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Original Article

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Effects of Motor Development Stimulation on Anthropometric Indices of Infants Aged 1-12 Months in Foster Care Homes

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Abstract

Background: The first three years of life have a pivotal role in growth and development of infants. Extra-uterine environment largely affects brain development of infants during the first year of life. However, no specific programs are available for brain development stimulation in foster homes.

Aim: This study aimed to evaluate the effects of motor development stimulation package on anthropometric indices of infants staying in foster homes.

Method: This experimental study was conducted on 50 infants aged 1-12 months at Ali Asghar foster home of Mashhad, Iran in 2013. Infants were randomly divided into two groups of intervention (n=25) and control (n=25). Motor development stimulation packages were used for intervention group three times a week for eight consecutive weeks (24 sessions, two hours each). Anthropometric indices of infants were evaluated using standard instruments before and after intervention. Data analysis was performed in SPSS V.11.5 using independent T-test and Mann-Whitney U test.

Results: In this study, mean age of infants in intervention and control groups was 6.04±3.48 and 4.3±3.70 months, respectively. In total, 68% of infants were male, and 32% were female. After intervention, Mann-Whitney test results showed no statistically significant difference in height (P=0.47) and head circumference (P=0.11) of infants between the groups. However, independent T-test showed a statistically significant difference in body weight of infants (P=0.007) between the groups after intervention with the stimulation care package.

Implications for Practice: According to the results of this study, use of evidence-based motor development stimulation package for eight weeks resulted in increased weight of infants, while it had no effect on height and head circumference. Therefore, it is recommended that complementary studies be conducted in this regard.

Keywords: Anthropometric parameters, Evidence-based practice, Foster home, Infants, Stimulation of motor development

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Introduction

Growth is defined as the gradual development of body organs, and appropriate growth plays a pivotal role in the well-being of children. Leading criteria for the assessment of growth in infants and children are height, body weight and head circumference. Disruption in these developmental factors is alarming and requires prompt diagnosis and treatment (1).

Growth and development occur at a rapid rate in children under five years of age, and malnutrition during this period could lead to delayed physical growth and motor development, as well as cognitive disorders. Studies in different countries have shown that malnutrition within early ages of life could drastically affect physical growth and brain development in children. According to the framework proposed by UNICEF, factors such as hygiene, proper nutrition and psychosocial stimulation are crucial for the improvement of quality of life in children. As such, children who receive proportionate healthy nutrition and mental stimulation have better development than others (2).

Children are the foundation of future generations; therefore, proper development of children is vital to the physical, mental, social and emotional progress of a society. Infants in foster care homes are frequently at the risk of developmental delay (3). This population requires particular attention due to high vulnerability and environment-related issues.

In the United States, more than half a million children are housed in foster care homes (4). In Iran, population of foster homes has been increasing in recent years. In 1997, about 2,564 infants were supported by welfare organizations, while official statistics have estimated the orphan population at 22,000 infants lately. In addition to this population, 9,372 orphan infants are reported to be housed in other care centers (5).

Previous research has indicated that compared to children who grow up in a family environment, children who stay in foster homes are at a higher risk of delayed physical, mental, emotional, social and communicative growth (4, 6).

Furthermore, these children are more frequently affected by various health problems due to several reasons, such as absence of parental care, living in crowded environments and lower health care level. Growth disturbance is the ultimate outcome of these factors (7).

In one study, Miller et al. (2007) observed that the majority of children had delayed growth indices upon admission to different medical centers. Among infants in the study population, 34% were underweight, 25% had short stature, and 34% had microcephaly. Infants with microcephaly received treatment to improve head circumference, which resulted in a significant increase by 62%. However, height of infants remained unchanged after interventions. After hospitalization and proper care, younger infants had a faster growth rate compared to older infants (8).

In another study, Pears et al. (2005) indicated that in addition to defected growth factors (e.g., height, weight and head circumference), communicative disorders, delayed spatial perception and cognitive disorders occur more commonly in infants living in foster homes. Results of the present study revealed that history of negligence in infant care is negatively correlated with growth parameters and developmental factors (9).

In a meta-analysis, Van Ijzendoorn et al. (2007) claimed that children at foster care homes involuntarily manifest symptoms of developmental delay. This delay is directly correlated with age, so that children at higher age ranges experience more severe delays in developmental indices compared to younger infants (8).

In general, due to the large number of children at foster homes and lack of adequate training for caregivers regarding the effect of growth stimulation on the proper development of children, these centers rarely offer programs to enhance infant motor development. However, these centers could occasionally provide infants with better conditions in case they come from underprivileged family environments (9).

Considering the key role of nurses in the management of foster homes and monitoring of caregivers' performance, it is essential that these professionals be aware of the importance of physical growth in infants (9). For instance, infants who are kept in bed, baby chair, cradle or other restrictive devices are more likely to experience growth delay (10). To promote the rate of growth and development, infants should be raised in environments where they have access to various physical and mental activities (2, 7).

The paramount importance of infant growth and development and its undeniable impact on the health and prosperity of future generations have encouraged researchers to seek and identify the main causes

and solutions for delayed child development. Operational programs in this regard mainly aim at the promotion of growth and development to its optimal level in children of different age groups (11).
Among the effective methods used to improve child development are the promotion of mother-infant relationship through breastfeeding (2), music therapy (12), use of food additives and micronutrients, disease control, improvement of child safety, reduction of maternal separation time upon admission to hospital (2) and training of mothers through related workshops (13). Growth stimulation is a developmental method used to enhance growth rate in children. This method has been proposed by the United Nations Children's Fund in recent years and has drawn the attention of many researchers across the world (2).
Developmental stimulation consists of different activities recommended by experts in order to reinforce the growth rate of infants and children. These activities are implemented by caregivers to promote developmental factors in children; such example is pointing and naming different objects (14). Growth stimulation occurs through communication between caregivers and infants, later providing children with more complex developmental opportunities in accordance with their abilities. Inadequate communication could have an adverse effect on child development by disrupting the activity of basic neural circuits. Neural disruption in infants is usually detected via the measurement of stress hormone levels and brain imaging. Basic developmental stimulation processes could strengthen neuro-cognitive performance and brain function, especially in premature infants (15).
Child development is a multidimensional issue, which requires specific interventions. Various aspects of child development may overlap, in such way that delay or improvement in one phase of development could directly influence other growth aspects (16). Therefore, developmental stimulation should simultaneously trigger different growth aspects, especially in children who are at risk of common developmental delays. Moreover, principles of these programs should be observed during related interventions.
In this regard, Rezaeian et al. (2013) designed an evidence-based stimulation package to promote motor development of infants in foster homes using an integrated review approach. Their care package consisted of elements such as child toys, various skills, caregiver-infant interactions, care giving practices and environmental factors for improving motor development of infants. Since this package was designed based on the principles of child development, related interventions were performed in accordance with chronological or developmental age of infants (16).
Foster homes are recognized as susceptible environments requiring specialized interventions due to several factors, such as large number of children in foster care homes, disproportionate number of caregivers, lack of adequate opportunity for proper development of children and low awareness of caregivers about effective environmental stimulation on the growth and development of children.
In the present study, we aimed to design an evidence-based care package for improving motor development in infants staying at foster care homes. Another goal of this intervention program was to raise the awareness of caregivers and orphanage managers about effects of environmental stimuli on the growth rate of children. Increased knowledge of authorities will ultimately result in the enhancement of environmental conditions at children foster homes and promotion of growth and development in these children.
This study aimed to evaluate the effects of motor development stimulation package on the anthropometric indices of infants aged 1-12 months at Ali Asghar Nursery Center of Mashhad, Iran.

Methods

This experimental study was extracted from a pilot research project performed to evaluate the effect of brain stimulation program on motor development and anthropometric indices of infants aged 1-12 months at Ali Asghar Nursery Center in Mashhad, Iran. We aimed to determine the effect of evidence-based care package on anthropometric indices of infants staying at foster homes. Our study population consisted of infants aged 1-12 months housed in Ali Asghar Nursery Center in 2013.
Sampling method was based on determining the minimum sample size for comparing the mean data of two independent populations, and findings of the pilot study were also used for sampling. Sample size was determined based on the following parameters before and after intervention, respectively:
Height: 60.6±8.5 vs. 66.2±6.5 cm (n=5); head circumference: 40.4±3.9 vs. 43.1±3.3cm (n=5); body weight: 6.1±2.3 vs.7.4±1.8 kg (n=7). Considering factors such as sample loss and ease of statistical analysis, our sample size was finally determined at 25 infants in each group (total: 50).

Confidence interval was estimated at 95% with test power of 80%. Available sampling was carried out for infants who were present at the study setting, or were admitted during the course of study, who met the inclusion criteria. Moreover, random allocation technique was used for dividing infants into intervention and control groups. As for infants who were admitted after the beginning of intervention, they were randomly allocated to either one of the study groups until the ideal sample size was obtained.

Inclusion criteria of the study were as follows: 1) age range of 1-12 months; 2) lack of physical disabilities (e.g., hearing and vision loss, physical deformities, mental retardation, chronic diseases, growth disorders and diagnosed behavioral disorders); 3) no medication use and 4) recorded chronological age of infant in medical record.

Exclusion criteria of the study were as follows: 1) hospital admission; 2) presence of diseases; 3) need for isolation at medical center and 4) leaving the study environment for any reason (e.g., temporary guardianship, permanent adoption).

Data were collected using demographic forms including information such as age, sex, mode of care giving, length of stay in foster home, and height, weight and head circumference of infants. In addition, we used prepared checklists for research unit selection containing the inclusion and exclusion criteria.

Data collection tools were designed based on previous findings, and content validity was confirmed by a panel of ten experts. Other instruments, such as standard analog scale, non-flexible measuring tape and height measurement board, were used to collect anthropometric data of infants. Accuracy of scales was evaluated by placing 500 grams of weight on measuring instruments. For sampling, demographic data of infants were collected initially, and following that, anthropometric indices were determined using the aforementioned tools.

In this study, intervention was performed using an evidence-based stimulation package, which was reviewed in an integrated package design based on valid scientific resources and databases; details of this process have been published in an integrated review (16). In order to promote motor development of infants, a set of targeted interventions was also applied focusing on different aspects, such as emotional communication, sensory stimulation, curiosity stimulation, encouraging motor skills and use of child toys.

These interventions were selected from available care packages based on evidence-based practices (e.g., values, former experiences, environment resources and recent data). Interventions had a dynamic nature and were chosen to be different every week. Interventions were performed based on environmental factors in order to improve motor development of infants, and the Environmental modification included on the user's guideline of package. Guidelines are available in the user's manual.

Second part of the stimulation care package involved the use of Toys with the nature of stimulate the motor skills, which were provided of age-appropriate toys in the context of package. . In addition to the use of toys, appropriate interactions between caregivers and infants during intervention aimed to promote motor skills, and were presented in the training package. The fourth component package, were including care practices aiming to promote skills development especially motor development.

Our intervention package also consisted of components to reinforce motor development during the neonatal period, which mainly focused on spontaneous exploration of objects during the first phase of infancy, and promotion of mobility during the second half of infancy. All interventions were carried out considering the principles of growth and development in infants and neonates.

In this study, interventions were conducted in 24 sessions (two hours each) (11) during eight weeks (three days a week). For infants under six months, interventions were performed in specific rooms at the foster care center since adequate equipment was available. As for infants above six months, they received the interventions in other rooms designed for this study. Interventions were performed by co-researchers present at the foster home who were willing to participate in the project.

Each co-researcher received four hours of theoretical training and three days of practical training on the objectives and methods necessary for interventions. Experiments were conducted under the supervision of one researcher in a special room. Selection of co-researchers from the foster care center mainly aimed at keeping the interventions consistent after the end of the study. All co-researchers received wages from the foster care center for each shift of participation in the study.

During the intervention process, chronological age of infants was extracted from their medical records based on Denver Developmental Screening Scale in two dimensions of specific and general motor development skills in order to obtain the developmental age of infants. Data on the chronological age of infants is included in the intervention package.
Developmental age of infants was defined as the mean of specific and general motor skills. Afterwards, interventions were commenced, and anticipated care giving practices were also registered in intervention packages. For Example, the developmental needs to chronological age developmental/evolution from birth to 2 months of age were included: emotional communication, stimulate the senses, strengthening reflect grab and strengthen the back muscles. The aforementioned needs of infants were met through the recommended interventions in the motor development stimulation package (e.g., proper eye contact, speaking alternately in both sides of infant's face). As the age of infants increased to several weeks, changes were made to intervention procedures depending on the progress of study. Evidence-based interventions were designed based on the developmental age predetermined of infants and their position on the timeline package were criterion for starting intervention of the study (16).
Interventions were performed with the assistance of co-researchers under the supervision of one researcher in the room intended. Infants were provided with toys and other instruments required for the study, so that they would receive specific developmental care in groups. Each infant received specific developmental intervention for 10-15 minutes and had enough time to interact with prepared stimulation packages (17).
Infants in the control group received routine nursery care; those aged less than six months spent more time in bed, while those aged over six months could also play in the study room. After the intervention, anthropometric indices were measured again, including height, body weight and head circumference. To measure height in centimeters, infants lay on the bed, and head circumference was measured using a tape measure. Maximum diameter of head circumference was also recorded in centimeters.
Body weight of infants was measured using electric Tanita bioimpedance device (model: Bc-418 MA) with accuracy of 50 grams while infants had no clothes on (weight of diapers was deducted from total value). Device accuracy was determined by placing 500 grams of weight on the scale.
For moral consideration, authorities of the foster care center were asked to use the collected data for infants in the control group as well. Data analysis was performed in SPSS V. 11.5 at confidence interval of 95% and test power of 80%. In addition, Kolmogorov-Smirnov test was used to determine normal distribution of data. For normally distributed data, we used independent T-test, while data without normal distribution were analyzed using Mann-Whitney and Wilcoxon tests.

Results

In this study, in the intervention group 16 infants (64%) were male, and 9(36%) were female and in the control group 18 infants (72%) were male, and 7(28%) were female. Mean age of infants in intervention and control groups was estimated at 6.04±3.5 and 4.28±3.7 months, respectively, which had no statistically significant difference based on the results of Mann-Whitney test. In the control group, 11 infants (44%) had attendants and 14 infants (66%) had non attendants, and in the intervention group, 10 infants (40%) had attendants and 15 infants (60%) had non attendants.
Results of the first and second phases of anthropometric index measurement are presented in Table 1. Mean height of infants before intervention in intervention and control groups was 61.3±8.6 and 57.6±8.9 cm, respectively, and Mann-Whitney test showed no significant difference between the groups in this regard (P=0.07). Infants in both groups were matched in terms of height before intervention.
Eight weeks after the use of motor development stimulation package, mean height of infants in intervention and control groups was 65.4±6.6 and 62.2±8.8 cm, respectively, and Mann-Whitney test was indicative of no statistically significant difference between the groups in this regard (P=0.47).
Before intervention, mean of head circumference in infants of intervention and control groups was 40.6±3.7 and 38.8±4.8 cm, respectively, and Mann-Whitney test showed no statistically significant difference between the groups in this regard (P=0.43). Infants in both groups were matched in terms of head circumference before intervention.
Eight weeks after the use of motor development stimulation package, mean of head circumference in infants of intervention and control groups was 42.9±3.1 and 41.3±3.7 cm, respectively, and

independent T-test was indicative of no statistically significant difference between the groups in this regard (P=0.11).
Mean of body weight before intervention was calculated to be 5.8±2.1 and 1.8±5.5 kg for infants in intervention and control groups, respectively, and independent T-test was indicative of no significant difference between the groups in this regard (P=0.62). Infants in both groups were matched in terms of body weight before intervention.
Eight weeks after the use of motor development stimulation package, mean of body weight in intervention and control groups was 7.1±2.0 and 5.6±1.6, respectively, and independent T-test showed a statistically significant difference between the groups in this regard (P=0.007).

Table 1: Mean and Standard Deviation of Anthropometric Indices of Infants before and After Intervention Classified by Two Phases of Anthropometric Evaluation

Anthropometric Indices	Mean±SD		P-value
	Intervention Group	Control Group	
Baseline Height (cm)	61.3±8.6	57.6±8.9	0.07*
Baseline Body Weight (kg)	5.8±2.1	5.5±1.8	0.62**
Baseline Head Circumference (cm)	40.6±3.7	38.8±4.8	0.43*
Height (8 weeks after intervention) (cm)	65.4±6.6	62.2±8.8	0.47*
Body Weight (8 weeks after intervention) (kg)	7.1±2.0	5.6±1.6	0.007**
Head Circumference (8 weeks after intervention)(cm)	42.9±3.1	41.3±3.7	0.11**

*Mann-Whitney test
**Independent T-test

Discussion

The present study aimed to evaluate the effect of evidence-based motor development stimulation package on the anthropometric indices of infants aged 1-12 months at Ali Asghar foster home of Mashhad, Iran during eight weeks. According to our findings, use of evidence-based stimulation package resulted in increased body weight, while it had no effect on the height and head circumference of infants. This finding is consistent with the results obtained by Ijzendoorn et al. (2007).
By reviewing the results of 122 meta-analyses, Ijzendoorn et al. (2007) observed that children who do not receive adequate care and proper motor stimulation in foster homes are more likely to have delayed growth parameters (e.g., height, weight and head circumference). However, if children are raised in healthy environments
With sufficient care and stimulation, a significant increase occurs in their height and weight, whereas head circumference may remain unaffected.
In the current study, use of evidence-based motor development stimulation package resulted in the proper interaction of infant and caregiver, which had a significant effect on body weight of infants (8). In another study, Nahar et al. (2012) evaluated the effects of psychosocial stimulation on the growth and development of severely malnourished infants aged 6-24 months in Bangladesh. Factors investigated in that study were mental stimulation with or without nutritional supplementation, living environment and maternal depressive symptoms. The results indicated that mental stimulation had a positive effect on growth parameters of infants (2).
Findings of the aforementioned research are in line with the results of our study. As such, we included mental stimulation as a major intervention in motor development stimulation package. Findings of Nahar et al. and our results indicated that despite the satisfactory nutrition status of infants in foster homes, this parameter has no significant effect on the enhancement of growth parameters. Nevertheless, results of the present study revealed that use of motor development stimulation could positively affect the body weight of infants. This could be due to the increased mobility of infants in our study since adequate physical activity could boost metabolism and lead to higher food intake in infants.
Therefore, it could be concluded that with increased interactions between infant and caregiver, reduced negligence, increased motor stimulation and higher calorie intake, use of motor development stimulation care package could result in weight gain in infants. Correspondingly, we observed that infants who were aware of environmental interactions (aged over six months of age) showed no

appetite for food upon receiving inadequate attention, which is a common phenomenon in foster care centers.

As for height and head circumference, it should be stated that since these indices have a slower growth rate during infancy compared to body weight, more time is needed as to determine the exact mean of these parameters after motor development stimulation (18). Considering the fact that height increases in a gradual manner (19), it is possible that duration of interventions (eight weeks) were not correspondent with the growth pattern of height in our sample size.

One of the limitations of the present study was the short length of interventions despite the fact that the 8-week intervention period was selected based on reliable sources. Our findings indicated that this period might not have been sufficient for the developmental completion of parameters with slower growth rates (e.g., height and head circumference). Nevertheless, it was observed that use of developmental stimulation could have significant effects on anthropometric indices of infants since the majority of our subjects experienced weight gain after intervention.

Therefore, it is recommended that future studies in this regard be conducted within longer durations as to determine the precise effect of developmental stimulation on the overall growth rate of infants through measuring different parameters.

Implications for Practice

According to the results of this study, implementation of evidence-based motor development stimulation package during eight weeks could increase body weight of infants staying at foster homes. However, no significant increase was observed in other growth parameters, such as height and head circumference.

Results of the present study could be beneficial in upholding the use of developmental stimulation packages in nursery homes for infants, as well as training health staff in these centers with appropriate skills to provide infants with adequate care and support.

In conclusion, findings of the present study indicated that anthropometric indices may be affected by developmental stimulation in infants. Therefore, it is recommended that related programs be implemented focusing on mental and developmental factors, as well as dietary intake of calories, in order to promote growth rate in infants.

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Conflict of interest

The authors declare that there is no conflict of interest.

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