Iran Red Crescent Med J. 2017 September; 19(9):e13799. doi: 10.5812/ircmj.13799.

Published online 2017 September 2. **Research Article**

The Effects of Developmental Care on Short-Term Outcomes of Preterm Infants: A Quasi-Experimental Study

Shirin Hasanpour,[1] Elaheh Ouladsahebmadarek,[2,*] Mohammad Bagher Hosseini,[3] Mojgan Mirghafourvand,[4] Seifollah Heidarabadi,[5] and Mohamad Asghari Jafarabadi[6]

[1]Instructor, Women's Reproductive Health Research Center, Tabriz University of Medical Sciences, Tabriz, IR Iran
[2]Professor, Women's Reproductive Health Research Center, Tabriz University of Medical Sciences, Tabriz, IR Iran
[3]Associate Professor, Pediatric Health Research Center of Tabriz, Tabriz University of Medical Sciences, Tabriz, IR Iran
[4]Associate Professor, Department of Midwifery, Tabriz University of Medical Sciences, Tabriz, IR Iran
[5]Assistant Professor, Department of Pediatrics, Tabriz University of Medical Sciences, Tabriz, IR Iran
[6]Assistant Professor, Road Traffic Injury Research Center, Tabriz University of Medical Sciences, Tabriz, IR Iran

[*]*Corresponding author*: Elaheh Ouladsahebmadarek, Women's Reproductive Health Research Center, Alzahra Hospital, Artesh Street, Tabriz, IR Iran. Tel: +98-9141144132, Fax: +98-4135541221, E-mail: elmadarek33@gmail.com

Received 2017 April 16; **Revised** 2017 May 21; **Accepted** 2017 July 29.

Abstract

Background: Technological advances in neonatal care have increased the survival rate of preterm infants, but they have not been able to reduce the risk of the multiple complications developing in them.
Objectives: To determine the short-term effects of developmental care on preterm infants.
Methods: The present quasi-experimental study was conducted on 105 preterm infants (three groups of 35) born in Al-Zahra hospital of Tabriz, Iran, from September 2013 to November 2015. The sampling method was convenience, based on study's eligibility criteria. The control group received no developmental care. Intervention group 1 received developmental care at the neonatal intensive care unit and the neonatal ward, and intervention group 2 received developmental care from birth in the delivery and operating rooms and continued to receive it at the NICU and the neonatal ward. Short-term neonatal outcomes were analyzed with descriptive and inferential statistics.
Results: The overall duration of hospital stay was significantly shorter in intervention group 2 compared to the control group (mean difference: - 13.6; confidence interval: -24.8 to -2.4; P = 0.013) and intervention group 1 (-12.5; -23.7 to-1.3; P = 0.024), and the duration of NICU stay was also shorter in intervention group 2 compared to the control group (-12.4; -22.2 to -2.5; P = 0.009). The incidence of sepsis was significantly lower in intervention groups 1 and 2 compared to the control group, and the incidence of prematurity anemia and the need for blood transfusion were also significantly lower in intervention group 2 compared to intervention group 1 and the control group ($P < 0.05$). No significant differences were observed between the groups in terms of neonatal growth parameters at full term corrected age.
Conclusions: The results obtained showed that developmental care for preterm infants, especially when initiated as early as in the delivery and operating room, can improve certain short-term neonatal outcomes.

Keywords: Premature infant, Care, Development, Outcome

1. Background

Preterm birth refers to birth before the 37th week of gestation and is considered as a major problem in maternal and neonatal health causing neonatal morbidity and mortality (1). Approximately 13 million preterm births occur across the world every year, with a reported prevalence of 5% to 12% in developed and 40% in developing countries (2). Sporadic studies conducted in Iran have reported the prevalence of preterm childbirth as 7% to 8% (3).

Technological advances in neonatal care have increased the survival of preterm infants, but they have failed to reduce the risk of the serious complications affecting them (4). Respiratory distress syndrome (RDS), broncho-pulmonary dysplasia (BPD), apnea, necrotizing enter colitis (NE), retinopathy(ROP), patent ductus arteriosus (PDA), intra-ventricular hemorrhage (IVH), anemia, hypoglycemia, growth retardation, and cerebral palsy are some of the short- and long-term complications in preterm infants (5).

Right after birth, preterm infants become exposed to various stressors in the delivery and operating rooms, the neonatal intensive care unit (NICU) and the neonatal ward. These include painful stimuli, sleep disruption, high levels of light and noise pollution, and separation from the mother, which are strikingly different from the environment experienced in the mother's womb, and since they are unable to control the incoming stimuli, the neonates

get easily stressed, thereby, getting exposed to higher risk of hypoxia, apnea, and fluctuations in blood pressure (2, 6, 7). Such a highly stressful environment can adversely affect the infants' vision, hearing, sleep patterns, and neurobehavioral development (8, 9).

To prevent these problems, many clinicians and researchers have begun to focus on improving the NICU environment for neonates and parents using developmental care programs (7, 10, 11). A pilot of developmental care project began in Iran in 2013 in four hospitals including Al-Zahra Hospital of Tabriz. Developmental care is a stress-mitigation approach using nursing and medical interventions (11, 12). These interventions have been developed for proper neonatal neurobehavioral development and include the reduction of environmental stressors known to cause physiological and behavioral disorders such as Light and noise reduction, clustering in nursing care, parental participation, and special support techniques (such as using special pacifiers, creating opportunities for grabbing, swaddling and nesting), and Kangaroo mother care (13).

Many studies have shown that modifying care techniques in such a way as to reduce neonatal stress and pain improves their neurobehavioral and clinical functions (14); yet, not all studies indicate the usefulness of developmental care (6, 7), and most of these studies have examined the newborn individualized developmental care and assessment program (NIDCAP) which has been started to establish in NICUs (4, 14-16).

In a meta-analysis conducted on the effect of NIDCAP on neonatal outcomes, Jacobs et al. (2002) concluded that there is no definite evidence confirming the positive effects of developmental care and argued that further studies are required with larger sample sizes and longer follow-up periods (15).

In a systematic review study, Symington et al. (2003) reported limited evidence on the benefits of developmental care on respiratory protection, hospital stay, and developmental costs and outcomes at the modified age of 24 months in preterm neonates (17).

Considering the contradictory findings, the need for further research about developmental care's outcomes was recommended in previous studies (13, 16, 18-21). Developmental care is very new in Iran and since the researcher was unable to find any studies on the initiation of developmental care from the moment of birth in the delivery and operating rooms, where infants are exposed to high levels of light and noise, painful stimuli, and severe stressors; and given that, since like any other new intervention, the initiation of developmental care from birth requires precise scientific evaluation prior to a routine application, the present study was conducted to determine the effects of developmental care on short-term outcomes in preterm infants born before the 33rd week of gestation at Al-Zahra hospital in Tabriz, Iran.

2. Objectives

To determine the short-term effects of developmental care on preterm infants.

3. Methods

3.1. Study Design and Participants

The present quasi-experimental study has been conducted at Al-Zahra hospital (a tertiary referral hospital located in Tabriz city, north – west of Iran) from September 2013 to November 2015. The research proposal was approved by the women's reproductive health research center and the ethics committee of the Tabriz University of Medical Sciences (code: 9345) and registered at the IRCT registration site (IRCTID: IRCT20140517556 3N5).

The study inclusion criteria consisted of the inborn neonates with gestational age of 26 - 32 weeks and birth weight of 600 to 1500 grams, from the mothers who did not use alcohol and opiates during pregnancy and received mechanical ventilation or CPAP in the first three hours after birth which continued for at least 24 hours. The neonates with chromosomal abnormalities or congenital anomalies, severe congenital infections (TORCH and HIV), those who required surgery, and inappropriate birth weight for gestational age (LGA and SGA) were excluded from the study.

3.2. Sampling and Intervention

The data presented in this article is part of a large study carried out by the authors. The sample size was, therefore, determined according to a study by Vameqi et al. (22) and taking into account the results obtained from all the ASQ (ages and stages questionnaire) subscales, estimating a 20% increase in the mean neonatal developmental and with a confidence interval of 90% and a statistical power of 90% (M1 = 51, M2 = 61.2, sd1 = sd2 = 12.8, $\beta = 0.20$, $\alpha = 0.05$). Considering a potential sample loss of 10%, the sample size was determined 105 which was divided in three groups of 35.

Convenience sampling was performed in three groups.

The first group was the control group, selected from the medical records of eligible neonates hospitalized in Al-Zahra hospital's NICU before December 2013 (as no developmental care was performed in the NICU or neonatal ward until this date).

The second group, intervention group 1, received developmental care at the NICU and neonatal ward, included

reduction in light and noise pollution, pain management, positioning the neonate and nesting and parental training and involvement in their neonatal care and KMC.

The third group, intervention group 2, received developmental care just from the delivery and operating rooms, which was continued at the NICU and the neonatal ward. The developmental care measures included milking of the cord (cord was clamped and cut at approximately 20 cm distal to umbilicus and milked from distal toward infant 3 times, then clamped 2 to 3 cm from the umbilical stump) (23), covering the neonate's eyes with a cap for reducing the exposure to light, the allocation of a low noise setting for preterm deliveries, positioning the neonate, and using covered incubators for their transfer.

The three groups were matched in terms of birth weight and gestational age at birth.

3.3. Data Collection

Written consent was obtained from the neonates' mothers in all the three groups and the severity of the neonates' conditions was assessed according to the CRIB (clinical risk index for babies) score for assessing initial neonatal risk. The researcher filled out questionnaires regarding mothers' demographic- obstetrics history, medical background of infants and neonatal outcomes from birth to their discharge from the hospital according to their medical records. The neonates were discharged from NICU to Neonatal unit when they no longer needed mechanical ventilation or CPAP for a 24-hour period and weighed more than 1,200 grams, and they were discharged from the hospital when they no longer required supplemental oxygen and were able to feed orally. All the three groups of neonates were assessed in terms of growth parameters at full term corrected age (38 to 42 weeks) at the neonatal clinic. Weight was measured with a Seca- Infant weighing balance, Length was measured with a seca height gauge in the supine position, and the head circumference was measured with a normal non- stretch tape and the instruments used in all groups were the same. All of the measurements were done by the same researcher.

The short-term medical outcome variables included the duration of hospitalization in neonatal intensive care unit and neonatal ward, need for respiratory support (ie, mechanical ventilation, CPAP, and oxygen) or surfactant, growth parameters at corrected age of full term, the incidence of RDS, IVH, BPD, PDA, sepsis, retinopathy of prematurity, meningitis, necrotizing enterocolitis, pneumothorax, osteopenia, anemia of prematurity, and gestational age and weight at discharge.

Initial neonatal risks were evaluated by using CRIB score and their birth weight, gestational age, maximum and minimum inspired oxygen concentration, maximum base excess in the first 12 hours, and congenital anomalies were scored (24).

Neonatal developmental care during the hospital stay was offered by trained personnel and the research team gave the hospital personnel and the parents any necessary training for parental involvement in neonatal care during the hospitalization. The outcome evaluator and the data analyst were blinded to the study groupings.

3.4. Data Analysis

The obtained data were analyzed using SPSS-21 software. Descriptive statistics were used to describe the variables including the mean (SD), median (IQR), and number (percentage). The qualitative variables were compared between the three groups using the Chi-square test and Fisher's exact test; and for comparing the quantitative variables between the groups, the One-Way ANOVA for normal distributed variables and the Kruskal-Wallis tests for non-normal distributed variables were used. The Mann-Whitney's, Chi-square, and Tukey's post-hoc tests were used for the paired comparison of the groups. The normal distribution of the quantitative variables was assessed using the K-S test, and the non-normally distributed variables were converted using appropriate methods. The level of statistical significance was set at $P < 0.05$.

4. Results

The study has been conducted on 105 neonates born at 26 to 32 weeks of gestation who were all assessed in terms of growth parameters at full term corrected age at the neonatal clinic. The neonates who died in the hospital or who were transferred to another hospital were excluded from the study and were replaced with other samples (Figure 1).

According to the results, the mean (SD) age of the neonates' mothers in control, intervention 1 and 2 groups were 28.3(5.2), 28.5(5.2) and 28.8(6.1) years, respectively. In all groups the majority of both parents had intermediate education, with mothers more likely being housewives and fathers being self-employed. Most families had a moderate income and lived in the city. Comparison of the demographic details of the three groups showed no significant intergroup differences ($P > 0.05$), (Table 1).

In all groups, most mothers were primiparous, had no history of miscarriage, and underwent cesarean section. The percentage of maternal risk factors of neonates' mothers in control, intervention 1 and 2 groups were 97, 94, and 100 percent, fetal risk factors were 23, 46, 43 percent

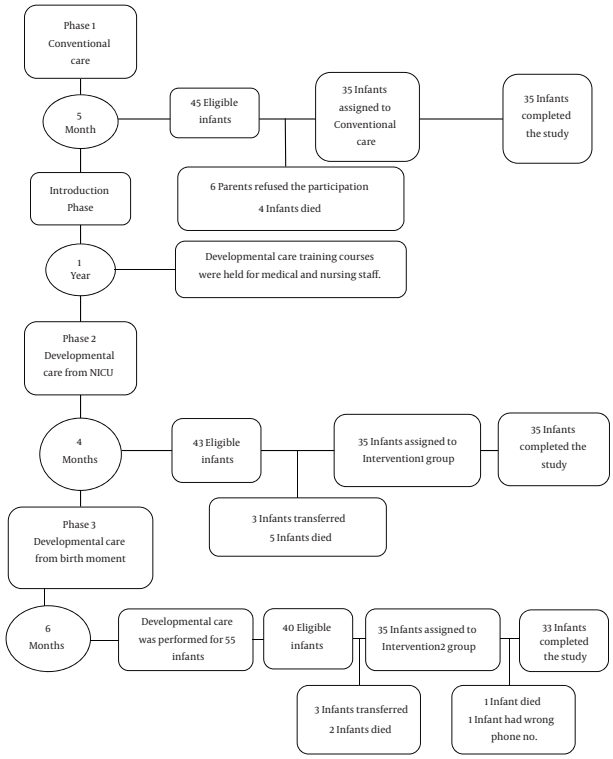

Figure 1. Study Flowchart

and placental risk factors were 17, 20, and 6 percent, respectively. Regarding the obstetric history of the mothers, there was no significant difference among the three groups ($P > 0.05$), (Table 2).

The mean (SD) gestational age of the neonates in control, intervention 1 and 2 groups were 28.5 (5.2), 28.4 (1.4) and 28.3 (1.3) months, respectively. The majority of neonates in control and intervention 2 groups were male and the majority of twin infants were in intervention 1 group (45.7%). The neonates' medical background variables were similar in 3 groups and statistical analysis indicated no significant difference among the groups ($P > 0.05$), (Table 3).

Comparison of short-term outcomes among the three groups showed significant differences in hospital stay ($P = 0.007$), NICU stay ($P = 0.012$), the incidence of sepsis ($P = 0.003$), anemia of prematurity ($P = 0.002$), and need for transfusion ($P = 0.000$). There was no meaningful difference among the groups from the point of respiratory support, growth parameters at term age, gestational age at discharge, or complications such as BPD, IVH, Ventriculomegaly, Pneumothorax, PDA, and ROP ($P > 0.05$), (Table 4). None of the infants was involved by meningitis or necrotizing enterocolitis.

4. Discussion

The present study compared the effect of developmental care on short-term neonatal outcomes in two groups of preterm neonates, one receiving developmental care from birth and the other receiving developmental care in the NICU and neonatal ward, with a control group that received no developmental care during their hospital stay. The results obtained showed some positive effects of these care measures. Considering the lack of studies on the initiation of developmental care from birth, the discussion and comparison of the present findings are done with the results of other studies which presented the developmental care in NICU and mostly in the form of NIDCAP (25).

According to the present findings, the total duration of hospitalization and NICU stay in the group receiving developmental care from the delivery and operating rooms (intervention group 2) and the group receiving developmental care in the neonatal ward and NICU (intervention group 1) was shorter than the control group that received no developmental care, with the difference being significant between intervention group 2 and the control group. The duration of hospital and NICU stay was also significantly shorter in intervention group 2 than in interven-

Table 1. Parental Demographic Features in the Study Groups

Variables	Control (n = 35)	Intervention 1 (n = 35)	Intervention 2 (n = 35)	P Value
Maternal age, y[a]	28.3 (5.2)	28.5 (5.2)	28.8 (6.1)	0.927[b]
Mothers' education level[c,d]				0.340[e]
Low	9 (25.7)	7 (20.0)	6 (17.1)	
Intermediate	18 (51.4)	22 (62.9)	16 (45.7)	
High	8 (22.9)	6 (17.1)	13 (37.2)	
Fathers' education level[c,d]				0.140[e]
Low	8 (22.9)	8 (22.9)	6 (17.1)	
Intermediate	16 (45.7)	23 (65.7)	16 (45.7)	
High	11 (31.4)	4 (11.4)	13 (37.2)	
Mothers' job[c]				0.726[f]
Housewife	33 (94.3)	33 (94.3)	31 (88.6)	
Employed	2 (5.7)	2 (5.7)	4 (11.4)	
Fathers' job[c]				0.518[f]
Worker	5 (14.3)	2 (5.7)	2 (5.7)	
Employee	7 (20.0)	9 (25.7)	12 (34.3)	
Self-employment	23 (65.7)	24 (68.6)	21 (60.0)	
Family income[c]				0.118[f]
Adequate	10 (28.6)	9 (25.7)	14 (40.0)	
Relatively adequate	25 (71.4)	20 (57.1)	20 (57.1)	
Inadequate	0 (0.0)	6 (17.1)	1 (2.9)	
Residing Place[c]				0.953[e]
Urban	25 (71.4)	26 (74.3)	25 (71.4)	
Rural	10 (28.6)	9 (25.7)	10 (28.6)	

[a] Values are expressed as mean (SD).
[b] One-way ANOVA.
[c] Values are expressed as No (%).
[d] Low = uneducated and elementary, intermediate = guidance (junior high) and (senior) high school, high = university.
[e] Chi-square test and P value < 0.05 was considered significant.
[f] Fisher's exact test.

tion group 1. Given that developmental care empowered the parents, especially the mothers, in taking care of their neonates, there was less need for hospitalization in the group of neonates receiving this care, especially in the group receiving them from birth, since parental training began immediately after birth in this group. The studies were conducted by ALS et al. (1994), Melnyk et al. (2006), Peters et al. (2009), McAnulty et al. (2009), and Gonya et al. (2014) about the effect of the NIDCAP on neonatal outcomes which were in favor of our findings (14, 26-29). In contrast to those, Maguire et al. (2008) showed that basic developmental care has no effects on the duration of hospital and NICU stay (7). Maguire's study did not mention any programs for the mothers' empowerment for taking care of their neonates and they had no clear protocol for neonate's discharge. So, this disparity of results can be attributed to the differences in the intervention type and the flexibility of discharge rules.

In the present study, there was no significant difference among the groups from the point of corrected neonatal age at discharge. This finding was in line with the results obtained by Westrup et al. (30), whereas other studies by Als et al. (1994) and McAnulty et al. (2009) found a significant difference in the neonates' corrected age at discharge between their NIDCAP and control groups (26, 28). The samples' age and weight in latter studies were lower than ours, and their intervention in the experimental group was NIDCAP.

Table 2. Obstetrical History of Participants' Mothers[a]

Variables	Control (n = 35)	Intervention 1 (n = 35)	Intervention 2 (n = 35)	P Value
Maternal risk factors (diabetes, hypertension, etc)	34 (97.1)	33 (94.3)	35 (100.0)	0.771b
Placental risk factors (Placental abruption, placenta previa, etc.)	6 (17.1)	7 (20.0)	2 (5.7)	0.295c
Fetal risk factors (oligohydramnious, meconium staining, etc.)	8 (22.9)	16 (45.7)	15 (42.9)	0.129c
PPROM > 18 hours	5 (14.3)	3 (8.6)	6 (17.1)	0.674[b]
Antenatal glucocorticoids				0.475[c]
Complete	18 (51.4)	12 (34.3)	19 (54.3)	
Incomplete	12 (34.3)	16 (45.7)	10 (28.6)	
Gravida				0.766[c]
1	19 (54.3)	17 (48.6)	16 (45.7)	
$\geq$ 2	16 (45.7)	18 (51.4)	19 (54.3)	
Parity				0.517[c]
1	25 (71.4)	21 (60.0)	21 (60.0)	
$\geq$ 2	10 (28.6)	14 (40.0)	14 (40.0)	
Abortion				0.657[c]
0	27 (77.1)	24 (68.6)	24 (68.6)	
$\geq$ 1	8 (22.9)	11 (31.4)	11 (31.4)	
Mode of delivery				0.474[c]
Vaginal	8 (22.9)	5 (14.3)	9 (25.7)	
Caesarean section	27 (77.1)	30 (85.7)	26 (74.3)	

[a] Values are expressed as No. (%).
[b] Fisher's exact test and P value < 0.05 was considered significant.
[c] Chi-square test.

Table 3. Medical Background Variables of Infants

Birth Characteristics	Control (n = 35)	Intervention 1 (n = 35)	Intervention 2 (n = 35)	P Value
Gestational age Mean in weeks[a]	28.5 (5.2)	28.4 (1.4)	28.3 (1.3)	0.874[b]
Birth weight Mean in g[a]	1106.0 (215.8)	1095.2 (211.5)	1144 (234.9)	0.627[b]
Length Med in cm (p25 - p75)	35 (33 - 40)	37 (35 - 38)	38 (36 - 38)	0.063[c]
Head circumference Mean in cm[a]	26.7 (3.1)	27.2 (1.9)	27.8 (1.8)	0.129[b]
Gender[d]				
Male	19 (54.3)	14 (40.0)	21 (60.0)	0.226[e]
Female	16 (45.7)	21 (60.0)	14 (40.0)	
Twin[d]	7 (20.0)	16 (45.7)	13 (37.1)	0.065[f]
CRIB Score Med (p25 - p75)	3 (2 - 4)	3 (1 - 3)	2 (1 - 3)	0.116[c]
RDS[d]	19 (54.3)	18 (51.4)	18 (51.4)	0.963[e]
Surfactant[d]	18 (51.4)	25 (71.4)	16 (45.7)	0.167[f]

[a] Values are expressed as mean (SD).
[b] One-way ANOVA.
[c] Kruskal-Wallis test.
[d] Values are expressed as No. (%).
[e] Chi-square test and P value < 0.05 was considered significant.
[f] Fisher's exact test.

Table 4. Short Term Outcomes of the Study Groups

Outcomes	Control (n = 35)	Int. 1 (n = 35)	Int. 2 (n = 35)	P Value	Comparison Among the Groups		
					Int. 1 vs. Control MD (95% CI)[a] P[b]	Int. 2 vs. Control MD (95% CI)[a] P[b]	Int. 2 vs. int. 1 MD (95% CI)[a] P[b]
Days of hospitalization[c]	48.3 (22.0)	47.2 (15.6)	34.7 (20.8)	0.007[b]	-1.1 (-12.3 to 10.0)	-13.6 (-24.8 to -2.4)	-12.5 (-23.7 to -1.3)
					0.968	0.013	0.024
Days in NICU[c]	31.1 (17.4)	26.5 (16.2)	18.7 (18.1)	0.012[b]	-4.6 (-14.4 to 5.2) 0.508	-12.4 (-22.2 to -2.5) 0.009	-7.8 (-17.6 to 2.0) 0.148
Gestational age at discharge to home[c]	35.2 (2.0)	34.8 (1.6)	34.2 (2.0)	0.087[b]	-0.4 (-1.5 to 0.6)	-1.0 (-2.1 to 0.06)	-0.6 (-1.6 to 0.49)
					0.623	0.07	0.398
Days of mechanical ventilation					P[d]	P[d]	P[d]
Median (percentile25-prcentile$_{75}$)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)	0.389[e]	0.225	0.014	0.161
Days of CPAP, Median (percentile 25-prcentile$_{75}$)	2 (1 - 3)	2 (1 - 3)	2 (1 - 3)	0.698[e]	0.405	0.793	0.576
Total days supplemental O_2 Median (percentile 25-prcentile$_{75}$)	8 (3 - 38)	6 (4 - 15)	5 (3 - 7)	0.109[e]	0.514	0.064	0.091
Total days of respiratory support, Median (percentile 25-prcentile$_{75}$)	3 (2 - 7)	4 (3 - 7)	3 (2 - 5)	0.250[e]	0.432	0.572	0.070
Growth parameters at term age, Median (percentile 25-prcentile$_{75}$)							
Weight, g	2100 (1830 - 2310)	2200 (1950 - 2350)	2300 (2000 - 2460)	0.107[e]	0.341	0.105	0.215
Head circumference, cm	33 (32 - 34)	34 (32 - 34)	34 (32 - 34)	0.718[e]	0.504	0.461	> 0.999
Length, cm	45 (44 - 46)	45 (45 - 47)	46 (45 - 47)	0.109[e]	0.330	0.031	0.304
					P[f]	P[f]	P[f]
BPD[g]	10(28.6)	5 (14.3)	4 (11.4)	0.390[h]	0.430	0.203	> 0.999
IVH[g]							
Grade 1	5(14.3)	3 (8.6)	4 (11.4)	0.807[h]	0.592	0.734	> 0.999
Grade 2	0 (0.0)	1 (2.8)	0 (0.0)				
Grade 3	1 (2.8)	0 (0.0)	0 (0.0)				
Ventriculomegaly[g]	7 (20.0)	2 (5.7)	1 (2.8)	0.073[h]	0.151	0.055	> 0.999
Sepsis[g]	11 (31.4)	1 (2.8)	4 (11.4)	0.003[f]	0.002	0.041	0.356
Pnomotorax[g]	1 (2.8)	2 (5.7)	1 (2.8)	> 0.999[h]	> 0.999	> 0.999	> 0.999
PDA[g]	1 (2.8)	0 (0.0)	3 (8.6)	0.320[h]	> 0.999	0.614	0.239
ROP[g]	3 (8.6)	6 (17.1)	3 (8.6)	0.584[h]	0.477	> 0.999	0.477
Anemia of prematurity[g]	28 (80.0)	24 (68.6)	14 (40.0)	0.002[f]	0.413	0.001	0.015
Transfusion[g]	24 (68.6)	25 (71.4)	13 (37.1)	< 0.001[f]	0.794	0.008	0.004

[a] One-way ANOVA.
[b] Tukey test and P value < 0.05 was considered significant.
[c] Values are expressed as mean (SD).
[d] MANN-Whitney U test.
[e] Kruskal-Wallis test.
[f] Chi-square test.
[g] Values are expressed as No. (%).
[h] Fisher's exact test.

The number of days required for respiratory support including mechanical ventilation or CPAP and the need for supplemental oxygen was almost similar among groups. Maguire's and Peters' studies revealed the same results as well (7). On the contrary, Westrup et al. (2000) could not

find any meaningful difference between the NIDCAP and control group in terms of need for respiratory support. In a meta-analysis conducted by Symington et al. (2003), the need for ventilator was significantly lower in the neonates receiving the NIDCAP, although their need for oxygen was similar to the control group (17). An explanation for various results of these studies could be the flexible decision-making about the type of respiratory support in our study, the difference in applied interventions, and the variety in neonates' basic details.

This study confirms the findings of Maguire et al. (2008) and Als et al. (2011) regarding the similarity of the neonates' growth parameters at term age between control and intervention groups (7, 31). On the contrary, Borimnejad et al. (2013) showed that empowering programs for mothers of preterm infants can increase weight gain in intervention group after 2 month (32). In this study, they did not mention basic characters of infants.

The results showed a significant reduction in the incidence of sepsis in intervention groups. The study of Aqudelo et al. (2005) was in favor of our findings (33). This decline can be attributed to mother- infant contacts in intervention groups increasing the level of oxytocin hormone and boosting the immune system indirectly. Also, milking of cord in intervention group 2 reduced the incidence anemia of prematurity and the need for transfusion, so the risk of infection may be limited in this group.

Six of the subjects in the control group developed intra-ventricular hemorrhage, one of them was grade 3; in groups which received developmental care, four cases developed IVH, none of which was severe. In the control group, seven neonates had ventriculomegaly, while only two neonates developed this complication in intervention group 1 and one case in intervention group 2. Although the differences between the groups were not statistically significant, clinically speaking, even one such case is significant, since it imposes heavy financial costs on the healthcare system and psychological effects on the family. However, the results in this area, due to small sample size and phase-lag scheme of study, should be interpreted with caution.

Maguire's research on the effect of basic developmental care on short-term outcomes showed no significant differences between the intervention and control groups in terms of BPD, IVH, ventriculomegaly, sepsis, PDA, ROP, NEC, and meningitis (7). Apart from sepsis, the result of our study was the same as Maguire's.

Of the RCT studies conducted on the effect of the NIDCAP on short-term neonatal outcomes, the one done by Westrup et al. (2000) showed no significant differences between the NIDCAP and control groups in the development of IVH, sepsis, and ROP (30). ALS et al. reported a significant difference between their cases and controls in the development of BPD and IVH (26). In both studies the sample size was too small. Maguire et al. (2009) in another study with a large sample size (164 infants) showed a significant difference between their cases and controls in the development of PDA which was higher in NIDCAP group with no plausible explanation. The results of this study about other neonatal outcomes such as BPD, IVH, ventriculomegaly, and ROP were in favor of our findings (4). McAnulty et al. (2009) showed a significant difference between their cases and controls in the development of BPD, pneumothorax, IVH and ventriculomegaly (28), while Peters et al. (2009) with almost the same sample size and study conditions reported a significant difference between their cases and controls only in the development of chronic lung disease (14). Regardless of the controversies, a systematic review (2013) of the eighteen RCT studies with 627 neonates examined the effectiveness of NIDCAP on neonatal outcomes and concluded that NIDCAP could not improve short- term medical outcomes (20).

The present study showed significant reductions in prematurity anemia and the need for blood transfusion in intervention group 2 compared to the other groups; this reduction can be attributed to umbilical cord milking immediately after birth in intervention group 2 which received developmental care as early as in the delivery and operating rooms. In all of previous studies, developmental care was started from NICU and none of them implemented developmental care in the delivery and operating rooms.

The limitations of the present study include the non-random sampling because of research design. Since the control group had to be selected from the neonates who were born before the initiation of developmental care in the hospital; moreover, the developmental care given to intervention group 2 began in the delivery and operating rooms before the eligibility of the neonates could be fully determined (ie, their birth weight, need for respiratory support, etc), and estimating potential sample loss was, therefore, impossible. In a Phase-Lag scheme, medical and nursing care services may change over time; any such changes were beyond the researcher's control. Developmental care measures were performed in the neonatal ward and the NICU by trained personnel and it is possible for them not to have been fully administered in some of the hospital shifts. Considering these limitations, the present findings cannot be easily generalized to other populations.

This is the first study about Developmental Care and its outcomes in Iran. The strength points of this study include the initiation of developmental care from birth in the delivery and operating rooms as neonates are exposed to severe sensory stimuli in these wards such as light and noise

pollution; and the mother empowerment program was started as soon as possible after birth. Neonatal growth parameters at full term age were assessed by an expert who was blinded to the study groupings, so it reduced the bias.

Assessing the effect of developmental care just from birth on neonatal outcomes requires further studies, and it is, therefore, recommended that clinical trials be conducted to evaluate short-term and long-term neonatal outcomes in larger sample sizes. Moreover, given the novelty of this type of care in Iran, the attitudes of the medical personnel and the parents of the neonates toward developmental care should also be further studied.

Based on the present findings, it seems that the implementation of developmental care programs, especially when initiated from birth moment, can be beneficial from certain aspects such as shorter hospitalization and a lower incidence of neonatal sepsis and prematurity anemia which result in great savings in costs, time, and energy. These findings can therefore be helpful for policy-makers and healthcare providers in implementing developmental care programs for preterm neonates and encouraging them to support the program either by providing the necessary facilities or training for neonatal care units.

Acknowledgments

This article has been taken from a PhD thesis approved and funded by the women's reproductive health research center, Tabriz University of Medical Sciences. Hereby, the authors would like to express their gratitude to all the parents who cooperated in the study and all the personnel of the delivery room, operating room, NICU, and neonatal ward at Al-Zahra Hospital of Tabriz who assisted in conducting this study.

Footnote

Conflict of Interest: The authors declare no Conflict of Interest.

References

1. Swamy GK, Ostbye T, Skjaerven R. Association of preterm birth with long-term survival, reproduction, and next-generation preterm birth. *JAMA.* 2008;**299**(12):1429–36. doi: 10.1001/jama.299.12.1429. [PubMed: 18364485].
2. Villar J, Merialdi M, Gulmezoglu AM, Abalos E, Carroli G, Kulier R, et al. Characteristics of randomized controlled trials included in systematic reviews of nutritional interventions reporting maternal morbidity, mortality, preterm delivery, intrauterine growth restriction and small for gestational age and birth weight outcomes. *J Nutr.* 2003;**133**(5 Suppl 2):1632S–9S. [PubMed: 12730477].
3. Afrakhteh MES, Valayi N. Preterm Labor Incidence and Related Factores. *Pejouhandeh.* 2003:341–3.
4. Maguire CM, Walther FJ, Sprij AJ, Le Cessie S, Wit JM, Veen S, et al. Effects of individualized developmental care in a randomized trial of preterm infants <32 weeks. *Pediatrics.* 2009;**124**(4):1021–30. doi: 10.1542/peds.2008-1881. [PubMed: 19786441].
5. FG C. Williams Obstetrices and Gynecology. Golban; 2010.
6. Montirosso R, Del Prete A, Bellu R, Tronick E, Borgatti R, Neonatal Adequate Care for Quality of Life Study G. Level of NICU quality of developmental care and neurobehavioral performance in very preterm infants. *Pediatrics.* 2012;**129**(5):e1129–37. doi: 10.1542/peds.2011-0813. [PubMed: 22492762].
7. Maguire CM, Veen S, Sprij AJ, Le Cessie S, Wit JM, Walther FJ, et al. Effects of basic developmental care on neonatal morbidity, neuromotor development, and growth at term age of infants who were born at <32 weeks. *Pediatrics.* 2008;**121**(2):e239–45. doi: 10.1542/peds.2007-1189. [PubMed: 18245399].
8. Wielenga JM, Smit BJ, Merkus MP, Kok JH. Individualized developmental care in a Dutch NICU: short-term clinical outcome. *Acta Paediatr.* 2007;**96**(10):1409–15. doi: 10.1111/j.1651-2227.2007.00451.x. [PubMed: 17850401].
9. Modi M, Saluja S, Kler N, Batra A, Kaur A, Garg P, et al. Growth and neurodevelopmental outcome of VLBW infants at 1 year corrected age. *Indian Pediatr.* 2013;**50**(6):573–7. [PubMed: 23255692].
10. De Bernardo G, Svelto M, Giordano M, Sordino D, Riccitelli M. Supporting parents in taking care of their infants admitted to a neonatal intensive care unit: a prospective cohort pilot study. *Ital J Pediatr.* 2017;**43**(1):36. doi: 10.1186/s13052-017-0352-1. [PubMed: 28412958].
11. Westrup B. Family-centered developmentally supportive care: the Swedish example. *Arch Pediatr.* 2015;**22**(10):1086–91. doi: 10.1016/j.arcped.2015.07.005. [PubMed: 26382641].
12. Sehgal A, Stack J. Developmentally supportive care and NIDCAP. *Indian J Pediatr.* 2006;**73**(11):1007–10. [PubMed: 17127783].
13. Sizun J, Westrup B. Early developmental care for preterm neonates: a call for more research. *Arch Dis Child Fetal Neonatal Ed.* 2004;**89**(5):F384–8. doi: 10.1136/adc.2002.025114. [PubMed: 15321953].
14. Peters KL, Rosychuk RJ, Hendson L, Cote JJ, McPherson C, Tyebkhan JM. Improvement of short- and long-term outcomes for very low birth weight infants: Edmonton NIDCAP trial. *Pediatrics.* 2009;**124**(4):1009–20. doi: 10.1542/peds.2008-3808. [PubMed: 19786440].
15. Jacobs SE, Sokol J, Ohlsson A. The Newborn Individualized Developmental Care and Assessment Program is not supported by meta-analyses of the data. *J Pediatr.* 2002;**140**(6):699–706. doi: 10.1067/mpd.2002.123667. [PubMed: 12072873].
16. Als H, Duffy FH, McAnulty G, Butler SC, Lightbody L, Kosta S, et al. NIDCAP improves brain function and structure in preterm infants with severe intrauterine growth restriction. *J Perinatol.* 2012;**32**(10):797–803. doi: 10.1038/jp.2011.201. [PubMed: 22301525].
17. Symington AJ, Pinelli J. Developmental care for promoting development and preventing morbidity in preterm infants. *The Cochrane Library.* 2006.
18. Smith GC, Gutovich J, Smyser C, Pineda R, Newnham C, Tjoeng TH, et al. Neonatal intensive care unit stress is associated with brain development in preterm infants. *Ann Neurol.* 2011;**70**(4):541–9. doi: 10.1002/ana.22545. [PubMed: 21976396].
19. Symington A, Pinelli J. Developmental care for promoting development and preventing morbidity in preterm infants. *Cochrane Database Syst Rev.* 2006(2):CD001814. doi: 10.1002/14651858.CD001814.pub2. [PubMed: 16625548].
20. Ohlsson A, Jacobs SE. NIDCAP: a systematic review and meta-analyses of randomized controlled trials. *Pediatrics.* 2013;**131**(3):e881–93. doi: 10.1542/peds.2012-2121. [PubMed: 23420913].
21. Niemi AK. Review of Randomized Controlled Trials of Massage in Preterm Infants. *Children (Basel).* 2017;**4**(4) doi: 10.3390/children4040021. [PubMed: 28368368].

22. Vamegi RSF, Habibollahi A, Lornejad H, Tolueie A, Kraskian A. Standardization of Ages and Stages Questionnaire in Iranian Children. ; 2010.
23. Upadhyay A, Gothwal S, Parihar R, Garg A, Gupta A, Chawla D, et al. Effect of umbilical cord milking in term and near term infants: randomized control trial. *Am J Obstet Gynecol.* 2013;**208**(2):120 e1–6. doi: 10.1016/j.ajog.2012.10.884. [PubMed: 23123382].
24. Yang MB, Donovan EF, Wagge JR. Race, gender, and clinical risk index for babies (CRIB) score as predictors of severe retinopathy of prematurity. *J AAPOS.* 2006;**10**(3):253–61. doi: 10.1016/j.jaapos.2006.01.004. [PubMed: 16814180].
25. Lawhon G, Hedlund RE. Newborn individualized developmental care and assessment program training and education. *J Perinat Neonatal Nurs.* 2008;**22**(2):133–44. doi: 10.1097/01.JPN.0000319100.90167.9f. [PubMed: 18496073] quiz 145-6.
26. Als H, Lawhon G, Duffy FH, McAnulty GB, Gibes-Grossman R, Blickman JG. Individualized developmental care for the very low-birthweight preterm infant. Medical and neurofunctional effects. *JAMA.* 1994;**272**(11):853–8. [PubMed: 8078162].
27. Melnyk BM, Feinstein NF, Alpert-Gillis L, Fairbanks E, Crean HF, Sinkin RA, et al. Reducing premature infants' length of stay and improving parents' mental health outcomes with the Creating Opportunities for Parent Empowerment (COPE) neonatal intensive care unit program: a randomized, controlled trial. *Pediatrics.* 2006;**118**(5):e1414–27. doi: 10.1542/peds.2005-2580. [PubMed: 17043133].
28. McAnulty G, Duffy FH, Butler S, Parad R, Ringer S, Zurakowski D, et al. Individualized developmental care for a large sample of very preterm infants: health, neurobehaviour and neurophysiology. *Acta Paediatr.* 2009;**98**(12):1920–6. doi: 10.1111/j.1651-2227.2009.01492.x. [PubMed: 19735497].
29. Gonya J, Martin E, McClead R, Nelin L, Shepherd E. Empowerment programme for parents of extremely premature infants significantly reduced length of stay and readmission rates. *Acta Paediatr.* 2014;**103**(7):727–31. doi: 10.1111/apa.12669. [PubMed: 24766486].
30. Westrup B, Kleberg A, von Eichwald K, Stjernqvist K, Lagercrantz H. A randomized, controlled trial to evaluate the effects of the newborn individualized developmental care and assessment program in a Swedish setting. *Pediatrics.* 2000;**105**(1 Pt 1):66–72. [PubMed: 10617706].
31. Als H, Duffy FH, McAnulty GB, Fischer CB, Kosta S, Butler SC, et al. Is the Newborn Individualized Developmental Care and Assessment Program (NIDCAP) effective for preterm infants with intrauterine growth restriction? *J Perinatol.* 2011;**31**(2):130–6. doi: 10.1038/jp.2010.81. [PubMed: 20651694].
32. Borimnejad L, Mehrnoosh N, Fatemi NS, Haghani H. Impacts of creating opportunities for parent empowerment on maternal stress: A quasi-experimental study. *Iran J Nurs Midwifery Res.* 2013;**18**(3):218–21. [PubMed: 23983758].
33. Conde-Agudelo A, Diaz-Rossello JL, Belizan JM. Kangaroo mother care to reduce morbidity and mortality in low birthweight infants. *Cochrane Database Syst Rev.* 2003(2):CD002771. doi: 10.1002/14651858.CD002771. [PubMed: 12804436].