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Impact of motor developmental stimulatory training of the mothers on motor development of healthy full-term infants aged 6 months

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Abstract

Background: The first 6 to 8 months of a human baby's life are among the most crucial periods of development. Mothers can enhance an infant's development by offering environments rich in appropriate stimuli. The study aimed to evaluate the effectiveness of motor developmental stimulatory training on mothers' motor development (Fine and gross) in healthy, full-term, 6-month-old infants.

Methods: This experimental study was conducted 2016 on 72 mothers and their healthy six-month-old infants in Gorgan (Iran). The block randomization method assigned participants to the intervention (n=36) and control (n=36) groups. The motor developmental stimulatory training program was performed for five 90-minute weekly sessions by a midwifery consultant for children's mothers. The fine and gross motor development of infants in both groups was evaluated before the intervention, in the end, and two weeks after the intervention by a research assistant using the Denver-II tool. The data were analyzed using the Friedman and the Mann- Whitney U Tests using SPSS software version 26.

Results: At the beginning of the study, infants' mean fine motor skills scores were 6.22±0.47 in the intervention group and 6.05±0.43 in the control group, showing no significant difference. Likewise, the mean gross motor skills scores were 6.65±0.52 for the intervention group and 5.7±0.42 for the control group, which was also insignificant (P-value < 0.012). However, by the end of the training, the mean ages for fine motor skills in the intervention group rose to 9.41±0.75 compared to 7.51±0.42 in the control group, and two weeks later, they were 11.43±0.49 in the intervention group against 8.64±0.54 in the control group, with these differences being significant (P-value < 0.001). The mean ages for gross motor skills at the end of the training were 7.94±0.61 in the intervention group and 6.7±0.34 in the control group, and two weeks later, 9.3±0.47 in the intervention group compared to 7.46±0.55 in the control group, which was also significant (P-value < 0.001).

Conclusion: Developmental stimulatory training significantly improves 6-mount infants' gross and fine motor skills. Midwifery consultants can educate mothers about the motor development stimulation package so that they can use it to enhance the fine and gross motor skills of their healthy infant.

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Highlights

What is current knowledge?

Based on human motor development theories, infants' physical, cognitive, and psychosocial stimuli can improve their motor development.

What is new here?

The motor developmental stimulatory package can promote healthy infants' fine and gross motor development.

Introduction

Human development encompasses individuals' physical, cognitive, and psychosocial transformations (1). One specific aspect of human development is motor development, which involves improving motor skills (2). This encompasses both gross and fine motor skills. Gross motor skills are typically the initial skills to develop (3) and involve larger muscle groups, such as those in the legs, torso, arms, and head (4). In contrast, fine motor skills pertain to hand-eye coordination and the utilization of smaller muscle groups, particularly in the fingers (5).

Motor development occurs throughout a person's life and is closely linked to age (1). It plays a vital role in infants' health, daily functioning, and future achievements (4). The infancy period is marked by substantial brain development (2), including neural growth such as the formation of cells, neurons, and synapses, alongside rapid physical and cognitive advancements (6). In This critical phase, as infants interact with their environment, they learn through exploration and movement, which fosters their cognitive growth. This dynamic interplay between physical and mental development allows them to profoundly adapt and understand the world around them (7). Consequently, understanding these aspects can lead to better support for children's developmental needs and ultimately enhance their well-being and potential (8).

Human development progresses sequentially and interactively (2). From one point of view, the child's motor development is a dynamic process in interaction with multiple subsystems, including the child, the environment, and experience (9). From the "embodied cognition perspective", the body is at the center of cognitive processes. For this reason, the interaction must be done at the physical body level, a factor that affects the nature of mental activity through contact with the environment (7). Also, there is an overlap between cognitive and physical movement processes. This underscores the importance of actively promoting the development of movement skills in children. By fostering their physical abilities, we can help them build a strong foundation for healthy growth and participation in various activities (3,7,8).

A longitudinal study found that using baby walkers and hammocks significantly enhanced gross motor skills in children (9). Another study about the massage evidence map based on the analysis of published articles showed that massage improved the neuromotor development of children (10). In this regard, a study showed that preschool children with less participation in urban sports programs, games without parents, and daycare center programs had more negative physical findings and less visual-motor coordination than those who participated (11). In contrast, A longitudinal study found no systematic pattern in the gross motor development of children aged 15 days to 13 months (9). Also, a study showed children's fine motor development, those who did the exercises suggested by the parents had better scores than expert-guided children (12).

In this regard, some studies found parents, particularly mothers, significantly influence their children's development through their constant interaction with them (11,13). An interview with Swedish health visitors showed that the three-part program (Examining the motor development status of 15-day to 3-year-old children, donating a toy bag to mothers at the 2- to 3-month visit and sending videos of motor exercises to mothers), increasing the parents' ability and willingness to participate in the implementation of child development programs (13).

Due to the significant impact of children's motor development on their overall lifespan (7), the critical importance of a rich, experience-filled environment in supporting this development (12,14), the vital role mothers play in enhancing their children's skills (13), and the limited and conflicting research available on healthy motor development in children (9-12), the researchers aimed to evaluate the effect of motor developmental Stimulatory training for mothers on the gross and fine motor skills of their infants.

Methods

This experimental study was done on 72 healthy mothers, 35-18 years old, and their healthy 6-month-old infants, born at 37-42 weeks in the health care centers affiliated with Golestan University of Medical Sciences, Gorgan (Iran).

The sample size was calculated based on Rezaeian et al.'s studies of pre-and post-test developmental motor skill scores (15). Expecting at least 10 units of score increase as a result of the intervention, a confidence level of 95%, power of 80%, and an attrition rate of at least 10%, the number of samples was determined to be 36 people in each group.

Convenient sampling was done from four selected health centers in Gorgan. Then the samples were allocated to two equal intervention and control groups using block randomization.

The researcher explained the research objectives to the participants. After obtaining written informed consent from the mothers, the demographic information form was completed by the mothers.

The Denver Developmental Screening Test-II (DDST-II) measured the infants' motor development. Denver-II has 125 skills in four areas, including personal social development (25 questions), fine movement development (29 questions), gross movement development (32 questions), and verbal development (39 questions) in infants from birth to 6 years (16). One or more of its dimensions can be used alone. In this study, gross and fine motor areas have been used (17).

To score fine and gross motor development, after determining the child's calendar age to months and full weeks, a vertical line is drawn on the Denver scale in such a way that it cuts the horizontal line of the form (Child's age) and continues to the top. Then, the tasks related to each child's age line, plus three tasks from the left side of the age line and the continuation of the task from the right side of the infant's age line are checked. It continued until the child could not do three tasks in a row. Based on the tasks on the right and left side of the vertical line to the calendar age, the age equivalent to the end of the box is the child's developmental age (15,17).

Davari et al. stated that the validity and reliability of the DDST-II have been examined and confirmed in various studies (17). Shahshahani and colleagues showed that the DDST_II is highly valid and reliable for measuring the motor development of children aged 0 to 6 in Tehran, Iran (18).

The intervention was conducted by holding small group training sessions of nine people using the "Infant Motor Development Stimulation Package" (Table 1) (19) in five 90-minute weekly sessions in the form of Q&A, role-playing, class assignments, and homework. During the training sessions, mothers practiced. They were asked to do the techniques daily at home with their infants. To ensure that mothers completed the exercises, questions about them were asked at the beginning of each session.

A research assistant assessed the infants' gross and fine motor development in both groups. Evaluations were conducted at three-time points: before the intervention, at the end of the intervention (Week 5), and two weeks after the intervention concluded (Week 7). These last two time points were selected to examine the immediate and early impacts of the intervention.

Statistical analysis

The analysis was conducted using SPSS software, version 26. Descriptive statistics were used to summarize the data, including mean, standard deviation, frequency, and percentage. The Shapiro-Wilk test was applied to evaluate the normality of the data. The scores for infants' fine and gross motor development did not conform to a normal distribution on three occasions. To compare the mean scores of fine and gross motor developments in infants, we utilized the Friedman and the Mann-Whitney U tests for the data collected before the intervention, at the conclusion of the intervention, and two weeks afterwards. A p-value of less than 0.05 was deemed statistically significant.

Table 1. Content of training sessions based on the infant motor development stimulation package

Session number	Content
1	**Introduction and induction** • Establishing initial communication between group members. • Statement of class objectives. • Explanation of general topics of the counselling sessions. • Explanation of general duties of group members. • Explanation of the concept, importance, and necessity of child development counselling. • Explanation of the effects and benefits of motor development stimulation training. • Preparation for the next session: Mothers were asked to bring cloth, paper, and safe disposable items for toy-making training.
2	**Developing motor skills and learning during play** • Defining the concept of play and its role in child development. • Explaining the importance of matching play to the child's age. • Explaining the characteristics of a good toy. • Explaining how to use toys. • Explaining important practical tips about playing with children (Number of toys, playing time, paying attention to the child's preferences, the roles of mother and child in developmental games). • Developmental stimulation toys appropriate to the infant's developmental age. • Making toys with safe and harmless disposable materials, such as making balls, dolls, and cloth books from pieces of disposable cloth, waste newspapers, and books of different thicknesses and diameters. • Performing exercises during the session by mothers, guided by the researcher. • Homework: Practice the techniques taught at home daily with the infant.
3	**Promoting the development of motor skills** • Muscle-strengthening interventions to strengthen muscles and prepare infants for movement, such as helping the infant kick with their feet to strengthen the hip and leg muscles or promoting eye-tracking and head movements (4 to 8 months). • Using different and suitable positions and helping the baby to change positions. • Multi-sensory stimulation such as lullabies, singing, and hanging colorful objects. • Performing exercises during the session by mothers, guided by the researcher. • Homework: Practice the techniques taught at home daily with the infant.
4	**Interactions of promoting motor development** • Ways to create an emotional bond between mother and child. • Making eye contact with the child. • The importance and methods of addressing the infant by name. • Assisting the child in developing self-awareness, such as engaging in play with the child using a mirror. • Performing exercises during the session by mothers, guided by the researcher. • Homework: Practice the techniques taught at home daily with the infant.
5	**Promoting the development environment** • The child's development environment as an effective educational space • Features of the appropriate environment (Supportive, provocative) • Appropriate equipment • Environmental safety • Performing exercises during the session by mothers, guided by the researcher. • Homework: Practice the techniques taught at home daily with the infant.

Results

Seventy-two mothers with an average age of 29.4±4.12 and their healthy infants participated in this study, and no samples were excluded (Figure 1). Most participants were of Persian ethnicity, university-educated, housewives, and had single children. The two groups had no significant differences in demographic characteristics (Table 2).

The results showed that the mean age of the infants' gross and fine motor development in the intervention and control groups before the intervention (The motor developmental stimulatory training), at the end of the intervention (Week 5), and two weeks after the intervention (Week 7) did not significantly differ (Table 3).

There was a significant difference in the mean age of gross motor development between the two intervention and control groups at weeks 5 and 7 compared with before the intervention (Table 3). The growth percentage of gross motor development five and seven weeks after training compared with before the intervention was 66% and 32%, respectively (Figure 2).

There was a significant difference in the mean age of fine motor development between the two intervention and control groups five and seven weeks after the beginning of the study compared with before the intervention (Table 3). The growth percentage of gross motor development five and seven weeks after training compared with before the intervention was 85% and 43%, respectively (Figure 3).

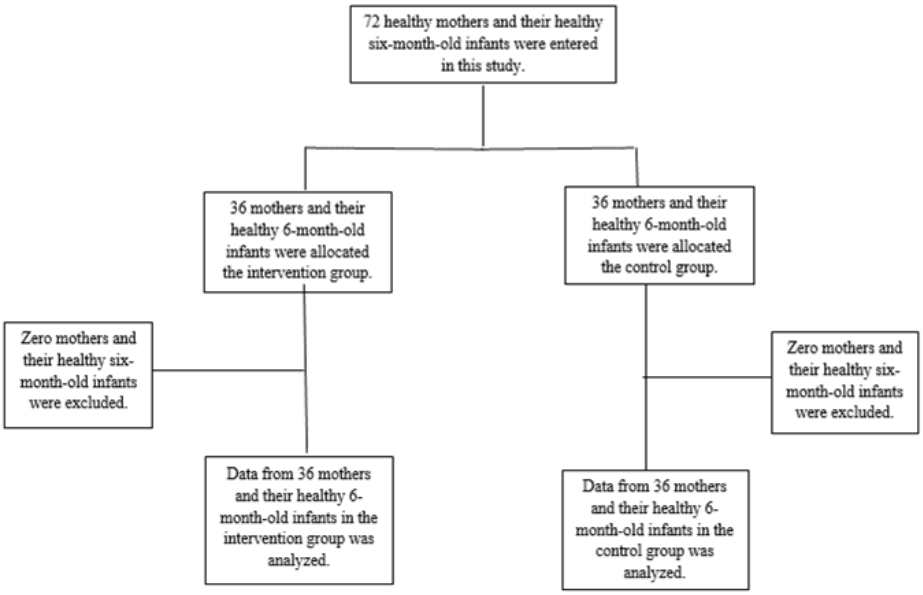

Figure 1. The flowchart of the study's inclusion, allocation and follow-up of participants

Table 2. Comparing mean values and frequency of demographic information between the two study groups

Variables		Intervention group	Control group	Total	P-value *
		Mean± SD	Mean± SD	Mean± SD	
Mother's age		29.52±3.79	29.28±4.48	29.4±4.12	0.779 [a]
Variables		N (Percentage)	N (Percentage)	N (Percentage)	P-value *
Education	Below diploma	6 (16.7)	12 (33.3)	18 (25.0)	0.076 [b]
	Diploma	11 (30.6)	14 (38.9)	25 (34.7)	
	Higher graduation	19 (52.8)	10 (27.8)	29 (40.3)	
Occupation	Employed	27 (75.0)	30 (83.3)	57 (79.2)	0.384 [b]
	Housewife	9 (25.0)	6 (16.7)	15 (20.8)	
Income (IRR)	< 10000000	23 (63.8)	27 (75.0)	50 (69.4)	0.088 [c]
	10000000 - 15000000	7 (19.4)	7 (19.4)	14 (19.4)	
	≥ 15000000	6 (16.7)	2 (5.6)	8 (11.1)	
Ethnicity	Persian	29 (80.6)	29 (80.6)	56 (80.6)	1[c]
	Others	7 (19.4)	7 (19.4)	7 (19.4)	
Number of children	One	17 (47.2)	13 (36.1)	30 (41.7)	0.43 [b]
	Two	14 (19.4)	14 (19.4)	28 (38.9)	
	Three	5 (13.9)	9 (25.0)	14 (19.4)	
Infant's sex	Male	20 (55.6)	19 (52.7)	39 (54.2)	0.813 [b]
	Female	16 (44.4)	17 (47.2)	33 (45.8)	

* P-values less than 0.05 were considered statistically significant.
a: The results of the independent sample test
b: The results of the Chi-square
c: The results of the Fisher's test

Table 3. Comparison of the mean score of fine and gross motor development of infants before the intervention, at the end of the intervention, and two weeks after the intervention between the two study groups

Type of motor development	Group	Before	End of the intervention	Two weeks after the intervention	P-Value
		Mean± SD	Mean± SD	Mean± SD	
Fine motor development	Intervention group	6.22±0.47	9.41±0.75	11.43±0.49	< 0.001*
	Control group	6.05±0.43	7.51±0.42	8.64±0.54	< 0.001*
	P-Value	< 0. 116**	< 0.001**	< 0.001**	-
Gross motor development	Intervention group	6.65±0.52	7.94±0.61	9.3±0.47	< 0.001*
	Control group	5.7±0.42	6.7±0.34	7.46±0.55	< 0.001*
	P-Value	< 0.610**	< 0.001**	< 0.001**	-

* Friedman Test
** Mann-Whitney U Test
Pairwise comparisons in each group were conducted using a nonparametric post hoc test (Friedman test with post hoc test).

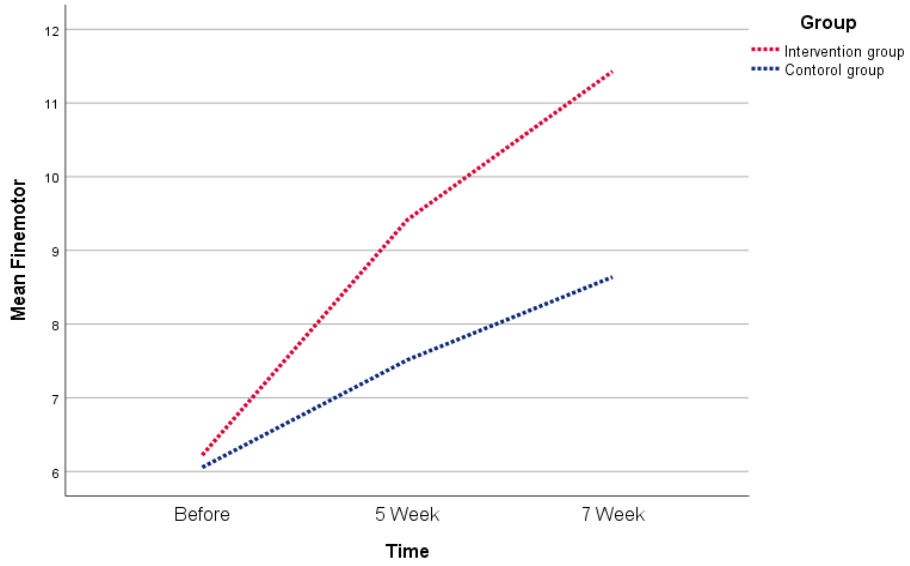

Figure 2. Comparison of the mean score of fine motor development of infants before the intervention, at the end of the intervention, and two weeks after the intervention between the two study groups

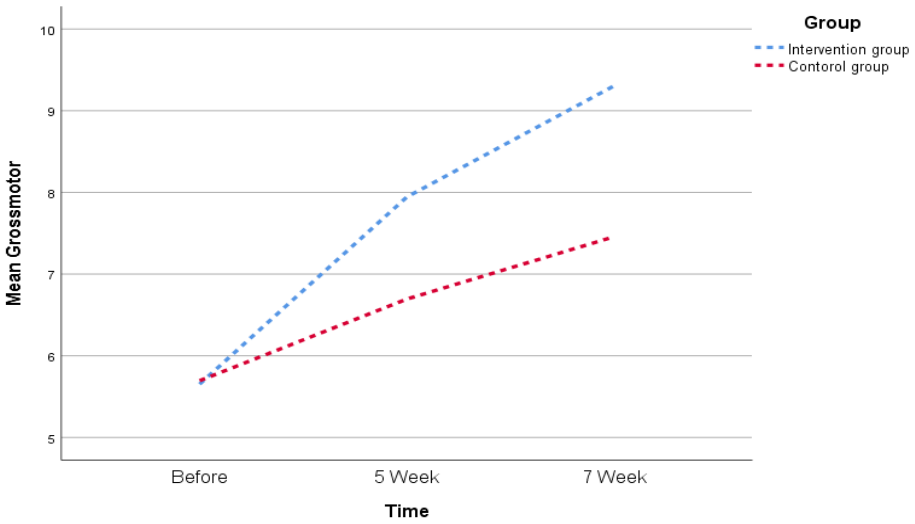

Figure 3. Comparison of the mean score of Gross motor development of infants before the intervention, at the end of the intervention, and two weeks after the intervention between the two study groups

Discussion

The study aimed to assess the effectiveness of motor development stimulation package training for mothers on the gross and motor development of healthy, full-term infants who are 6 months old. The results showed that the mean age of gross and fine motor development of the infants in the intervention group increased significantly at the end of the intervention and two weeks after the intervention concluded.

A review of previous studies indicates that many earlier results are in close agreement with the conclusions of the current research. For instance, a study conducted in Bangladesh revealed that a bi-weekly parenting program for mother-child pairs improved children's motor skills between the ages of 5 and 24 months (20). In another investigation, healthy children aged 6 to 10 months who regularly participated in aquatic activities demonstrated better reflexes, improved grasping abilities, and enhanced motor skills (7). Furthermore, research found that a 12-week functional training program positively affected gross motor development in healthy children aged 5 to 6 (21). Additionally, training programs focused on vertical jumping also fostered children's growth (8). In China, a quasi-experimental study involving 249 children aged 4 to 6 years showed that a 10-week ball-based skill program, known as the "Hello Sunshine curriculum project,' significantly improved their fundamental movement skills (22). Furthermore, it is crucial to highlight that: interventions and policies designed to improve family involvement in early learning opportunities at home can have positive and independent effects on early childhood development (23). Mothers are the determining factor in developing the child's motor skills (13).

The current study is similar to previous research, as it utilizes training programs to enhance children's developmental motor skills in their interactions with the environment. These vividly illustrate the crucial impact structured activities and engaged parental involvement have in nurturing motor skill development among young children. But this study presents a distinctive methodology that sets it apart from current research in this field. It employs a specialized developmental motor stimulation package (Table 1) (19) meticulously crafted to align with the varying age characteristics of children. This approach embraces a holistic perspective on child development, comprehensively addressing physical, cognitive, and emotional growth.

In contrast, a study found that despite the positive correlation between gross and fine motor skills, gross motor exercises of 6-11-year-old children did not affect fine motor control (24). The disparities between the current study and the previous one may stem from several key factors, including the type and diversity of intervention, the intensity of the developmental motor stimulation (22), the intervention's length, and the follow-up time (24). Most studies have used instruments that assess development as a whole or have examined only one dimension. This study, however, has the advantage of assessing child development in two dimensions.

One significant limitation identified in this study was the lack of adequate educational facilities for mothers at most health centers. As a result, training sessions could only be held at two centers, which posed challenges for some participants who had to travel long distances. To address this issue and improve accessibility, it is recommended that new technologies be utilized, allowing mothers without access to appropriate facilities to participate in training remotely.

Additionally, while this study focused on six-month-old children, future research could expand its scope to include other age groups, providing a more comprehensive understanding of developmental needs. Finally, involving a broader range of family members, including fathers and siblings, in future studies could enhance research outcomes and support a more holistic approach to child development.

Conclusion

Using a specific motor developmental stimulation package, motor developmental stimulation training can improve healthy infants' gross and fine motor skills. This study focused on a 5-week training program (The specialized developmental motor stimulation package) aimed at mothers, which promotes motor development in healthy infants aged 6 months.

In conclusion, midwifery consultants can significantly use this programme to elevate children's developmental skills. Additionally, health planners can apply the findings from this study to effectively incorporate this programme into child health services, ensuring a more integrated approach to child development and health care.

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Ethical statement

This study was approved by the Ethics Committee of Golestan University of Medical Sciences, Gorgan, Iran (Code: IR.GOUMS.REC.1395.6).

Conflicts of interest

Funding or research support: No; employment: No; personal financial interests: No; stocks or shares in companies: No; consultation fees: No; patents: No; personal or professional relations with organizations and individuals (Parents and children, wife and husband, family relationships, etc.): No; unpaid membership in a government or non-governmental organization: No; are you one of the editorial board members or a reviewer of this journal: No.

Author contributions

Study concept and design: ASB, MH and ZV; Analysis and interpretation of data: NB, MH, and ASB; Drafting of the manuscript: ASB; Critical revision of the manuscript for important intellectual content: ASB and MH; Statistical analysis: NB; Administrative, technical, and material support: ASB, MH, NB and ZV; Study supervision: ASB and ZV.

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