *Early Hum Dev.* 2014;**90**(12):863–7. [PubMed: 25463833].
18. Welch MG, Myers MM, Grieve PG, Isler JR, Fifer WP, Sahni R, et al. Electroencephalographic activity of preterm infants is increased by Family Nurture Intervention: a randomized controlled trial in the NICU. *Clin Neurophysiol.* 2014;**125**(4):675–84. [PubMed: 24140072].
19. Kucukoglu S, Celebioglu A. Effect of natural-feeding education on successful exclusive breast-feeding and breast-feeding self-efficacy of low-birth-weight infants. *Iran J Pediatr.* 2014;**24**(1):49–56. [PubMed: 25793045].
20. Kuo CP, Chuang HL, Lee SH, Liao WC, Chang LY, Lee MC. Parenting confidence and needs for parents of newborns in taiwan. *Iran J Pediatr.* 2012;**22**(2):177–84. [PubMed: 23056883].
21. Kenner C, McGrath J. Developmental care of newborns and infants: A guide for health professionals. Mosby Incorporated; 2004.
22. Zahed PY, Ahmadpour KM, Alaee E, Foroozesh R, Rasouli M, Tirgar A, et al. Light and sound consideration in neonatal intensive care unit. *JBUMS.* 2014;**16**(5):55–61.
23. Darcy AE, Hancock LE, Ware EJ. A descriptive study of noise in the neonatal intensive care unit. Ambient levels and perceptions of contributing factors. *Adv Neonatal Care.* 2008;**8**(3):165–75. [PubMed: 18535422].
24. Kellam B, Bhatia J. Sound spectral analysis in the intensive care nursery: measuring high-frequency sound. *J Pediatr Nurs.* 2008;**23**(4):317–23. [PubMed: 18638675].
25. Peirano PD, Algarin CR. Sleep in brain development. *Biol Res.* 2007;**40**(4):471–8. [PubMed: 18575679].
26. Yates CC, Mitchell AJ, Booth MY, Williams DK, Lowe LM, Whit Hall R. The effects of massage therapy to induce sleep in infants born preterm. *Pediatr Phys Ther.* 2014;**26**(4):405–10. [PubMed: 25251794].
27. Torkzahrani S, Soleimani F, Rafiey H. Introducing a model for improving the quality of developmental care in the neonatal intensive care unit in Iran [In Persian]. *J Shahid Beheshti School Nurs Midwifery.* 2016;**25**(89).
28. Mosqueda R, Castilla Y, Perapoch J, Lora D, Lopez-Maestro M, Pallas C. Necessary resources and barriers perceived by professionals in the implementation of the NIDCAP. *Early Hum Dev.* 2013;**89**(9):649–53. [PubMed: 23701747].