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Original Article (Pages: 11973-11986)

The Effect of Development Education on Fine Motor Skills of 18-Month-Old Children

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Abstract

Background

The initial years of life particularly the first two years are regarded as the most important brain development period. The development of children is an important determinant of health throughout the whole of life. We aimed to evaluate an educational program to improve the fine motor skills of 18-month-old children.

Materials and Methods: This randomized clinical trial was conducted in the city of Saqqez, Iran in 2015-2016. Seventy 18-month-old infants were randomly assigned to control (n=35), and intervention (n=35) groups. The training of fine motor skills was given to the mothers of the children of intervention group, including: painting, building a tower, stringing, tearing and crushing a piece of paper, targeting and dropping. Fine motor skills were measured before intervention and 4 and 8 weeks after the intervention using ASQ-II screening tool (Age and Stage Questionnaire, Second Edition). Data were analyzed using SPSS software version 20.0.

Results: In the intervention and control group, 51.5% (n=17) were male and 48.5% (n=16) were female. Statistical test of Chi-square showed that there was no statistically significant difference in terms of gender (p=0.59). According to independent t-test, there was no significant difference in the mean of fine motor score before intervention in the two groups with (p = 0.13). The repeated measurement test showed that 4 and 8 weeks after training, the scores of fine movements with (p = 0.04) became significant.

Conclusion

Based on the results, developmental skills training compared with control group improved the fine motor skills of 18-month-old children in this study.

Key Words: Child; Development; Intervention; Fine Motor.

*Please cite this article as: Ahmadi J, Ahmadi Doulabi M, Sajedi F, Nasiri M. The Effect of Development Education on Fine Motor Skills of 18-Month-Old Children. Int J Pediatr 2020; 8(9): 11973-986. DOI: **10.22038/ijp.2020.48779.3915**

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Received date: Apr.10, 2020; Accepted date: Jul. 22, 2020

1- INTRODUCTION

Given that the development specialists consider the infancy period of each person as the most sensitive period in the development of them, attention to this age is very important. Although perceptual – motor abilities are generated by environment and inheritance with different ratios, one of the most important factors in the development of perceptual – motor abilities of children is how the early and sensitive years of child`s life how is it going (1). Development means aspects of growth that involve physical, mental, emotional, and social changes, and refers to a progressive increase in the skill and capacity of function, which in fact is a qualitative change in the actions of the child (2, 3). Development is divided into specific areas such as gross and fine movements, cognitive, linguistic, emotional and social development. The fine movements also include the fine movements of the hands and fingers, examples for this skill at 18-month-old include: putting four cubes together, using cups and drawing vague lines (4).

However, in some studies, the definition of Fine Motor Skill has been expressed as small muscle movements requiring close hand-eye coordination (5). Developmental disorders that are divided into different areas (gross movements; fine movements; social skills and mental – speech skills), have an important impact on individual and social performance of a person (2). The risk factors for delaying development include familial marriage, maternal age during pregnancy, multiple births, diabetes and hypertension in the mother, infection during pregnancy period, and the use of teratogenic drugs (6). A developmental delay refers to children that do not show developmental characteristics according to their age (7). It is estimated that about 200 million children under the age of five do not have or are not in the process of achieving desirable development around the world (8). The developmental delay incidence in Iran has been reported from 7% to 26.3% in various cities (6, 9-12). Sajedi et al. (2016) in a meta-analysis study on the development of Iranian children reported cumulative frequency of developmental delay of 14.6% based on conducted studies (13). The development of basic motor skills is associated with positive health outcomes and it requires learning, training and reinforcement (14).

Motor development of children is especially important in their preschool period. When we hear this term, we think of motor development of the entire body (gross motor skills), and rarely of the development of small muscle groups in fingers (fine motor skills), which are essential for the development of a child. Early planned introduction of activities for the development of fine motor skills has an important effect on a child’s independence and later literacy and numeracy education. Furthermore, fine motor skill development promotes the development of a child’s brain (15). However, the need for prevention and promotion measures in situations where there is more likely to be developmental delay or disorders in the development of children remains a major challenge; and studies show that many of the defects and brain – movement disorders may be preventable (16, 17).

Considering that human development takes place through an interactive and progressive process between personal growth and development, activities and environmental stimuli (18), and given that only one factor is usually not effective in developing developmental delay, identification of risk factors is very important (19). The primary living environment has a critical impact on the development of the brain of children, a child is born with billions of brain cells. In an environment filled with initial stimulus, there will be wider and more positive communication forms among the brain

cells and the child will progress in all aspects of life regarding physical, mental, linguistic, emotional and social development (20). The results of various studies indicate the effect of interventions on improving developmental skills of children of different ages (3, 21-25). Early Childhood Education is education that is organized with the aim of facilitating the child's overall growth or emphasizing the development of all aspects of the child's personality. Early childhood education is the provision of efforts to stimulate, guide, nurture and provide learning activities and skills to children (26).

In a study by Rezaian et al. (2014) entitled "Investigation of the effect of a developmental stimulatory package on the fine motor development of 1-12-month-old foster care infants", they stated that by performing motor interventions, fine motor skill has been significant (27). Miquelote et al. (2012) conducted a study on the impact of home environment on cognitive and motor behavior of foster care infants in Brazil, and they showed that play, physical activities and also available physical space are effective in improving overall motor performance and cognitive development of children (28).

Moreover, Ahmadi et al. (2017) showed in their study that developmental training would significantly improve motor skills in 12-month-old children (29). Hill (2001), and Rechetnikov and Maitra (2009), found a significant relationship between linguistic development impairments and motor development impairments in their systematic review studies (30- 31). Considering the above studies and the relation between other developmental areas with the field of motor development, the importance of motor skills in individual and social life can be realized and the necessity of early identification and appropriate interventions becomes clearer, and because there has been no comprehensive study with these age groups and sample size in Saqqez, the researcher decided to measure the effect of developmental education on the fine motor skills of 18-month-old children referring to the healthcare centers of Saqqez city, Iran.

2- MATERIALS AND METHODS

2-1. Design and setting

This study was part of a larger study with a clinical trial nature whose objective was to determine the influence of Education on Fine motor skills in 18-month-old children in 2015-2016 who had been taken to healthcare centers in Saqqez city, Kurdistan province, Iran.

2-2. Participants

The research population consisted of all 18-month-old children and their mothers who referred to healthcare centers in Saqqez, Iran. The sampling method was random cluster sampling. So health centers in Saqqez were considered as clusters. From a complete list of health centers, two clusters were randomly selected. One cluster was used to conduct training and another cluster was used to select the control group to prevent the publication error.

2-3. The inclusion criteria for children

Infants must be born in singleton pregnancy with gestational age of more than 37 weeks, with birth weight of more than 2,500 grams, with no obvious abnormalities at birth, with no history of hospitalization (except for physiological jaundice), and no growth retardation (according to growth-monitoring card), with no history of central nervous system disorders such as convulsions, epilepsy, traumatic brain injury, meningitis, encephalitis, etc., and finally with a score of -1 Standard deviation lower than the mean or more from Ages and Stages Questionnaire (natural development). It is worth mentioning that the cut-off point for fine motors is 37.7. Those with scores

higher than this value could enter the study. Moreover, Iranian mothers with at least elementary school education who were mentally and physically healthy and had no history of smoking and/or drinking alcohol or using other addictive drugs could enter the study. The criteria for exclusion were not filling out the questionnaires and not participating in two training sessions out of four. The sample size of this research was calculated as 32 persons using the formula "to determine minimum sample size for comparing the mean of two independent populations", and based on data collected from similar studies. Finally, sample size was calculated as 35 persons for each group and 70 persons in total with 10 percent probability of loss, 95 percent confidence level (CI), and 80 percent power of test.

$$n \geq 2\frac{\left(z_{\alpha/2}+z_{\beta}\right)^2\sigma^2}{\left(\mu_1-\mu_2\right)^2}$$

Where,

$\alpha = 0.05 \Rightarrow z_{\alpha/2} = 1.96$	Type 1 error probability
$\beta = 0.20 \Rightarrow z_{\beta} = 0.85$	Type 2 error probability
$1-\beta = 0.90$	Power
$\left(\mu_1-\mu_2\right)/\sigma = 0.70$	Size of observed influence
$n = 2(1.96+0.85)^2\left(\frac{1}{0.70}\right)^2 = 32$	Minimum sample required

μ1, μ2, and σ respectively, are the mean score of motor development in intervention and control group, and standard deviation (SD), that was derived from Razaeian et al.'s study (2013) (3).

2-4. Intervention

The required teachings on the type of interventions were provided under the guidance of supervisor and advisor professor expert in the field. The teachings to intervention group were also provided by the researcher as a MSc. student of Midwifery. Initially, the scores of the fine motor skills of the children who entered the study were assessed using the 18-month ASQ questionnaire. Training was given to mothers of children and were provided based on identified behavioral objectives within four sessions. The interventions were designed as four training sessions every two weeks since the beginning of the intervention for 2 hours within 2 months. For each training session, behavioral objectives were determined. In order to prevent infants from being bored and also to control the impact of interventions, the training was changed every two weeks based on the age of infants and fine motor skills were taught in each session. The training sessions were held in the first, third, fifth and seventh weeks (**Table. 1, Figure. 1**). Fine motor skills included building towers, painting, stringing, tearing and crushing pieces of paper, targeting and dropping, giving children books, etc. The training was presented through lectures, question and answer as well as group discussions. The training was provided by Iran's Ministry of Health and Medical Education, the proposed intervention by ASQ (Ages and Stages learning activities 0-5 years), written by Twombly and Fink (39), and derived from other interventions was taught in training sessions.

Table 1: Description of the educational program.

Session	Description	Time	Place
First Session	*Tearing paper:* Your child may love to tear pieces of paper, let it fall. Show your child how to cut leaves of lettuce and spinach into a bowl. Show your child how to make a ball with pieces of paper with.	2 hours	Khatam Al-Anbia Health Center
Second Session	*Targeting and dropping:* Show your child how to do small things, like putting a spoon or cloth in a basket. Let your child shake the basket and hear the sound.	2 hours	Khatam Al-Anbia Health Center
Third Session	*Building a tower:* Let your child play with wooden cubes or building blocks. Show your child how to build a tower with building blocks. *String things:* Show your child how to string different things like: dried fruit, beads, etc.	2 hours	Khatam Al-Anbia Health Center
Fourth Session	*Painting and writing:* Give your child plenty of opportunities to paint and write. Provide paper and pencil for your child and tape or pin your paintings to the wall. *Help with food:* Let your child play a role in preparing food, under your supervision. The child can open a jar of jam and a package of butter and use a plastic knife to put them on the bread. Give your child a spoon and let him eat alone.	2 hours	Khatam Al-Anbia Health Center

Fig. 1: Exercises of fine motor skills.

At the end of each session, questions were asked on the topics of the same session and the educational pamphlet was given to mothers. Before beginning each session, a checklist of intervention assessment of the previous session was filled out by the mothers (**Table.2**). It is worth mentioning that the control group received no training from the researchers and only some routine training was provided to them by healthcare centers. The intervention period was 8 weeks; but measuring after 4 weeks was merely to diagnose developmental changes. Fine motor skill, 4 and 8 weeks after the training, was assessed using the ASQ questionnaire for 20-month-old child.

Table-2: Mothers Performance Assessment Checklist.

Baby's name:----- Gender:----- Age: ----- Health Center Name:----	Yes	No
Have you participated in the previous training session?		
Did you learn the lessons correctly?		
Did you play and practice with your child?		
Have you played with your child for at least a quarter of an hour during the day?		
Did you work with the ordered toy?		
Did your child enjoy playing?		
Explain what games you played with your child.		

2-5. Measuring tools

The baseline characteristics questionnaire, which is a researcher made questionnaire, contains 16 questions. The obstetric questionnaire, which is a researcher made questionnaire, contains 9 questions. To determine the validity of demographic and obstetric characteristics content validity questionnaire was used, so that the questionnaire confirmed by professors and advisors, to ten faculty members of the Department of Midwifery and Reproductive Health, Shahid Beheshti University of Medical Sciences and Health Services and based on their views, the final questionnaire was developed.

This screening test identified the developmental status of 4 to 60 month-old infants in 19 different age groups (4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 27, 30, 33, 36, 42, 48, 54 and 60 months old) divided into five developmental fields including gross motor, fine motor, communication, problem solving and personal-social developments, and they were assessed and compared with determined cut-off points which were standardized for Iranian children (32). Each developmental field contained 6 questions and totally, the questionnaire contained 30 questions. This questionnaire was filled out by parents with at least elementary school education and was scored by the researcher. There were three choices for each question. Ten scores were assigned for "Yes", 5 scores for "Sometimes" and 0 score for "Not yet" choices. The highest possible score was 10 for each question and 60 for each developmental field. The sum of scores of each field was separately assessed with each cut-off point appropriate to the age and infants with scores equal to or less than the cut-off point were referred to a specialist for more precise inspection of developmental delay. If the scores in each of the developmental domains are based on the cutting points:

• Equal or greater than to (-1SD), the child currently has no problem and parents should be advised to do exercises to develop and teach the child in the relevant way in order to improve the child's natural development (37.7).

• Equivalent or less than to (-2SD) cut-off point, the child should be referred for more accurate follow-up and evaluation (26.2).

• Between the numbers(-1SD), and (-2SD), parents should do exercises for the child's growth and learning in the relevant discipline, and after 2 weeks, the child should be tested again.

There are also 6 open questions that ask parents' concerns about visual, auditory, or any other problems. The simple and straight-forward language of the test, use of pictures with questions and being simple enough so that no special training was needed to complete the questionnaire were the advantages of this test. It took about 10-15 minutes to implement the test (36); for this study fine motor skills were used and the research team decided to design the intervention based on motor

fields. In the present study the ASQ-II, a parent-report questionnaire, was chosen because it has been proven to be a valid and/or reliable screening test for Iranian infants and children (32). There was no other standard test (as Beylay, Gesell, etc.) for determination of developmental delay in all domains of development for Iranian infants and children during performance of this study. Also, it has been proven to be a valid and/or reliable screening test, even in its translated and culturally adapted versions in several studies in different populations of children (33). In a multinational trial involving 18 countries in Asia, Africa, Europe, North and South America and reported in 2007, the sensitivity and specificity were determined to be 88% and 82.5%, respectively (34, 35). In the study of Ahmadi et al. (2017), and Sajedi et al. (2016) the reliability of this scale was obtained as 0.88, using the test-retest method (37, 38).

2-6. Ethical considerations

The Center for Midwifery and Reproductive Health funded this research project. This study was the result of a research project fulfilled at the Center for Midwifery and Reproductive Health of Shahid Beheshti University of Medical Sciences. We hereby express our thanks to all those who contributed to this study. This study was approved by the ethics committee with code of ethics IR.SBMU.PHARMACY.REC.1399.138. The study was also registered in the Iranian Registry of Clinical Trials (with the registration code of IRCT2016012526193N1). The participants were provided with details about research objectives, ensured about data confidentiality, and asked to sign an informed consent form.

2-7. Data analysis

Data were analyzed using SPSS software version 20.0. In order to investigate data, Mann-Whitney, Chi-square test, independent t- test and repeated measures were employed. Mann-Whitney and Chi-square test were applied for qualitative variables like demographic information, t-test was used to show the mean difference of fine motor skill scores before the intervention. As the comparison of scores was done three times (before, 4 and 8 weeks after the intervention), fine motor skills were assessed by repeated measures test to indicate the mean difference of fine motor skills scores during the intervention. P-value of less than 0.05 was considered significant.

3- RESULTS

At the beginning of the study, 70 subjects entered the study. However, due to incomplete filling of the questionnaires, 33 subjects were present in the intervention group and 32 in the control group by the end of the study (**Figure. 2**).

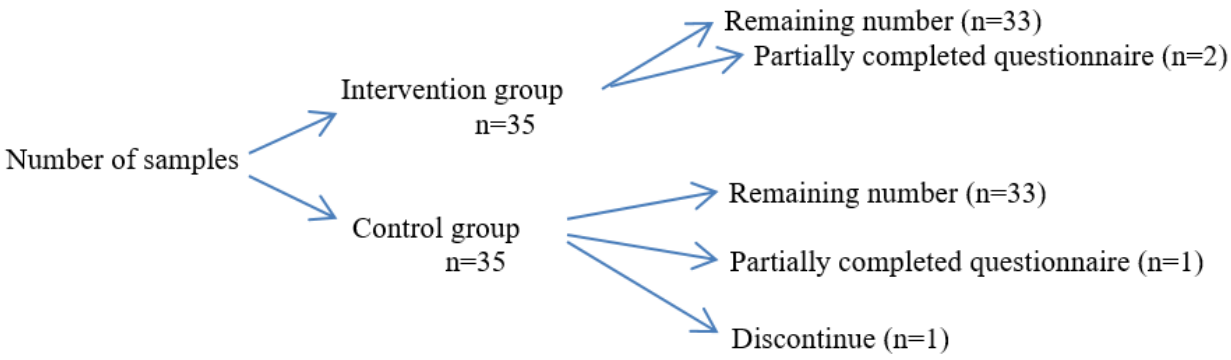

Fig 2: Flowchart of study.

In both of groups 48.5% (n=16) were girls and 51.5% (n=17) were boys. Regarding the level of mother's education, in intervention group, most subjects (30.3%) had high school diploma and in control group, 45.5% had high school diploma education; 75.8% of mothers in intervention group and 69.7% of them in control group were housewives; 24.2% of subjects in intervention group and 39.4% in control group had an income of 10 to 15 million Rials per month. The fathers of most research units in both intervention group (48.5%) and control group (60.6%) were self-employed. Also, 42.4% of subjects in intervention group and 57.6% in control group were tenants **(Table.3)**.

Table-3: The frequency distribution of characteristics of families of 18 month old children under study in Saqqez, Iran.

Variables	Sub-group	Intervention group	Control group	(P-value) (Mann-Whitney)
Mother's level of education	Elementary Middle School High School Diploma Associate Degree Bachelor Master Degree and PhD	9.1 27.3 30.3 18.2 12.1 3.0	6.1 12.1 45.5 18.2 15.2 3.0	0.66
Father's level of education	Elementary Middle School High School Diploma Associate Degree Bachelor Master Degree and PhD	12.1 18.2 30.3 15.2 18.2 6.1	3.1 6.1 33.3 15.2 39.4 3.0	0.12
Mother's job	House Wife Employee Self-employed	75.8 21.2 3.0	69.7 15.2 15.2	0.21
Father's job	Unemployed Self-employed Employer Employee Worker other	3.0 48.5 12.1 21.2 9.1 6.1	0.0 60.6 6.1 21.2 12.1 0.0	0.51
Housing status	Private house Rented house Organized house Non-rented house	48.5 42.4 0.0 9.1	33.3 57.6 0.0 9.1	0.43
Monthly income (Rial)	Less than 10 million 10-15 million 15-20 million More than 20 million	24.2 24.4 26.1 25.3	21.2 24.2 39.4 15.2	0.61

The mean of scores for fine motor skills before intervention was 48.94±8.81 (out of 60), and 45.76±8.20 (out of 60) in intervention group and control group, respectively; independent t- test revealed no statistically significant difference for fine motor skills (P=0.13). The ANOVA test results with repeated measures demonstrated that for fine motor skills, 4 and 8 weeks after the intervention, the mean of scores in intervention group was higher than in control group (P=0.04), and

the mean of scores in three periods (before intervention, 4 and 8 weeks after the intervention) was significantly different (P=0.001) (**Table. 4, Figure. 3**). The results revealed that in this study, the scores of fine motor skills, four and eight weeks after the intervention, in the group in which mothers were trained was better than those in control group.

Table-4: The comparison of mean of scores of fine motor skills in intervention and control groups in 18 month old children.

Variables	Sub-group	Before intervention	4 weeks after intervention	8 weeks after intervention
Scores for fine motor skills Mean ± (SD)	Intervention group	8.81± 48.94	9.02± 47.73	8.48± 50.76
	Control group	8.20± 45.76	7.40± 44.24	7.88± 45.61
Comparison of two groups		0.04		
Comparison of time periods*		0.001		

*ANOVA test. Repeated measures test results to indicate inter-group effects, SD: Standard deviation.

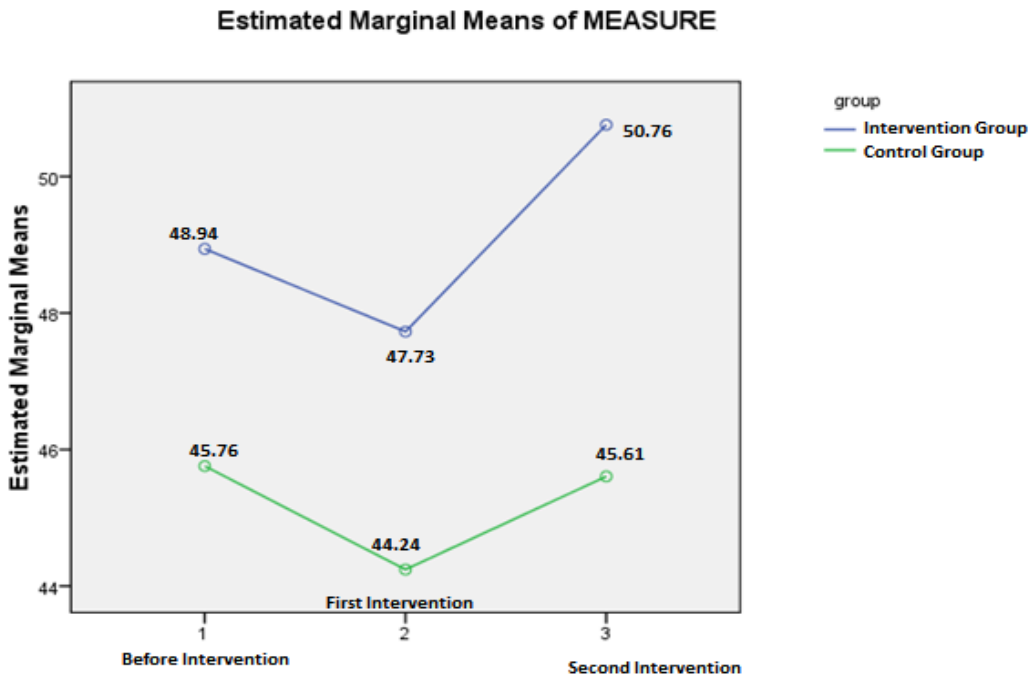

Fig. 3: ANOVA test results with repeated measures indicated that for fine motor skills, the mean of scores in intervention group was more than in control group (p=0.04), and the mean of scores in three time periods was significantly different (p=0.001). Bonferroni test results demonstrated that the mean of scores in period 2 (4 weeks after the intervention) was not significantly different from that of period 1 (before the intervention) (p=0.14). However, in period 3 (8 weeks after the intervention), the mean of scores was increased as compared with that of period 2 (p= 0.001).

4- DISCUSSION

The research results revealed that there was no statistically significant difference between the mean of scores for fine motor skills in intervention group and control group before the intervention; 4 and 8 weeks after the intervention, a significant difference was observed in the scores of fine motor skills in intervention group. In

this way, the educated children gained more points in the grades of fine motor skills than the control group. Some research on the effect of training on fine motor skills has confirmed the positive effect of training and is consistent with the results of recent research (3, 27). Akin (2019) conducted a research to investigate the effect of physical education based intervention program, aiming to help the development of writing skills of primary school children, on fine motor skill precision and fine motor skill integration; They found fine motor skill sensitivity and fine motor skill integration values improved in the experimental group compared to the control group (40).

The results of the research by Ahmadi et al. (2017), which was on the effect of care package on motor development among 12-month-old infants, showed that gross and fine motor skills, were significant 8 weeks after the interventions (29). One of the main parts of the interventions in the present study was playing to improve fine motor skills. According to the studies, playing has an important role in brain development and is essential for the physical, social, emotional and cognitive development of children. When playing with children, parents, particularly mothers, find an ideal opportunity to participate in the development and growth of their children (41). Children learn things through playing that cannot be taught by anyone. Playing is the work of children. Through playing, children continuously practice complex and stressful life situations, communicating and developing satisfactory relationships with others (42).

It confirms application of play in an appropriate way accelerates children's learning and academic skills as well as physical, mental and socioemotional development (43). Fine motor skill competence is an essential component of daily life activities. Poor fine motor skills can cause increased anxiety, distress in academic achievement and poor self-esteem (44). Findings support the idea of fine motor skill being involved in the development of cognitive abilities (45). In younger kindergarten children, it is conceivable that early reading and fine motor skills are correlated because children in this phase of life are undergoing development in a number of areas, encompassing cognitive, language, physical, and motor development (5).

Also, it was reported that arithmetical abilities (object-based arithmetic) at the age of 5 years were more strongly predicted by fine motor skills than visuospatial working memory at 3 years (46). The results of the present study indicated that games parents play with their children at home can improve the fine motor activities of children. Ghasempour et al. (2016) carried out a quasi-experimental study to investigate the effect of sensory integration training on fine motor skills in children with trainable mental retardation. The results of their study demonstrated that with sensory integration training (pencil drawing, marker drawing, drawing with closed eyes, drawing lines, crumpling paper, making paper ball, etc.), after fifty sessions each lasting 45 minutes, fine movements in the experimental group were significantly improved ($p < 0.05$) (47).

Moreover, Ericsson and Karlsson (2012) conducted a study entitled "Motor skills and school performance in children with daily physical education in a school-a 9-year intervention study" and showed that daily physical education and motor skills training not only improve motor skills but also school performance (48). Furthermore, Sajedi and Barati (2014) investigated the effect of perceptual motor training on motor skills of preschool children and concluded that after training, the intervention group achieved a significant improvement in fine motor skills (49). In line with the results of the

present study, McGlasgan et al. (2017) carried out a study entitled "Improvement in children's fine motor skills following a computerized typing intervention". They utilized Battery for Children-2 Movement Assessment (MABC-2), and Tapping Task tools. The children in the intervention group were trained for 4 weeks and then the results revealed that the children in the intervention group significantly improved their fine motor skills compared to those in the control group (50). Basa et al. (2020) conducted a study to determine finger painting learning to stimulate motor development in early childhood; the results of their study were consistent with the present study (26). However, Khodakarami et al. (2011) did a clinical trial on 2-4 month-old infants and the results of their study confirmed the significant relationship between developmental stimulatory and gross motor development, but there was no significant relationship concerning fine movements (51).

The results of this study were not compatible with those of the present study regarding fine motor development. One of the differences between their study and the present study was the age of samples. Salehi et al. (2013) showed that the higher the age of subjects, the greater their motor learning abilities will be (52). Moreover, Goodman et al. (1985) conducted a research to investigate the effect of early neurodevelopmental therapy in normal and at-risk survivors of neonatal intensive care. The results of their study indicated that there was no statistically significant difference between the intervention group and the experimental one in motor effects (53).

4-1. Study Limitations

In this study, the homes of samples under the study were not visited, so as to check the home environment and the way mothers played with their infants.

5- CONCLUSION

The results of the present study demonstrated that developmental training to the mother of children improved fine motor skills and these changes occurred 4 and 8 weeks after intervention. It is recommended that the interventions in these healthcare centers be taught to parents of infants in other age ranges. Moreover, the results of this study can be utilized as an appropriate basis for other similar studies in Iran. Since the number of samples was limited, the results could not be generalized to the society. It is, therefore, recommended that further studies be carried out with more samples and other developmental fields like problem solving, personal-social and communication be taken into consideration in the investigations.

6- ACKNOWLEDGMENTS

The Center for Midwifery and Reproductive Health funded this research project. This study was the result of a research project carried out at the Center for Midwifery and Reproductive Health of Shahid Beheshti University. We hereby express our thanks to all those who contributed to this study.

7- CONFLICT OF INTEREST: None.

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