

Sensory Diet in Attention Deficit Hyperactivity Disorder (ADHD)

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Abstract

Background and Objectives: The present study conducted to determine the effect of family-based sensory diet program on attention deficit/hyperactivity of ADHD children. In this program, parents were directed to the activities that they use the stimuli of the vestibular sense, deep sense, sense of touch, sense of vision and hearing to maintain a focused and organized consciousness of the child.

Methodology: This research was a semi-experimental study with a pretest-posttest design with an experimental group. Wechsler Intelligence Scale for Children, (WISC-IV) and Conner's Parent Rating Scale used to measure the variables. The statistical population of the study included all children with attention deficit hyperactivity disorder aged 6 to 12 years referred to Hasti, Bahar and Masir Sabz Health Clinics in 2020. The statistical sample of this study consisted of 15 children who were selected by convenience sampling method and intervened. Statistical tests of analysis of covariance, etc. were used in SPSS (V20) software.

s: Based on the results of paired samples t-test, obtained t from the variables of attention deficit and hyperactivity has become significance at the level of less than 0.01 ($P=0.000$). It means that assumption of accepted test and family-based sensory diet sessions have been effective in reducing attention deficit/hyperactivity disorder in ADHD children. **Conclusion:** According to the findings, implementing the sensory diet program by the child's family can be effective in reducing attention deficit hyperactivity in children with ADHD. Also, it can reduce these symptoms which were effective on hyperactivity and attention deficit, respectively, based on the degree of effectiveness.

Keywords: Sensory Diet, Attention Deficit Hyperactivity Disorder, Sensory Tools

1. Main text

Attention deficit hyperactivity disorder is one of the most widespread psychological neurological disorders during childhood which has been the focus of many researches. This disorder is described as repetitive sample of hyperactivity, impulsiveness, and negligence which it often begins before the age of seven and is more severe than can be attributed to normal growth. In America, it affects the life of 3.5 to 5 percent of children (1). Furthermore, it is more prevalent in male children and, in some cases, the hyperactivity disappears but attention deficit and impulsiveness remains. So, the educational progress of these people is less than other normal people (2). This disorder could lead to damage in normal functions such as academic achievement, school behavior, family interaction, and peer communication. These problems cause these children to be rejected by their peers and by the society (3). For these reasons, finding effective treatments in strategies to prevent the spread of the problems of these children is one of the main goals of research in this field.

Among all the various treatments, the effect of sensory integration therapy, which includes controlled sensory stimuli in the context of self-controlled and significant activities, on improving some behavioral, motor, educational and oral functions and skills of children, (especially children with learning disabilities, autism and attention deficit hyperactivity disorder) was analyzed and proved (4).

Various pharmacological, cognitive, behavioral, combination and complementary therapies are used to treat children with ADHD. Among the therapies used in this area is sensory integration therapy. Treatment of sensory integration

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includes controlled sensory stimuli in the structure of self-directed and meaningful activities, in a way that leads to an adaptive response. Moreover, some functions and behavioral, motor, educational and linguistic skills of children are improved through the integration of sensory inputs (5). The integration of different sensory information leads to an increase in the ability of the children in sensory-motor and perceptual-motor functions. As a result, it empowers the child in different aspects as well. Sensory integration helps the child's control which consequently gives the nervous system the ability to change and keep stimulation level that is necessary for the development of abilities such as paying attention to homework, impulse control, increasing failure tolerance, and balance in emotions (6).

In a study conducted by Rathod et al (2015), the results showed that sensory integration therapy in itself and in combination with cognitive-behavioral therapy had a significant effect on reducing ADHD symptoms in Conner's scale (7).

Similarly, Ebrahimi et al. (2013) conducted a study entitled "The effectiveness of sensory integration with emphasis on deep and vestibular senses on the academic achievement of 6-12 year-old children with attention deficit hyperactivity disorder in Semnan city". In this study, 32 students with ADHD selected and divided into two groups of 16 intervention and control. The results indicated that sensory integration with an emphasis on deep and vestibular senses has an effect on the academic achievement of students with ADHD (8).

Peterson et al (2018) conducted a study entitled Providing Sensory Diet by California Occupational Therapists. The results show that sensory diet in children with ADHD has positive effects on reducing abnormal behaviors, increasing domains of attention and the level of mental retention (9).

Rahmani et al (2010), examined the effect of sensory integration therapy in reducing ADHD symptoms. The results of the study show that children who received sensory integration therapy reported a significant improvement in their primary ADHD symptoms in comparison with control group (10). Similarly, Sahoo & Senapati (2014), in their study established that sensory diet therapy based on sensory integration theory has a significant effect on functional behavior of ADHD children (6).

Amrovan (2015), in the results of her dissertation entitled as "The effectiveness of sensory integration on executive actions of children with attention deficit hyperactivity disorder" states that the performance of test group significantly improved compared to the control group the in components of response inhibition, sustained attention and working memory (11). Ebrahimi et al (2013), in a research examined the effect of sensory motor integration activities on the symptoms of ADHD. Such activities led to reducing attention deficit, hyperactivity and impulsivity in the participants (8).

Therefore, considering the high prevalence of attention deficit hyperactivity disorder in school children and their consequent problems in different aspects of their personal and social life, and also considering the importance of early intervention in these cases, and the effectiveness of sensory integration therapy in improving different functions of children (including their behavioral, motor, educational, and lingual functions of the children with other disorders) and part of the treatment of sensory integration is the sensory diet, and since there has been only a few researches done on the effect of sensory diet on improving the symptoms in ADHD patients, the researcher is trying to answer the question: whether planning a family-based sensory diet can be effective on attention deficit/hyperactivity disorder of ADHD children or not.

2. Methodology:

The present study was applied in terms of purpose and semi-experimental in terms of method with pretest-posttest design. The statistical population of the study included all children 6-12 years who were diagnosed with attention deficit hyperactivity disorder in Tehran city. Samples selected by convenience sampling method. In order to collect data, the 6-12 year-old children who referred to Hasti, Bahar and Masir Sabz treatment clinics during the last quarter of 2020, they who had ADHD criteria after performing Connors test (1973) and had other criteria for entering the research, were considered as research samples. Inclusion requirements included the capacity to converse and talk. The absence of visual or hearing impairments, the absence of seizures, the absence of mental issues and a minimum Wechsler test score of 85, as well as non-cooperative exclusion conditions for participation in programs. After that, Participants (N= 15) went through 12 sessions of a complete family-centered diet education program, which was followed by a post-test and

statistical analysis of the data. Participants were then subjected to 12 sessions of comprehensive family-centered sensory diet training program, which after the program, post-test performed and the results were statistically analyzed.

The family-based sensory diet: This program was based on Wilbarger Therapy Protocol (2018), which is a comprehensive approach to treat sensory problems. This theory, formally known as the deep pressure, deep sense, and mouth touch technique, is used to help organize the mind, brain, and body. Also, it increases attention, participation in daily activities, reduces tactile defense and increases body self-regulation. This protocol consists of three components: pulling the sensory brush to the body, compressing the joints, and sensory diet. Sensory diet involves a set of sensory activities and sensory inputs to the body and nervous system to maintain optimal levels of arousal. These activities are included in the child's daily planning according to her/his needs. It reduces tactile defense, increases the awareness of body about itself, the environment and others, participating in activities, interaction with peers and more efficiency.

The general sensory diet exercises used for the intervention group were as follows:

Table (1) the purposes and contents of educational programs

Contents	Purpose	Sessions
1. Consultation between the family and therapist for evaluating the sensory 2. Using a timetable and a specific plan 3. Teaching and correcting environmental stimuli Filtering visual and auditory stimuli Scheduling times at the desk (15 minutes' work with frequent rest times) Having a place for serenity	Getting familiar with the family and introducing the work process and the atmosphere in which the child is going to practice	First
1. Deep massage before the class with a foam roll (5 minutes) 2. Walking with sandals which have a slippery surface 3. Wearing a heavy vest and basketball cap for sitting in class 4. Sitting on a rocking chair during the class	Receiving vestibular and deep sensory stimuli	Second
1. Jumping (twice a day before starting homework or class. 10 minutes) 2. Sitting on yoga ball and talkativeness (twice a day. 10 minutes) 3. Walking in a serene place with dust or playing with sand (twice a day)	Using visual and vestibular inputs	Third
1. Listening to light music with headphones while doing the written homework 2. Chewing gum while doing written homework 3. Sitting on ball chair while reading and memorizing materials 4. Doing yoga (once a day)	Using vestibular and visual inputs	Fourth
1. Leaning on a pillow for elongation of sitting at the desk time 2. Pressing jelly ball while listening to class 3. Going into a sleeping bag (once a day in the afternoon. 15 minutes) Playing with a cloud mattress (in the afternoon. 10 minutes)	Stimulating deep sense and increasing tolerance	Fifth
1. Doing heavy physical exercises (before doing homework. like vacuuming. 20 minutes) 2. Gathering together in an enclosed area and doing homework 3. Playing with skateboard 4. Moving things in class is on the child	Deep sensory exercises	Sixth
reevaluating the function and sensory function	Evaluating the level of improvement	Seventh

1. Dancing (twice a day before the class starts.15 minutes) 2. Visualizing growing circles (once in the afternoon. before starting the homework) 3. Pressing sponge in a water dish 4. Throwing oneself on a mattress (once every in the afternoon. 10 minutes)	Stimulating deep senses	Eighth
1. Rope games (every morning. 10 minutes) 2. Crawling on the ground at home (once a day in the afternoon. 10 minutes) 3. Going up and down a suspended ladder and repeating the homework one has to memorize 4. Listening to recorded educational materials and walking on the straight lines of the carpet simultaneously	Vestibular and improving the interaction between brain hemispheres	Ninth
1. Ball playing with wall while changing the distance (twice a day) 2. Going into Swedish swimming model and staying in that model for 5 minutes (twice a day) 2. Doing structural puzzle activity (once a day) 4. Playing on the swings and repeating the educational material (in the afternoons)	Using visual and vestibular inputs	Tenth
1. Keeping balance on an unstable surface. (twice a day. in the mornings) 2. Cutting narrow lines from a paper by scissors 3. Drawing ropes with two hands simultaneously 4. Bicycle riding (once a day. in the afternoons)	Deep sensory and balance exercises	Eleventh
1. Reevaluation 2. Conclusion	Complementary evaluation of the students	Twelfth

It is worth mentioning that in each of therapy sessions, 5 to 6 exercises were practiced with the children; as each child progressed, other exercises were applied or their difficulty increased in subsequent sessions. At the end of the intervention, the subjects underwent posttest again.

Wechsler's intelligence scale for children (WISC-IV): in the present study, the fourth edition of Wechsler's intelligence scale for children was used which was published in 2003. The fourth edition of this scale, total intelligence and four different intelligences are measured that include verbal comprehension (similarities, words, comprehension, general information, verbal deduction), cognitive deduction (designing with squares, visual concepts, visual deduction, and completion of images), active memory (the breadth of figures, sequence of letters, numbers and calculation completion) and speed of processing (cryptography, symbolization, complementary line drawing). Sadeghi, Rabeei, and Abedi (2011), in a research analyzed the validity and reliability of the fourth edition of Wechsler's intelligence scale. The results of the validity between this scale and Raven's progressive matrices showed a significant correlation of the two scales. The validity of the test was calculated by two methods of halving (splitting) and retesting, during which the validity of retest of the subscales was obtained from 0.80 to 0.88 and the validity coefficients of the halving were from 0.83 to 0.91.

Connors' questionnaire: it measures attention deficit, hyperactivity and impulsiveness; it is one of the common tools used for measuring children's behavior based on dimensional classification system. It contains various behavioral questionnaires designed for children. Connors introduced a 93-item scale in 1973. Then a short form of this scale with 48-items was introduced by Goyt, Connors, and Elvish in 1978. Connors' classification scale was first designed to evaluate the effect of stimulant drugs on children with attention deficit hyperactivity disorder and in order to distinguish these children from normal children. Today, a modified questionnaire consisting of 27 items is used to diagnose children with attention deficit / hyperactivity disorder. The reliability coefficient of retest for the total score is 0.58 and alpha Cronbach coefficient for total score is 0.73 and its validity is 0.84 which measures three factors of oppositional behavior, hyperactivity, and attention deficit. The range of scores for each question varies from zero to 3 that the scales has formed

as: 1) not true at all (never), 2) only slightly true (occasionally), 3) relatively true (often), 4) absolutely true (very high) (Shahiyan et al., 2007).

3. Results:

The required information was collected using a questionnaire. More details about the Demographic characteristics of the subjects based on mothers' education level.

Table (2) Demographic characteristics of the subjects according to the level of education of mothers, employment status of mothers and age of students

Cumulative frequency percentage	frequency percentage	Frequency		
33.3	33.3	5	Diploma and lower level	level of education of mothers
80	46.7	7	Bachelor	
100	20	3	Master's degree and higher	
	100	15	Total	
60	60	9	employed	employment status of mothers
100	40	6	housewife	
	100	15	Total	
46.7	46.7	7	6 to 8 years	age of students
73.3	26.7	4	8 to 10 years	
100	26.7	4	10 to 12 years	
	100	15	Total	

According to the table above, there were 5 diploma mothers, 7 bachelors and 3 masters and higher level, 9 of the subjects were employed and 6 were housewives. Also, 7 students were between 6 and 8 years old, 4 were between 8 and 10 years old and 4 were between 10 and 12 years old.

Table (2) descriptive data of children's attention deficit and hyperactivity variables in pretest and posttest stages

Numbers	Maximum	Minimum	Kurtosis	Skewness	Standard deviation	average	Stage	
15	47	31	-0.989	0.065	5,18	39,47	Pretest	Attention deficit
15	44	27	-1.180	0.068	5,46	35,40	Posttest	
15	20	12	0.354	-0.502	2,20	16,87	Pretest	Hyperactivity
15	14	7	0.181	-0.853	2,11	11,8	Posttest	

Table 3-4 Descriptive Statistics of Attention Deficit of ADHD Children

Standard deviation	Average	number	step	group
5.18	39.47	15	Pretest	Attention Deficit
5.46	35.40	15	Posttest	

Table 4-4 Correlation coefficient test

Significance level	Correlation coefficient	number	step	variable
0.000	0.983	15	Pretest and posttest	Attention Deficit

This table shows the correlation between two variables. The level of significance is equal to 0.000; the desired statistic is significant due to the small value of 0.05. In other words, the degree of correlation between two variables is significant.

Table 5-4 T-statistics of paired samples related to attention deficit of ADHD children

The difference between mean of pre-test and post-test						variable
At 95% confidence level		The difference between means	Significance level	Degrees of freedom	t	
High level	Low level					
4.64	3.494	4.067	0.000	14	15.250	attention deficit

The results of the above test show that the value of t-test statistics for this hypothesis is 15.250 and the degree of freedom is 14. Corresponding to that, a significant level has been calculated as 0.000. This value is less than 0.05, so the null hypothesis is rejected and the opposite hypothesis is accepted. This means that there is a 95% chance that the sessions of family-based sensory diet program have been effective on attention deficit of ADHD children. In other words, according to the means, it can state that there is a significant difference between the observed mean in attention deficit of ADHD children, post-test (35.40) and pre-test (39.47). So, the mean of post-test is lower than pre-test and this difference of means is -4.067. Considering the values of confidence interval (upper limit and lower limit) in post-test speed, because both of them are positive (4.64 and 3.494). Therefore, we can state that the sessions' average of the family-based sensory diet program had an impact on attention deficit of ADHD children and attention deficit of children has decreased.

Table 6-4 Descriptive statistics on ADHD in children

Standard deviation	average	number	step	group
2.20	16.87	15	Pretest	hyperactivity
2.11	11.80	15	Posttest	

Table 7-4 Correlation coefficient test

Significance level	Correlation coefficient	number	step	Variable
0.001	0.748	15	Pretest and posttest	Hyperactivity

This table shows the correlation between two variables. The level of significance is equal to 0.001; the desired statistic is significant due to the small value of 0.05. In other words, the degree of correlation between two variables is significant.

Table 8-4 T-statistics of paired samples related to hyperactivity of ADHD children

The difference between mean of pre-test and post-test						variable
At 95% confidence level		The difference between means	Significance level	Degrees of freedom	t	
High level	Low level					
5.916	4.217	5.07	0.000	14	12.794	hyperactivity

The results of the above test show that the value of t-test statistics for this hypothesis is 12.794 and the degree of freedom is 14. Corresponding to that, a significant level has been calculated as 0.000. This value is less than 0.05, so the null hypothesis is rejected and the opposite hypothesis is accepted. This means that there is a 95% chance that the sessions of family-based sensory diet program have been effective on attention deficit of ADHD children. In other words, according to the means, it can state that there is a significant difference between the observed mean in attention deficit of ADHD children, post-test (11.80) and pre-test (16.87). So, the mean of post-test is lower than pre-test and this difference of means is 5.07. Considering the values of confidence interval (upper limit and lower limit) in post-test speed, because both of them are positive (5.916 and 4.217). Therefore, we can state that the sessions' average of the family-based sensory diet program has an effect on attention deficit of ADHD children and attention deficit of children has decreased.

Discussion:

Analysis of covariance was used to test the research hypothesis, "family-based sensory diet program is effective on attention deficit and hyperactivity of ADHD children".

Based on the results of the first hypothesis, we can say that there is a significant difference between pre-test and post-test scores of the attention deficit in subjects. In other words, family-based sensory diet program reduces the attention deficit of ADHD children.

The results of this study are consistent with the findings of Niklasson et al (2010) and Vandenberg (2001) which showed the effect of using sensory stimulation on attention functions of ADHD children. (12,13). Also, the above results are consistent with the results of the study conducted by Salamati et al (2014) which examined the effect of sensory stimulation in the form of atrial stimulation in children with ADHD. Hence, its effectiveness on attention and auditory abilities of these children was proved (14). The effect of using sensory integration therapy in improving attention deficit of ADHD children does not go along with the study conducted by Ghareh Baghi et al (2011), in which the effect of sensory stimuli on attention function of children with learning disorders was analyzed (15). This difference might be due to the fact that in the above study, deep sensory stimulation was used in the form of only vest and saddle in occupational therapy sessions in which, according to the sensory integration principles based on combination of three proximal sensory systems, this effectiveness is disapproved. Moreover, lack of enough samples in their study can be one of the reasons of such disapproval.

In stating this finding, one can say that these problems along with attention deficit hyperactivity disorder, like disability in motor functions, attention deficit, learning disorder, aggression, educational problems, motor arousal and apathy are among the things worth paying attention. (16 and 7). The problems in sensory integration like unfit physical condition, weak visual responses and unnatural muscular consistency affects body scheme and bilateral and coordinated use of body members. These problems are due to weakness in processing and integration of received data from deep vestibular sense. This weakness in processing the information can cause motor aversion or motor fear, reduction in motor range, reduction in domains of attention, lack of emotional stability. Additionally, some problems may also be observed in their tactile system. The outcome of all these problems are reactions that we will see in therapy sessions: low concentration, irritability, unmotivated and unorganized behaviors (17).

Hyperactivity is one of the more prominent problem of children with attention deficit hyperactivity disorder in whom the brain function is problematic in different aspects and disorder in the right hemisphere and its injury, basic brain complex, and also prefrontal cortex can cause reduction in motor functions and hyperactivity. On the other hand, thalamus is effective in integration of sensory input data which, based on the definition by Ayres, sensory integration is the theory of the relationship between brain and behavior. Dolin et al believe that this process provides the needed basis for accurate sensory cognition and, consequently, appropriate motor reactions (8). Sensory diet by improving the central

nervous system in processing the information can lead to an improvement in the symptoms of these children which can be reduced to a high level through early diagnosis and choosing appropriate intervention methods for treating this disorder (18).

Based on the results of the second hypothesis, we can say that there is a significant difference between the pretest and posttest hyperactivity scores in the test group. In other words, family-based sensory diet program reduces hyperactivity of ADHD children.

The results of the present research indicate that in a study conducted by Batara et al in which the effectiveness of sensory stimulation on improvement of ADHD symptoms was analyzed (19). The results showed that sensory stimulation has a significant effect on three main symptoms of ADHD (19). Besides, these results are consistent with the results of the study done by Ebrahimi (2012) on the effectiveness of sensory integration therapy on attention deficiency and hyperactivity of ADHD children (4).

In order to explain the effect of sensory integration therapy on children with attention deficit disorder, it can be stated that attention deficit is one of the most obvious and biggest problems of these children. It leads these children to have problem in controlling different stimuli and responding to merely one of these stimuli and could not do this appropriately. The integration of deep and vestibular senses affects the function of the upper levels of the brain, which are responsible for excellent processes such as attention, and improves the organization of children's senses receiving from the environment and stimuli. In a way that spatial and temporal aspects of sensory processing data are processed, interpreted, related and incorporated and the brain chooses, improves, controls and compares the data and finally integrates them in a flexible and changeable sample (4).

Conclusion:

According to the results of this study, a sensory diet is considered an effective intervention in children with ADHD. Proper assessment of the type of sensory problems, the correct design of the program, and its correct execution, lead to more effective use of the sensory diet program. It is recommended that therapists and families consider using sensory diet programs along with other therapeutic and educational interventions

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