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Original Article

Effect of Development-based Care Programs by Mothers on Growth Indices of Infants with Low Birth Weight

Sara Asadian[1], Sedigheh Talakub[2], Alireza Sadeghnia[3], Mehri Golchin[2]*

1. Faculty of Nursing and Midwifery, Isfahan University of Medical Sciences, Isfahan, Iran
2. Department of Pediatrics, Faculty of Nursing and Midwifery, Isfahan University of Medical Sciences, Isfahan, Iran
3. Department of Pediatrics, Neonatology Specialist, Faculty of Medicine, Alzahra Hospital, Isfahan University of Medical Sciences, Isfahan, Iran

ABSTRACT

Background: This study aimed to investigate the effect of development-based care programs by mother on low birth weight (LBW) infants after being discharged from hospital. The present research was based on the assumption that there is a difference between intervention and control groups regarding the mean neonatal growth indices on the 15th and 29th days.

Methods: This quasi-experimental study was conducted on 60 infants with LBW (1,500-2,500 g) and gestational age of < 37 weeks in Beheshti Hospital, Isfahan, Iran. The study population was selected through convenience sampling method and then randomly divided into two groups of intervention (n=30) and control (n=30). In the intervention group, the mothers received developmental care training, and in the control group, the mothers received routine care. The data collection instrument were questionnaires, tape meter, stadiometer, and baby scale. The height, weight, and head circumference indices were measured and recorded on the 1st, 15th, and 29th days of birth.

Results: The repeated measures ANOVA in within-group analysis revealed a significant difference in the mean weight and height indices of the infants between the intervention and control groups on the 1st, 15th, and 29th days of birth (P<0.001). However, there was no significant difference between the two groups in terms of mean head circumference (P<0.05). Also, the Bonferroni post-hoc test showed a significant difference between the intervention and control groups regarding the weight index on the 29th day (P<0.05).

Conclusion: The results showed that the intervention could significantly increase the weight index in the infants. Given that some developmental care techniques are low-cost and executable by mothers, and LWB infants are at risk for various disabilities in the future, health managers are advised to utilize this technique to improve the quality of life in these infants.

Keywords: Low birth weight, Growth, Newborn

Introduction

The World Health Organization (WHO) has defined a birth weight of less than 2,500 g or 5.5 pounds as low birth weight (LBW). Low birth weight is still a major public health problem worldwide, and it is accompanied by a range of short-term and long-term consequences. It is generally estimated that between 15% and 20% of all newborns worldwide have LBW, representing more than 20 million births a year. The goal is to achieve a 30% reduction in the number of infants born with a weight lower than 2,500 g by the year 2025. This will require a relative reduction of 3.9% per year between 2012 and 2025 and a decrease in the number of infants with LBW from approximately 20 million to about 14 million (1).

Most infants of LBW are born in low-income countries, especially in vulnerable populations. Regional estimates show that the prevalence rates of LBW in South Asia, sub-Saharan Africa, and Latin America are respectively 28%, 13%, and 9%, which are relatively high. It is worth noting that LBW data are limited or unreliable because many deliveries are performed at homes or small health clinics; accordingly, they are not reported in official statistics. This may explain the lack of attention to the outbreak of LBW (2-4).

* *Corresponding author*: Mehri Golchin, Department of Pediatrics, Faculty of Nursing and Midwifery, Isfahan University of Medical Sciences, Isfahan, Iran. Tel: +989131141241; Email: megolchin@yahoo.com, golchin@nm.mui.ac.ir

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The prevalence of LBW varies in different cities of Iran. For example, it has the prevalence rates of 11.8%, 1.8%, 6.3%, 9.9%, 6.2%, 4.2%, and 9.6% in Zahedan, Hamadan, Gorgan, Jiroft, Babol, Tehran, and Bushehr, respectively (5). This rate was 9.5% in Isfahan province in 2009 (6). In Iran, two-thirds of the total mortality of infants with LBW occur in the first 21 h of birth (7). The mortality rate of LBW infants is 20 times higher than that of normal infants. Even after survival, they are more susceptible to infectious diseases and arrested cognitive development. Also, these children are more likely to develop chronic illnesses (8).

On the other hand, the embryo in the mother's uterus is constantly exposed to mild stimuli from the amniotic fluid. After the birth of premature and LBW infants, the baby experiences intense stimuli induced by displacement and movement. Given that premature and low-weight infants are in a critical condition in terms of physiology, the care environment should be prepared by controlling five areas of developmental care, including sleep care, management, and evaluation of pain, regular and daily care, a healthy environment in the neonatal intensive care unit (NICU), and family-centered care (9).

Developmental care requires basic skills, such as family-based care, adoption of the best diagnostic-therapeutic approach with least stimuli, monitoring of neonatal development, rehabilitation measures, pain relief and tension reduction of the patient and family, developmental evaluation, family training about developmental care, and infant and family follow-up (10). In the realm of developmental care, the stressful context of the NICU should be alleviated in terms of harmful stimuli for the baby. Developmental care aims to moderate the infant's environment in terms of stressors and the physiological stability of the body.

By doing so, the infant's energy is retained for growth and accelerated recovery (11). Studies show that developmental care is not still inclusive in NICU (12). For example, a study in the United States revealed that out of 146 developmental care nurses participating in the research, only 14% performed their job desirably, while the remaining 86% were not able to provide efficient care services (13). Wu (2014) reported that the most common types of developmental care provided by nurses and parents in Taiwan include nesting and positioning of the baby, and other procedures were not well implemented (14). Hamilton and Redshaw (2009) reported that the overall health care score in England was 6.8 out of 8 (15).

Considering studies addressing developmental care in the world, the heavy workload of nursing staff and consequently insufficient provision of care in NICUs, a series of actions undertaken by mothers due to their lack of knowledge, which may hamper the developmental process of their infants, and the inconsistency of the treatment team members are all major barriers to developmental care (16). It is necessary to monitor the execution of developmental care and growth indices in health care centers by nursing staff and mothers during the infancy period.

Accordingly, given the existing limitations for implementing developmental care programs by nurses, this study was carried out to investigate the effect of executing developmental care programs by mothers on growth indicators in LBW infants referred to selected hospitals of Isfahan. It was hypothesized that there is a difference between the mean growth indices (e.g. weight, height, and head circumference) of newborns in the intervention and control groups on the 1st, 15th, and 29th days of birth.

Methods

This was a quasi-experimental study, and data were collected for 5 months in three stages from both groups of newborns that did not need to stay in the hospital. The research setting covered the Rooming-in and Nursery Ward of Shahid Beheshti Maternity Hospital in Isfahan, Iran, because this Maternity Hospital is just for women clients and most of the pregnant women refer to this health center. The sampling was conducted using a convenience sampling method to find the necessary sample size. Then, the samples were randomly assigned into two groups. For this purpose, from among all infants with LBW, as measured by a scale on the first day of sampling, the researcher identified all newborns who met the inclusion criteria. The infants were then divided into A (intervention) or B (control) groups by flip of a coin. In this study, a sample size of 25 was estimated based on the comparison of means in the two groups. Considering the time required to investigate each sample and a 20% dropout in each group, 30 subjects were selected for each group.

The inclusion criteria consisted of a birth weight of 1,500-2,500 g, a gestational age of less than 37 weeks, no history of hospitalization, non-

use of medication by mother, lack of acute respiratory problems (e.g., respiratory distress syndrome), lack of congenital anomalies, and no history of distressed events 6 months before the delivery (e.g., the death of a family member). The exclusion criteria consisted of neonatal death, any clinical condition that requires the re-admission of the newborn, parents' unwillingness to continue participating in the study, onset of certain diseases in the mother that render her incapable of performing maternal duties, stressful events in the family, and the death of a family member during the study. The data gathering tools were questionnaires for collecting demographic information (e.g., gestational age, gender, birth weight, infant Apgar score, educational level, occupation and age of parents, birth order, and number of children in the family) and a questionnaire covering the infant's developmental care that included 22 items about skin care, sleep, baby's physical condition, and control of light and environmental sound. This questionnaire was given to mothers for two periods of 14 days.

In this study, we also used a tape meter for measuring head circumference, a stadiometer with a precision of 1 mm for measuring height, and a baby scale with a precision of 5 g for measuring weight. The data collection was performed based on observation, patient profiles, and administration of infant developmental care questionnaire, which was filled out by mothers. Growth indices were also measured and recorded using a tape meter, a longitudinal scale, and a constant scale.

The researcher first obtained the necessary permission from the university. In this study, the samples were selected from Shahid Beheshti Maternity Hospital. By studying the records of patients and checking the statistics of the ward, the researcher identified eligible samples that met the inclusion criteria, and then by explaining the research procedure and objectives to the parents of newborns, they signed a written informed consent form for participation in the study.

The infants in the control group received routine care and their mothers were trained by the nurse in compliance with the routine guidelines. After discharge from the hospital, to measure and record growth indices, the researchers visited them on the 15th and 29th days of birth in accordance with the national routine neonatal examination program.

In the intervention group, practically, the researcher trained developmental care techniques, and also gave instructions, educational booklet, and pamphlets to mothers before their discharge. Then, after the discharge of the mother and infant from the hospital, for follow-up, the researcher made a home visit to review the practical training and provide written educational materials. These materials were about sleep care, skin care, massage, kangaroo mother care, management and evaluation of pain, regular and daily care, noise and light control, avoidance of sudden movement, breastfeeding, and nesting and positioning of the baby. Therefore, mothers could refer to these instructions when necessary. It contained actions that the mother could perform for her baby. These activities were also provided for mothers in the form of a developmental care questionnaire so that they could record their cares.

During the study, the researcher contacted mothers twice a week, and she was accessible to mothers throughout the study period. In addition, according to the national program of neonatal examinations, on the 15th and 29th days of birth, besides measuring and recording the indicators of the infant growth, the researcher made a home visit to assess the quality of maternal care. Also, on the 15th day, the developmental care questionnaire was collected from the mothers, and they received the second questionnaire, and on the 29th day, the second questionnaire was filled out.

The data were analyzed by SPSS software (version 15), and the tables and charts were plotted in the Excel software. For data analysis, the independent t-test, Chi-square test, repeated measures ANOVA, and Bonferroni post hoc test were used.

Results

With regard to demographic characteristics of the infants, the independent t-test revealed that there was no significant difference between the subjects in the intervention and control groups regarding the mean scores of gestational age, Apgar score, weight, and height of infants at birth and parental age ($P<0.05$; Table 1). This means that the two groups were identical in terms of these variables, with the exception of the mean head circumference of infants at birth, which was significantly different between the intervention and control groups.

Also, most of the infants in the intervention and control groups were female (58.3%), 1st birth order (48.3%), and single child (56.7%). Regarding the education level, the fathers had higher than Diploma (76.7%) and mothers had Diploma (45%). In addition, in terms of occupation, 45% of the

Table 1. Comparison of the mean of gestational age, weight, height, head circumference, and Apgar scores of infants at birth and parental age between the intervention and control groups

Statistical index Demographic features	Group					
	Intervention		Control		Statistical results	
	Mean	SD	Mean	SD	T	P
Birth weight (g)	2375.67	103.83	2305.83	200.21	1.69	0.095
Gestational age (week)	35.7	0.87	35.73	0.69	-0.1663	0.87
Apgar's score	8.2	1.4	8.7	0.4	1.8	0.077
Father' age (year)	32.04	4.48	32.27	7.99	0.129	0.89
Mother's age (year)	29.69	5.28	28.42	5.57	0.843	0.40
Height at birth	49.0.	1.70	48.37	2.49	1.18	0.234
Head circumference at birth	33.38	1.24	32.57	1.36	2.43	0.018

Table 2. Statistical results about comparing the distribution of some demographic characteristics (e.g., gender, birth order, number of children, occupation, and parental education) in both intervention and control groups

Demographic features	Chi-square statistical results	
	$\chi 2$	P-value
Sex	0.69	0.793
Birth order	3.68	0.159
Number of children	1.09	0.297
Father's job	3.36	0.19
*Mother's job	*	*
Father's education	1.4	0.49
Mother's education	4.9	0.09

* All mothers in this study were housewives.

Table 3. Comparison of the mean of growth indices of low birth weight infants on the first, fifteenth, and twenty-ninth days of birth in both intervention and control groups

Group		Measurement time							
		1st day of birth		15th day of birth		29th days of birth		Repeated measures ANOVA	
								P-value	
		Mean	SD	Mean	SD	mean	SD	Time	Intervention control
Head circumference (cm)	Intervention	33.38	1.24	33.76	1.18	34.57	1.54	0.1	0.17
	Control	32.57	1.36	33.01	1.35	33.57	1.34	0.1	
Height (cm)	Intervention	49.02	1.70	49.90	1.62	51.10	1.69	<0.001	0.41
	Control	48.37	2.49	49.31	2.50	50.37	2.51	<0.001	
Weight (g)	Intervention	2375.67	103.91	2574.30	106.42	3019.73	135.62	<0.001	*0.026
	Control	2305.83	200.91	2496.20	201.22	2883.33	222.95	<0.001	

* Bonferroni post-hoc test showed a significant difference between the mean weight of newborns in the intervention and control groups on the 29th day.

fathers were businessman, and 100% of the mothers were housewives. Moreover, the Chi-square test did not show a significant difference between the two groups in terms of gender distribution, birth order, and the number of children, as well as education level and occupation of parents (Table 2).

The results of the repeated measures ANOVA and Bonferroni post-hoc tests in within-group analysis revealed a significant difference in the mean weight and height indices of the infants measured at the three study stages (i.e., 1st, 15th, and 29th days of birth) in the intervention and control groups (P<0.001), but this difference was not significant for the mean of head circumference index (P<0.05). Furthermore, the results of the same tests for the comparison of means (weight, height and head circumference of infants) on the 1st, 15th, and 29th days of birth between the intervention and control groups did not show any significant difference, except for the weight index, for which Bonferroni post hoc test indicated a significant difference only on the 29th day of birth (P<0.05; Table 3).

It is worth noting that considering the significance of the difference between the mean head circumference of newborns in the intervention and control groups and the effect of this factor as a confounding variable, the comparison of mean head circumference on the 15th and 29th days of birth did not reveal a significant difference between the intervention and control groups.

Discussion

The results of repeated measured ANOVA and

Bonferroni post-hoc test in within-group analysis suggested that the mean weight and height indices of the newborns were significantly different among various stages (i.e., 1st, 15th, and 29th days of birth) in the intervention and control groups (P<0.001). However, this difference was not significant among different times for the mean of head circumference index (P<0.05). The results of the above tests for the comparison of the means of growth indices between both intervention and control groups indicated that the mean of neonatal weight was different only on the 29th day of birth and there was no significant difference in other stages.

Overall, the results showed that the intervention led to a significant increase in some growth indices, especially the weight of the infants in the intervention group, compared to that in the control group. Therefore, it can be concluded that implementing developmental care program by mothers had a considerable effect on infants with LBW after discharge.

In this regard, Karakoç Tari and Çiğdem (2008) compared traditional and developmental care methods in neonates and found that weight gain was higher in infants who had received developmental care (17). Furthermore, Brown and Hayman, providing care support for 25 premature infants weighing less than 1,500 g, reported a significant difference in weight during discharge and admission (18).

Also, Golchin et al. (2010) investigated the effect of one of the developmental care interventions (i.e., deep massage or tactile-kinesthetic stimulation) on increasing body weight in LBW infants. They found that weight gaining in the intervention group was significantly better than that in the control group. Therefore, these findings showed that deep massage enhances weight gain in LBW infants (19).

In another study, Chen et al. examined the effect of developmental care in premature infants in the NICU. The results of this study also showed a significant increase in infant weight in the developmental care group (20). As evidenced in these studies, developmental care increases the weight of LBW and premature infants that are consistent with the results of the present study. Also, studies by Peters et al. (2009), Gonya et al. (2014), McAnulty et al. (2009), Melnyk et al. (2006), and ALS et al. (1994), on the impact of developmental care on premature infants and low weight were in line with the study, suggesting that developmental care improve the physical condition of LBW infants (21-25).

In contrast, Maguire et al. (2008) showed that developmental care does not affect the health of infants in the NICU (26). In 2013, Ozdemir et al. revealed that there was a significant difference between the intervention (maternal posture intervention and the mother' smell) and control groups in terms of height and weight (27). Therefore, the results of the mentioned study regarding weight index are in line with ours, but their findings on height index are inconsistent with our results.

Although height and head circumference indices were not significantly different, the mean values of these indices demonstrated a growing trend. It seems that prolonged and continued developmental care will induce significant changes in the height growth of the infants in the intervention group with the head circumference index representing a better index of the natural growth.

As reported by Arzani et al., the mean height index in the second month was significantly different from the mean height in the third month in both intervention and control groups (P<0.0001) (28). The results of the mentioned study are inconsistent with those of the present study, which may be due to measuring height index over a three-month period and recording variations over a longer time period, compared to the present study.

In addition, there was a slight and insignificant difference between head circumference index in the first month of the study and the baseline, but this difference became significant at the end of the study (P<0.0001) (28). If the mentioned study is compared to our research in terms of the time interval, it can be seen that over the same one-month period, there was no significant difference in both studies. As such, these findings are comparable to those of the present study.

Moreover, in the study by Ozdemir et al., no significant difference was reported between the mean changes in the head circumference of newborns during admission (27), which is in line with the results of the current study. However, they did not measure head circumference at the time of discharge, which gives an edge to the present study.

Conclusion

The results suggested that the intervention could significantly increase weight index in the intervention group, compared to that in the control group. Considering that some developmental care techniques were low-cost and could be

implemented by mothers, and the LBW infants are at the risk of various disabilities in the future, it is suggested that directors, doctors, and nurses working in the health system employ this method to improve the quality of life in these infants, thereby reducing the cost of treatment. Also, this study lay the ground for future research so that by controlling study limitations, such as neglecting neural development due to the duration of the research, parental unwillingness to participate in the research, and inadequate space to execute this program in the hospital and then follow-up at home, more inclusive results could be achieved.

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Conflicts of interests

The authors of the current study declare no conflict of interest for this study.

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