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Impact of a Developmental Stimulation Program on Language Evolution Age in 1- To 3-Year-Old Children with Celiac Disease

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ABSTRACT

Introduction:
Children younger than 5 years are in the fastest growth and developmental period of their lives. Regarding this, the present study was conducted to determine the effect *of a developmental* stimulation program on language evolution criteria in 1- to 3-year-old children with celiac disease.

Materials and Methods:
This clinical trial was performed on two groups (i.e., intervention and control) of 50 children aged 1-3 years with celiac disease using random allocation technique. A developmental stimulation program was implemented for the children in the intervention group in two-hour sessions every week for 2 months. The language evolution age was evaluated by the Bayley Scales of Infant Development (Bayley-III). The data were analyzed using SPSS software (version 11.5).

Results:
The mean age of the participants was 20.6±4.4 months. Prior to the intervention, the mean age of receptive and expressive language development showed no significant difference between the two groups (P=0.672 and P=0.166, respectively). Similarly, immediately after the intervention, the mean age of expressive language development in the intervention group (21.5±3.8) underwent no significant increase, compared to that in the control group (19.1±4.5). This variable was not also significantly different between the groups in the four-month follow-up (P=0.076). Nonetheless, with regard to the mean age of receptive language evolution, this variable demonstrated a significant increase in the intervention group (24.2±4.8), compared to that in the control group immediately after the intervention (19.1±4.3; P=0.002). The results of the four-month follow-up were also indicative of a significant difference between the two groups in terms of the mean age of receptive language evolution (P<0.001).

Conclusion:
Based on the findings of the present study, the developmental stimulation program can be used for promoting receptive language skills in children with celiac or other chronic diseases.

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Introduction

Optimal growth and development of children in the first years of life have an essential impact on their behavior, IQ, ability, and power of consistency throughout their course of life (1). Based on the statistics, by 2010, 200 million children under the age of 5 years will be at the risk of failure to reach their maximum developmental stage (2) .

In childhood, human brain develops immediately through the production of neurons, axons, and dendrites, as well as synapses and myelinated nerves, helping humans learn faster during childhood than during other life periods (3) . According to the literature, confrontation with social and psychological risk factors, such as poverty, malnutrition, and lack of simulation, influences brain development. In this regard, multiple confrontations of children with these risks at early ages of life change their brain architecture and result in devastating outcomes (3,4). Celiac or gluten-sensitive enteropathy is one of the most common chronic diseases and genetic disorders (5) . According to the statistics, this disease has a prevalence rate of 1% in Iran (1:100) (6). Lundberg et al. (1979), investigating hypotonia and delayed muscle disorder in celiac disease, found that general motion delay and hypotonia are evident in toddlers with celiac disease (7) . Children with celiac disease are prone to delay in natural development due to dietary restrictions and the need for repeated hospitalizations (8). They face many of these experiences early in life, when they are at a critical period for the physiological manifestation of their developmental characteristics. Repeated hospitalizations make these children more socially isolated. This isolation can be more influential than malnutrition and micronutrient deficiencies on their central nervous system maturation because it causes reduced social interaction, level of activity, exploratory behaviors, and attention. Moreover, the long course of the disease and its subsequent critical conditions negatively affect the muscle strength (via inflammatory mediators) (9). This disease negatively affects the developmental functions of the child as a result of reducing the changes in the distribution of electrolytes (e.g., potassium and sodium) and action potential (10). The United Nations Children's Fund has proposed various methods to improve children's development. Accordingly, developmental stimulation has recently attracted researcher's attention on a wider scope since it only leads to performance modification but also modifies the structure (2,3). Developmental stimulation means the application of the activities proposed by experts in order to enhance child development and learning by the caregivers to enhance child success in the achievement of developmental criteria. These activities are in the form of showing, displaying, and naming objects (11). Developmental stimulation occurs as a result of the accountability of caregiver and increased communication between caregiver and child and facilitates the provision of more sophisticated developmental opportunities for the child (proportional to the ability of the child). Inadequate stimulation and communication with children may affect their development through disrupting their basic neuronal circuits (12).Pediatricians consider the 21st century as the century of focus on the psychosocial and developmental abilities of the children (13). According to the systems theory, developmental stimulation can influence development criteria (14). However, there is a limited number of studies in this field, and despite the potential of this intervention for the improvement of different aspects of development is not perfectly clarified. The age of the child is an important point to be considered in developmental stimulation. The reduction of developmental flexibility with age poses the question whether the stimulation of development in the various age groups (e.g., infants, toddlers, and preschoolers) can be equally effective. As mentioned before, developmental studies have a long way to go to find the answers to multiple questions in the field. With this background in mind, the present study was conducted to investigate the effect of developmental stimulation program on receptive and expressive language evolution in 1- to 3-year-old children with celiac disease.

Materials and Methods

This clinical trial was conducted on 1- to 3-year-old children with celiac disease referred to Ghaem and Doctor Sheykh hospitals in Mashhad in two randomly selected groups. Research approval was obtained from the Ethics Committee of the university (IRCT2015021521090N1) and necessary arrangements were made with hospital officials. In addition, written informed consent was obtained from the participants' parents, and they were ensured about the confidentiality of the information. Research samples were selected using convenience method from children that their information were available in data base of children with celiac in order to order celiac dietary bread and Registry system designed by the Gastrointestinal team of Ghaem Hospital, who had inclusion criteria. The inclusion criteria were: 1) living with family, 2) celiac diagnosis based on serologic tests and the biopsy of the stomach villous, and final approval of pediatric gastroenterologist, 3) no history of head injury, asphyxia, or brain hemorrhage at birth, 4) lack of severe malnutrition, 5) lack of preterm condition, 6) absence of major physical illness or disorders in other body systems, and 7) lack of psychiatric disorders.

Out of 50 children with registered information, 50 parents were satisfied to take part in the study. Research samples were allocated randomly and homogenously in terms of age (1-3 years), gender (male and female), and developmental period into two groups of intervention (receiving developmental stimulation) and control. For the purpose of sampling, even numbers were assigned to the intervention group, and odd numbers were allocated to the control group. In order to implement the intervention, a timetable was designed using West Virginia guideline and the natural development stages of 1- to 3-year-old children every 2 weeks. This table included the activities that can be performed by the child in a specific age period. Accordingly, the activities were arranged from simple to complex. The criterion for the entry of the child into the development table was chronological age. To this end, the situation of the child was specified on the table, and this point was the starting point for implementing the interventions. Accordingly, each child was subjected to the interventions placed after his/her situation in the table. In this regard, the activities were more complicated than the skills shown by the child.

This program was implemented for each child separately but in a collaborative collective environment. Every child received direct stimulation for 10-20 min, and if several children were in the same time position in the table, the activity was applied in a group manner, and then they interacted in a room under the observation of the researcher with his indirect supervision. The interventions were held in 2-hour sessions in the morning of even days over 2 months (15)In this regard, five children in five groups (2 h per every group) came to the developmental stimulation room and received the intervention. The intervention was conducted by the researcher. During the implementation of the intervention, the control group only received periodic visits at the clinic.

The language evolution age was evaluated by the Bayley Scales of Infant Development (Bayley-III).

Soleymani et al. (2013) supported the content and face validity of this test (16). In addition, the content and face validity of this test was reapproved in the current study by consulting with 10 respective professors with expertise in child development. The reliability of the tool was measured using test-retest method in a 2-week interval, rendering an acceptable value (r=0.95). The measurement of the general motor development age was performed by the researcher before, immediately after, and 4 months after the intervention using the Bayley-III tool.

After the determination of general motor development age (performed prior to the intervention), a statistical comparison was established in order to ensure the homogeneity of both groups in this regard. Therefore, the intervention and control groups were homogenous in terms of age and motor development score before the intervention.

Statistical analysis

Data analysis was performed in SPSS software (version 11.5), with a confidence coefficient of 95% and testing power of 80%. In order to test the data in terms of normal distribution, Kolmogorov-Smirnov statistical test was used. The normally distributed data were analyzed using the independent sample t-test, while the non-normally distributed data were subjected to Mann-Whitney U and Wilcoxon tests. A p-value less than 0.005 was considered statistically significant.

Findings

According to the results, the study participants had a mean age of 02.66±4.4 years, and the two groups were comparable in this regard at the beginning of the intervention (P=0.692). The majority of the subjects in the control (n=10, 58.8%) and intervention (n=14, 56%) groups were female; accordingly, both groups were homogenous in terms of this variable (P=0.856). Moreover, most of the mothers of the subjects in the control (n=6, 35.3%) and intervention (n=14, 56%) groups had high school education, indicating the homogeneity of the two groups in terms of this variable (P=0.354). With regard to family size, 41.2% (n=7) and 40.0% (n=10) of the samples in the control and intervention groups had the family sizes of 5 and 4 members, respectively. However, there was no significant difference between the two groups in terms of family size (P=0.068). The mean height of children was 82.3±4.4 cm, and there was no significant difference between the two groups in terms of this variable (P=0.556). The children had a mean weight of 11.4±1 kg, and the results revealed that the two groups were comparable considering this variable (P=0.121). Prior to the intervention, there was no significant difference between the two groups in terms of the mean age of receptive and expressive language development (P=0.672 and P=0.166, respectively). With regard to the data obtained immediately after and 4 months after the intervention, the results revealed no significant difference in the mean age of expressive language development in both groups (P=0.069 and P=0.076, respectively; Table 1). In addition, the results of repeated measures ANOVA indicated while the effect of stage was significant (P<0.001), the effect of group was not significant (P=0.29). The mutual effect of group and stage (P<0.001) on the mean age of expressive language evolution was significant (Table 1). In addition, the changes in expressive and receptive language evolution age were compared between pre-intervention stage and immediately after the intervention, between pre-intervention and follow-up (4-month post-intervention) stages, and between immediately after the intervention and follow-up stage (Tables 2-4).

Table 1: Mean scores of expressive language development in the intervention and control groups before, immediately after, and 4 months after the intervention

Group	**Control**		**Intervention**		**Test**	
Variable	Mean± SD	Number	Mean± SD	Number	Test	Result
Before intervention	16/8±4/8	17	16/24±4/05	25	Independent t-test	P=0/672 t=0/4
Immediately after the intervention	19/1±4/5	17	21/52±3/8	25	Independent t-test	P=0/069 t=1/8
4 months after intervention	21 ±4/4	17	22/2±3/4	25	Independent t-test	P=0/076 t=1/8
Repeated measures						
Overall effect	P<0/001		F=988/8	Df=1		
Effect of group	P=0/29		F=15/1	Df=1/1		
Effect of stages	P<0/001		F=217/5	Df=2		
Group* stages	P<0/001		F=18/7	Df=1/2		

Table 2: Mean scores of expressive language development in the intervention and control groups before, immediately after, and 4 months after the intervention

Group	Control		Intervention		Test	
Stages	Mean±SD	Number	Mean±SD	Number	Test	Result
Difference before and after intervention	2/4 ± 2/3	17	5/4±1/8	25	M- Whitney	P<0/001 Z=4/2
Difference before and 4 months after intervention	4/2±2/3	17	7±1/8	25	M- Whitney	P<0/001 z=3/8
Difference immediately and after 4 months of treatment	1/9±0/5	17	1/7±0/1	25	M- Whitney	P=0/143 z=1/5

Table 3: Mean score of receptive language development in the intervention and control groups before, immediately after, and 4 months after the intervention

Group	Control		Intervention		Test	
Variable	Mean±SD	Number	Mean± SD	Number	Test	Result
Before intervention	16/7±3/3	17	18 ±5/8	25	Independent t test	P=0/166 t=1/4
Immediately after the intervention	19/1±4/3	17	24/2±4/8	25	M- Whitney	P=0/002 z=1/3
4 months after intervention	20/8 ±4/1	17	28/9±4/8	25	Independent t test	P<0/001 z=4/2
Repeated measures						
Overall effect	P <0/001		F=919/5	Df=1		
Effect of group	P <0/001		F=12/2	Df=1		
Effect of stages	P <0/001		F=243/8	Df=1/6		
Group* stages	P <0/001		F=38/9	Df=1/6		

Table 4: Mean scores of receptive language development in the intervention and control groups before, immediately after, and 4 months after the intervention

Group	Control		Intervention		Test	
Stages	Mean±SD	Number	Mean±SD	Number	Test	Result
Difference before and after intervention	5/2 ± 1/7	17	5/4±2/3	25	Independent t test	P<0/001 t=5/2
Difference before and 4 months after intervention	4±1/7	17	9/4±2/6	25	Independent t test	P0<001 t=8/2
Difference immediately and after 4 months of treatment	1/6±0/9	17	4±1/8	25	M- Whitney	P<0/001 z=4/01

Based on the results, the mean receptive language evolution showed a significant difference between the two groups both immediately after the intervention (P=0.002) and in the 4-month follow-up (P<0.001). In addition, the results of repeated measures ANOVA stage (P<0.001) and group (P<0.001) were found to have significant effects on the mean age of expressive language evolution both independently and mutually (Table 3).

Discussion

In the current study, the two groups were homogenous in terms of receptive language age before the intervention. However, 4 months after the intervention, the intervention group showed a significant increase in the receptive language evolution age in comparison to the control group. In addition, receptive language age was significantly higher in the intervention group, compared to that in the control group after 4 months, which suggests the reliability of the obtained results regarding receptive language evolution. The groups were also homogenous in terms of expressive language age before the intervention. The results revealed no significant difference between the groups in this regard both after 2 and 4 months of the intervention. Therefore, it can be concluded that the intervention had no significant impact on the expressive communication of children. This finding can be justified in this way that the population in the current study included toddlers. The main feature of language evolution in the toddling period is increasing language understanding and perception level. In the toddling level, the number of

learned words is considerable since the 4 words in the one-year-old age group boom to 300 words in the two-year-old group. However, the comprehension ability of the latter group is much higher than the number of words expressed by the child.

The best age of manifesting expressive ability in children is the post-toddling period (i.e., pre-school period). In the toddling period, the child's focus is mostly on the comprehension of terms and extension of vocabulary repertoire (17), The changes observed in the receptive language area support this fact.

Aparicio et al. (2002) conducted a study in Spain on 36 children with Down syndrome aged 0-7 months to investigate early language stimulation. Their results showed that the mean age of changes in language evolution was higher in the children exposed to stimulation program at younger ages, compared to that in the children exposed to the program at older ages. Furthermore, in the mentioned research, the results of one-way ANOVA between different stages indicated that the difference was significant in consecutive evaluations (P<0.001) (18). Although the mentioned study did not address language findings in terms of receptive and expressive aspects, the progress reported in the language skills of children is consistent with our findings regarding the receptive communication domain but inconsistent with the expressive communication area. According to the literature, in early childhood, the verbal focus of the child is on comprehending the terms and extending the vocabulary repertoire. The age overlap in the population under intervention with a maximum period of receptive language evolution led to the observation of significant changes in receptive language domain. However, expressive language did not show any significant change since it is bloomed at older ages (i.e., pre-school period). In a study performed by Aparicio et al., the long period of intervention and initiation of intervention at younger ages resulted in the achievement of generally higher scores in language performance, because if simulations are conducted at younger ages, it will be more effective (18). In a study, Yusefzehi et al. (2014) investigated the impact of responsive integrated stimulation and nutritional interventions delivered through a program for health female workers in Pakistan on child's development, evolution, and health. They showed that the responsive stimulation program was effective in the different aspects of cognitive (P<0.0001), language (P<0.0001), motor (P=0.002), and social-psychological (P<0.0001) functions. All results were significant for the 24- -month-old age group, except for social-psychological function (19). Attention to the role of mother and changing house environment can be stated as the factors leading to such influences. The provision of feedback about the way of playing leads to the correction of communicative obstacles between mother and child and instills a sense of importance in the child. Interaction with children and playing with them lead to the enhancement of accountable care and development of caregiving skills.

In the current study, the cultural backgrounds of individuals were considered in the implantation of the interventions. In this regard, before the intervention, the games and songs suggested in the Western Virginia Guideline were substituted by Iranian games and songs to make them more acceptable by the children and parents. According to the contextual perspective by Vygotsky, adults focus on the methods and principles through which they can transfer their values, beliefs, customs, and cultural skills to their children. As Vygotsky states, since the main purpose of all cultures is enabling children to acquire cultural values and skills of the communities, a background of culture should be taken into account in all developmental periods (20). On the other hand, in the current study, during the implementation of developmental stimulation, various sensory, visual, and aural stimulations were simultaneously applied for children in several evolutional dimensions. Since the evolution dimensions are interdependent and influence each other, it can cause a program to promote the development of various fields of society together. In addition, the intervention involved appropriate interactions between child and caregiver so that the child could trust the caregiver and accompany her during the playing and activity. These

interactions, including eye contact, feedback provision about child activities, participation in child role-play, and use of child's first name in a kind tone, varied and could enhance the child's developmental stage. One of the main limitations of the current study was the lack of the direct involvement of mothers in the implementation of the intervention. Maternal direct involvement not only increases mother-child interaction but also enhances mother's sensitivity and responsiveness to the child's needs, thereby promoting the child trust on mother. Although this point was not considered in this study, it is predicted that the results obtained for the 4-months follow-up can be somehow related to the presence of mothers and their indirect participation in the intervention because due to their presence in the intervention room may have familiarized some of them with the exercised activities, resulting in the persistence of those activities at home.

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