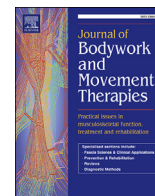




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Comparative study

The effect of tactile-kinesthetic stimulation on growth indices of healthy neonates



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A B S T R A C T

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Therapeutic touch is emphasized by healthcare professionals for improvement of neonates' growth and development. However, inconsistencies exist regarding effects and methods of massage in neonates. The purpose of this clinical trial is to assess and compare intervention and control groups regarding the effects of tactile-kinesthetic stimulation (TKS) by mothers on growth indices of healthy term neonates. Sixty healthy term neonates were randomly assigned into intervention and control groups. Mothers of neonates in the experimental group were trained to perform TKS for their newborns at home before feeding for at least 28 consecutive days, two times a day, and 15 min each time. Neonates in the control group were not required to receive this intervention. The neonates' growth indices were measured within 24 h after birth, and then at days 14 and 28. During the study and the three consecutive measurements, no significant difference was found between the mean weights, heights, and head circumferences of the neonates in the two groups ($p > 0.05$).

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1. Introduction

Growth indices, including height, weight, and head circumference, are the reliable measures for evaluation of neonates' and infants' physical growth and health status (Guzzetta et al., 2011). It has been frequently reported that nutrition pattern, gender, prenatal and postnatal care, birth weight, and type of maternal relationship affect neonates' growth and development (Dorea, 2012). Researchers have introduced some other innovative interventions that may further enhance growth and development of neonates and children. For instance, it has been reported that besides its calming effects, touching may improve growth and development of neonates (Ahmed et al., 2015). A feeling of being touched is the first

sense that a neonate experiences (Jabraile et al., 2016). This feeling enhances the maternal-neonate relationship, and continues during the prenatal period when neonates' senses, including taste, vision, touch, smell, and hearing, are developed. Evidence shows that the quality of the maternal-neonate relationship during the prenatal period has long-term effects on the child's growth and development (Seyyedrasooli et al., 2014).

Therapeutic touch has been emphasized by healthcare professionals, and the term *positive touch* is frequently used. Therapeutic touches consist of a variety of massage and touch techniques that can be used for neonates and infants (Kulkarni et al., 2010) to relieve disease symptoms and enhance recovery from illnesses (Seyyedrasooli et al., 2014; Kulkarni et al., 2010). Several studies have indicated the positive effects of massage therapy on neonates' growth and development (Kelmanson and Adulas, 2006; Procianoy et al., 2010), body weight (Kulkarni et al., 2010; Procianoy et al., 2010), behaviors (Scafidi and Field, 1996), and in the improvement of physiological jaundice (Seyyedrasooli et al., 2014). The

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positive effects of massage on parents-neonates' bonding and mothers' postpartum depression have also been shown (Kelmanson and Adulas, 2006). Another study indicated that abdominal massage can prevent feeding intolerance and reduce colic attacks in preterm infants (Tekgunduz et al., 2014). Some researchers have addressed the positive effects of infants' massage with lotions, olive oil, and other types of oil (Kulkarni et al., 2010).

Researchers have studied various massage protocols, including different sites, durations, methods, and frequencies of massage (Scafidi and Field, 1996; Tekgunduz et al., 2014; Ho et al., 2010). The present study was performed to investigate effects of mothers' tactile-kinesthetic stimulation (TKS) on the growth indices, weight, height, and head circumference, of healthy term neonates. TKS is a type of massage-therapy referring to a superficial tickle stimulus and a deeper pressure massage of the body, as well as passive flexion and extension of the extremities (Mokaberian et al., 2015). The purpose of this clinical trial is to assess and comprise intervention and control groups regarding the effects of tactile-kinesthetic stimulation (TKS) by mothers on growth indices of healthy term neonates.

2. Methods

2.1. Ethics statement

The study was approved by The Research Deputy and Research Ethics Committee of Kashan University of Medical Sciences, Iran. All participants completed consent forms and were willing to participate in the study.

2.2. Design and data collection

A clinical trial was performed on neonates who were born in educational hospitals affiliated with Kashan University of Medical Sciences, Kashan, Iran. Inclusion criteria for the neonates were body weight between 2500 and 4000 g; birth through single and normal delivery; normal activity, appearance, and skin color; Apgar score above 7; and absence of any fetal abnormalities, such as congenital cardiac, respiratory, absence of severe reflux (except cheesy vomiting); and neuromuscular defects, as well as being breastfed (iron and multivitamin use was permitted); having no sign of respiratory distress and sepsis; having a normal birth history; and being the first to third child of the family. Inclusion criteria related to mothers included having the ability to read and write in Farsi; lacking any type of substance abuse; and lacking any pregnancy-related disorders, such as gestational diabetes and hypertension; and having a normal and uncomplicated pregnancy and delivery. Exclusion criteria included parents' decision to withdraw from the study, mothers' noncompliance or inability to perform an accurate intervention, any neonatal disease or health problem, and any change in nutritional patterns of the neonates during the study.

Using the Pocock's sample size formula (Pocock, 1983), the optimal sample size of each group was estimated to be 30 participants. The sample size in each group was calculated based on the following assumptions: $\beta = 0.20$, $\alpha = 0.05$, $\sigma_1 = 143.6$, $\sigma_2 = 174.3$, $\mu_1 = 1842.8$, and $\mu_2 = 1772.1$ (Mokaberian et al., 2015). All healthy term neonates, who were born between April and December 2015, were assessed on the day of their birth in terms of meeting the criteria for this study. At first, 81 neonates were assessed for eligibility. Among those, nine neonates did not have the inclusion criteria, and six parents declined to participate. Therefore, 66 neonates were randomly assigned into two groups including experimental ($n = 33$) and control ($n = 33$) groups by block randomization. Out of 33 neonates assigned to the experimental group, 30 neonates completed the intervention. Three neonates did

not complete the intervention due to illness. Similarly, among the control group, three neonates did not complete the intervention due to travelling and illness (Fig. 1). Mothers were unaware of their allocated group.

2.3. Data collection instruments

Data were collected using interviews and checklists. Moreover, a tape measure and a Seca[®] scale (made in Germany) with an accuracy of ± 10 g were used to measure the neonates' weight, height, and head circumference. All neonates were weighed by the first author, after removal of the extra clothing and changing wet diapers, using a single scale that was calibrated daily.

2.4. Intervention

In 1-h individual sessions during discharge of the neonates from the hospital, mothers in the experimental group were taught to perform the TKS for their neonates. In these sessions, the first author performed the procedure on a baby mannequin, and the mother observed and then repeated the same procedure on the mannequin. Each mother's practice was observed by the first author. If mothers could not demonstrate an accurate TKS, their neonates were excluded from the study. Afterwards, the mothers were required to perform the same procedure at home on their neonates, before feeding, for at least 28 consecutive days, two times a day, and for 15 min each time. The mothers were asked to perform the procedure when neonates were calm and alert. They were trained to wash and dry their hands, and then massage the neonates using 0.5 mL of olive oil (Oila[®], made in Iran) to reduce skin friction and irritation. A 30-mL bottle of olive oil was provided by the researchers for each mother in the experimental group.

The TKS consisted of three 5-min phases, including two tactile phases and one kinesthetic phase (Mokaberian et al., 2015). In the first and the third phases, tactile stimulations were performed, and in the second phase, the kinesthetic stimulations were completed. All phases were conducted while the neonates were in the supine position. Tactile phases consisted of smooth and gentle top-down and rotational clockwise massages over the neonates' abdomen in these sequences: (1) One-minute top-down massages, (2) 1-min rotational massages, and (3) repeating these two sequences for 5 min. The pressure and depth of massage were adjusted, such that the neonates did not show any signs of behavioral distress, including crying for more than 30 s, limb-stretching, restlessness, yawning, hiccupping, fist-clenching, and inappropriate facial gestures (Arikan et al., 2008; Guzzetta et al., 2011). The kinesthetic phase consisted of slow and passive flexions of lower limbs in these sequences: (1) Five times of legs flexions to the abdomen (extension and flexion), (2) five times of bicycling movements of the legs, and (3) repeating these two sequences for 5 min (Mokaberian et al., 2015). Checklists were provided to mothers in the intervention groups to check the dates of intervention, as well as the completion of each intervention phase. Mothers of the neonates in the control group received routine training for maternal and neonatal care at discharge. They were not trained nor asked to perform the stimulations.

The growth indices, including weight, height, and head circumference, of the neonates in both groups were measured within 24 h after birth, and then were repeated at days 14 and 28, during home visits. A checklist, including incidence of health problems or concerns and types of traditional and non-traditional neonatal care, was also completed in each visit by the first author for both groups' participants. If mothers in the control group notified of receiving any massage by neonates, their neonates would be excluded from the study. To ensure adherence to the

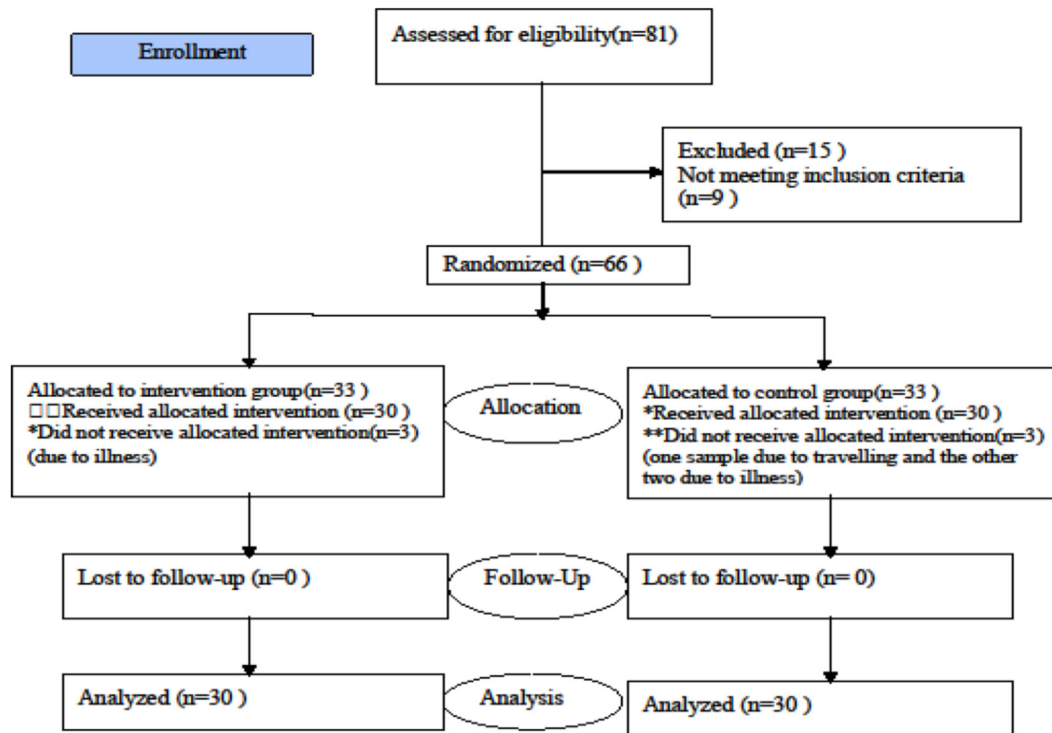


Fig. 1. The sampling Follow-up Diagram.

intervention, the first or second author reminded the mothers in the experimental group about the procedure, responded to their questions, and scheduled the next visits through daily phone calls.

2.5. Data analysis

Data analysis was performed using SPSS software version 16 (SPSS Inc. Chicago, IL). The normality of the data was assessed using Kolmogorov-Smirnov test. Mann-Whitney-U test was applied where the distribution of the data was not normal. Descriptive statistics were used for demographic variables. Using chi-squares and t-tests, demographic data of the two groups were compared. Using t-tests, the two groups were compared in terms of the mean differences of growth indices within 24 h after birth, day 14, and day 28. The mean differences of growth indices are defined as the mean scores of each growth index, including weight, height, and head circumference, at the time of measurement minus the related mean scores at a previous measurement point (see Tables 2–4). The significance level was set at 0.05.

3. Results

The two groups were not significantly different in terms of parental characteristics ($p \geq 0.05$). Furthermore, no significant difference was found between the baseline neonatal characteristics of the experimental and the control groups ($p \geq 0.05$) (See Table 1).

No significant difference was found between the mean weights, heights, and head circumferences of the neonates in the two groups in the three consecutive measurements ($p \geq 0.05$) (See Tables 2–4).

4. Discussion

The present study showed that four weeks of TKS did not significantly increase weight, height, and head circumference of a sample of healthy full-term neonates. There are inconsistent results

about effects of TKS on infants' growth and development. Several research teams have reported positive effects of TKS on weight and head circumference (Tekgunduz et al., 2014, Saeadi et al., 2015); however, others did not report significant findings (Aliabadi and Askary, 2013; Ho et al., 2010). Ho et al. (2010) and Aliabadi and Askary (2013) have reported that massage therapy had no positive effect on weight gain either in mature or in low-birth-weight neonates. The inconsistent results related to the TKS and massage on the infants' growth and developmental indices might be associated with differences in intervention protocols, such as the duration and site of massage, or quality of implementing the techniques by caregivers. For instance, Arikan et al. (2008) had implemented 4 min of massage daily and reported that the results were not significant in terms of growth and head circumference; however, Tekgunduz et al. (2014) had implemented the techniques over a longer period of time, 15-min sessions two times daily, and reported significant effects on weight gain and prevention of feeding intolerance in preterm infants (Tekgunduz et al., 2014). Saeadi et al. (2015) have also implemented a whole-body massage therapy using triglyceride oil on 121 premature neonates; they massaged the neonates, 5 min, four times a day, for a week, and reported that the intervention could significantly improve weight gain of infants in the intervention group (Saeadi et al., 2015).

Findings of several studies contradict our results, indicating the effectiveness of the massage interventions on neonates. Mokaberian et al. (2015) investigated the effects of TKS on the growth indices in low-weight neonates and found significant effects of the intervention on the improvement of weight, height, and head circumference. Hosseinzadeh et al. (2012) and Cho et al. (2012) showed that a 15-min massage by mothers is effective for physical growth and height in low-birth-weight neonates. These researchers explained that stretching movements of the lower limbs might stimulate the active estrogenic centers in the lower limbs, which consequently increased the height of the infants who received the TKS intervention. However, the present study showed

Table 1
Baseline and demographic characteristics of mothers and neonates in two groups.

Variables	Experimental group (n = 30)	Control group (n = 30)	p value
Weight of neonate (g)	3251.66 ± 298.98	3193 ± 391.22	0.51
Height of neonate (cm)	50.25 ± 1.92	48.13 ± 1.81	0.10
Head circumference of neonate (cm)	34.66 ± 1.19	34.50 ± 1.57	0.64
Gestational age (weeks)	38.82 ± 0.88	38.70 ± 0.98	0.63
Sex of neonate			0.100
Male	13 (43.3)	17 (56.7)	
Female	17 (56.7)	13 (43.3)	
Birth order of neonate			0.100
1	10 (33.4)	11 (36.7)	
2	14 (46.6)	16 (53.3)	
3	6 (20)	3 (10)	
Age of father	31.60 ± 5	31.46 ± 5.61	0.92
Age of mother	27.56 ± 5.82	28 ± 6.37	0.78
Fathers' education			0.35
Elementary	1 (3.3)	3 (10)	
Middle or high school level	19 (63.3)	21 (70)	
College	10 (33.3)	6 (20)	
Mothers' education			0.57
Elementary	1 (3.3)	3 (10)	
Middle or high school	22 (73.3)	21 (70)	
College	7 (23.3)	6 (20)	

Table 2
Comparing mean differences^a of weight in two groups.

Time	Groups		p-value ^b
	Control (n = 30)	Experimental (n = 30)	
Weight (0–14day)	549.169 ± 333.523	854.285 ± 666.586	301.0
Weight (0–28day)	084.270 ± 333.1158	126.319 ± 666.1211	488.0
Weight (14–28day)	696.271 ± 635	752.208 ± 625	874.0

^a Mean difference of weight is defined as mean score of weight at the time of measurement minus mean score of weight at a previous point in time.

^b Independent *t*-test.

Table 3
Comparing mean differences^a of height in two groups.

Time	Groups		p-value ^b
	Control (n = 30)	Experimental (n = 30)	
Height (0–14day)	1.172 ± 2.219	1.425 ± 2.033	0.589
Height (0–28day)	1.599 ± 4.333	0.9821 ± 4.033	0.521
Height (14–28day)	750.0 ± 2.116	0.955 ± 2	0.601

^a Mean difference of height is defined as mean score of height at the time of measurement minus mean score of height at a previous point in time.

^b Independent *t*-test.

that TKS massage, 15 min two times a day, did not significantly influence the growth indices of a sample of healthy neonates.

A hypothetical reason for these contradictory results (our neutral results compared to positive results of other studies) may

be related to the differences among study populations. Studies that showed positive results related to tactile or kinesthetic stimulation were predominantly conducted on premature or underweight neonates (Cho et al., 2012; Hosseinzadeh et al., 2012; Mokaberian et al., 2015; Saeadi et al., 2015; Tekgunduz et al., 2014). However, the neonates in this study were normal in their weights, births, growths, and weight gains and were within normal bounds. For our participants, we would not expect greater indices than normal growth or weight gain with the stimulation. It can be concluded that the massage and stimulation can be effective to help improve neonates with growth problems. To summarize, inclusion of clinical trials with different populations and results, which may be contradictory, in the body of knowledge about neonatal care can be essential for conducting future research, designing significant, effective interventions for neonates' care, and enhancing evidence-based practice.

4.1. Limitations and recommendations

Generalizability of our findings is limited to a convenient sampling. Although necessary and initial training and frequent phone calls for further directions were performed by the first author, the interventions by mothers were not directly supervised by an expert trainer. Likewise, there was no observation of the control group in terms of whether any massage was performed on neonates. A small number of studies have been conducted on the effects of TKS massage in neonates, and these studies have resulted in contradictory findings. Therefore, further research with modified methodologies and designs in this field is recommended. During each

Table 4
Comparing mean differences^a of head circumference in two groups.

Time	Groups		p-value ^b
	Control (n = 30)	Experimental (n = 30)	
Head circumference (0–14day)	0.518 ± 1.20	647.0 ± 333.1	0.3820
Head circumference (0–28day)	825.0 ± 316.2	797.0 ± 633.2	136.0
Head circumference (14–28day)	552.0 ± 116.1	4660. ± 30.1	170.0

^a Mean difference of head circumference is defined as mean score of head circumference at the time of measurement minus mean score of head circumference at a previous point in time.

^b Independent *t*-test.

home visit, to investigate whether the control group performed massages or kinesthetic stimulations, a checklist was used; however, the responses to the checklist might have been biased with mothers' memories as well as information about neonatal care from other caregivers.

Conflict of interest

The authors declare no conflict of interest in this study.

Acknowledgment

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